

**SELECTED VERTEBRATE
ENDANGERED SPECIES OF THE
SEACOAST OF THE
UNITED STATES**



Fish and Wildlife Service

U.S. Department of the Interior

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES

Prepared by
National Fish and Wildlife Laboratory
U.S. Fish and Wildlife Service
10th and Constitution Avenue, N.W.
Washington, D.C. 20560

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
1010 Gause Boulevard
Slidell, Louisiana 70458

This study was conducted in cooperation with the
Office of Endangered Species, U.S. Fish and Wildlife Service

Performed for
National Coastal Ecosystems Team
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior

The Biological Services Program was established within the U.S. Fish and Wildlife Service to supply scientific information and methodologies on key environmental issues that impact fish and wildlife resources and their supporting ecosystems. The mission of the program is as follows:

- To strengthen the Fish and Wildlife Service in its role as a primary source of information on national fish and wildlife resources, particularly in respect to environmental impact assessment.
- To gather, analyze, and present information that will aid decisionmakers in the identification and resolution of problems associated with major changes in land and water use.
- To provide better ecological information and evaluation for Department of the Interior development programs, such as those relating to energy development.

Information developed by the Biological Services Program is intended for use in the planning and decisionmaking process to prevent or minimize the impact of development on fish and wildlife. Research activities and technical assistance services are based on an analysis of the issues a determination of the decisionmakers involved and their information needs, and an evaluation of the state of the art to identify information gaps and to determine priorities. This is a strategy that will ensure that the products produced and disseminated are timely and useful.

Projects have been initiated in the following areas: coal extraction and conversion; power plants; geothermal, mineral and oil shale development; water resource analysis, including stream alterations and western water allocation; coastal ecosystems and Outer Continental Shelf development; and systems inventory, including National Wetland Inventory, habitat classification and analysis, and information transfer.

The Biological Services Program consists of the Office of Biological Services in Washington, D.C., which is responsible for overall planning and management; National Teams, which provide the Program's central scientific and technical expertise and arrange for contracting biological services studies with states, universities, consulting firms, and others; Regional Staff, who provide a link to problems at the operating level; and staff at certain Fish and Wildlife Service research facilities, who conduct inhouse research studies.

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

This report should be cited as follows:

National Fish and Wildlife Laboratory. Selected vertebrate endangered species of the seacoast of the United States. U.S. Fish and Wildlife Service, Biological Services Program; FWS/OBS-80/01; March 1980.

Citation of an individual chapter should be made according to this example:

National Fish and Wildlife Laboratory. Selected vertebrate endangered species of the seacoast of the United States: Columbian white-tailed deer. U.S. Fish and Wildlife Service, Biological Services Program; FWS/OBS-80/01.27; March 1980. 6 p.

ENDANGERED SPECIES ACCOUNTS

FWS/OBS-80/01.xx

- 01 Red Wolf
- 02 Blunt-Nosed Leopard Lizard
- 03 Whooping Crane
- 04 Light-Footed Clapper Rail
- 05 San Clemente Loggerhead Shrike
- 06 Pine Barrens Treefrog
- 07 Red-Cockaded Woodpecker
- 08 Ivory-Billed Woodpecker
- 09 Ocelot
- 10 Attwater's Greater Prairie Chicken
- 11 Cape Sable Sparrow
- 12 Leatherback Sea Turtle
- 13 Green Sea Turtle
- 14 Texas Blind Salamander
- 15 Yuma Clapper Rail
- 16 Santa Barbara Song Sparrow
- 17 Eskimo Curlew
- 18 Southern Sea Otter
- 19 Morro Bay Kangaroo Rat
- 20 California Least Tern
- 21 Kirtland's Warbler
- 22 Hawksbill Turtle
- 23 Indiana Bat
- 24 Atlantic Salt Marsh Snake
- 25 Dusky Seaside Sparrow
- 26 Hawaiian Goose (Nene)
- 27 Columbian White-Tailed Deer
- 28 Salt Marsh Harvest Mouse
- 29 Puerto Rican Parrot

FWS/OBS-80/01.xx

- 30 Kemp's (Atlantic) Ridley Sea Turtle
- 31 Bachman's Warbler
- 32 Florida Everglade Kite
- 33 Puerto Rican Whip-Poor-Will
- 34 Aleutian Canada Goose
- 35 West Indian Manatee
- 36 Island Night Lizard
- 37 Delmarva Peninsula Fox Squirrel
- 38 Houston Toad
- 39 American Alligator
- 40 Brown Pelican
- 41 Jaguar
- 42 Gray Bat
- 43 Okaloosa Darter
- 44 Eastern Cougar
- 45 Jaguarundi
- 46 Florida Panther
- 47 American Crocodile
- 48 Key Deer
- 49 Laysan Duck
- 50 Red Hills Salamander
- 51 Arctic Peregrine Falcon
- 52 Mississippi Sandhill Crane
- 53 Gray Wolf
- 54 Thick-Billed Parrot
- 55 San Clemente Sage Sparrow
- 56 California Clapper Rail
- 57 American Peregrine Falcon
- 58 Santa Cruz Long-Toed Salamander

Biological Services Program

FWS/OBS-80/01.1

March 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States-

THE RED WOLF



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

FWS/OBS-80/01.1
March 1980

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—

THE RED WOLF

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: U.S. FISH & WILDLIFE SERVICE

RED WOLF

Canis rufus Audubon and Bachman

KINGDOMAnimalia
 CLASSMammalia
 ORDER..... Carnivora
 FAMILY Canidae
 OTHER COMMON NAMES black wolf

DATE

Entered into SWIS. to be determined
 Updates. 20 December 1977, 14 September 1978,
 25 May 1979.

LEGAL STATUS

Federal: Endangered (35 FR 16047, 3 October 1970).
 States: Endangered: Delaware, Missouri, Mississippi, Texas.

REASONS FOR CURRENT STATUS

Local predator control programs as well as Federal, State, and local bounty hunters have decimated the red wolf population. By the 1920's, wolves were virtually extirpated east of the Mississippi River, and in Kansas, Oklahoma, and most of Texas (Nowak 1972). Extermination was accomplished by den hunting, steel trapping, poison baiting, and shooting.

Predator control has had a much greater impact on wolf populations than on the coyote (*Canis latrans*) populations because bounties were higher for wolves and people feared and hated wolves much more than coyotes. The result was that a few widely separated wolves remained among many coyotes. The few remaining wolves began to mate with coyotes and a hybrid swarm resulted which is today being replaced by pure coyotes (C. Carley personal communication). At present, there are probably no remaining popula-

tions of red wolves in the wild, although some genetically pure individuals may still exist (R. Nowak personal communication).

Any remaining red wolves are now restricted to coastal marshes and prairies which are being lost to industrial and urban expansion and to agricultural development (Riley and McBride 1972).

Other pressures include exploration and development of oil fields in Texas and Louisiana which have made remote areas more accessible to hunters and trappers (Pimlott and Joslin 1968). Some red wolf habitat occurs in hunting preserves and each year a few are killed by hunters (Riley and McBride 1972).

The few remaining red wolves are known to be physically weakened by diseases and parasites (Red Wolf Recovery Team 1973). Riley and McBride (1972) found heartworms (*Dirofilaria immitis*) to be present in all specimens examined. Infestation increases with age due to constant exposure to mosquito vectors. Animals over 3 years of age are usually heavily parasitized, reducing their tolerance to stress (Riley and McBride 1972). Other internal parasites include hookworms (*Ancylostoma*) which often cause death in pups (Paradiso and Nowak 1972), and in adults leads to anemia and conditions which foster low-level infections (Lowery 1974). Tapeworms (*Taenia*) and spiny-headed worms of the phylum Acanthocephala are also found in red wolves, as is the sarcoptic mange mite (*Sarcoptes scabiei*) (Riley and McBride 1972).

PRIORITY INDEX

Not assigned.

DESCRIPTION

The red wolf is dog-like, averaging about 165 cm in total length for males and 145 cm for females. Weights of 14 specimens from Chambers County, Texas, ranged from 19 to 28 kg (Riley and McBride 1972).

Pelage color is variable from tawny to grayish; muzzle is light with an area of white around the lips extending up the sides, leaving the bridge with a tawny to cinnamon coloration. Light areas also occur around the eyes on many red wolves.

The Red Wolf Recovery Team has established minimum sizes for the discrimination of red wolves from coyotes and coyote X wolf hybrids: male red wolves weigh between 22 and 36 kg, are more than 134 cm long, have a hind foot length of more than 22.8 cm, an ear length of at least 12

cm, and stand at least 68 cm high at the shoulder. Female red wolves weigh between 19 and 31 kg, are more than 129 cm long, have a hind foot length of more than 22 cm, an ear length of at least 11.4 cm, and stand at least 66 cm high at the shoulder (McCarley and Carley 1979).

Pure coyotes are considerably smaller and more "fox-like" than red wolves.

Photographs appear in Carley (1975), Horan (1977), Stevens (1977), Soileau (1977), and Neville (1978).

RANGE

Red wolves are presently restricted to Chambers, Jefferson, and Galveston Counties of southeastern Texas and adjoining Cameron and Calcasieu Parishes of Louisiana (Carley 1975).

They formerly occurred from central Texas eastward to the coasts of Florida and Georgia, and along the Mississippi River Valley north to central Illinois and Indiana (Hall and Kelson 1959).

RANGE MAP

Shaded areas on the following page indicate former and present distribution (C. Carley personal communication).

STATE/COUNTIES

Louisiana: Calcasieu, Cameron.

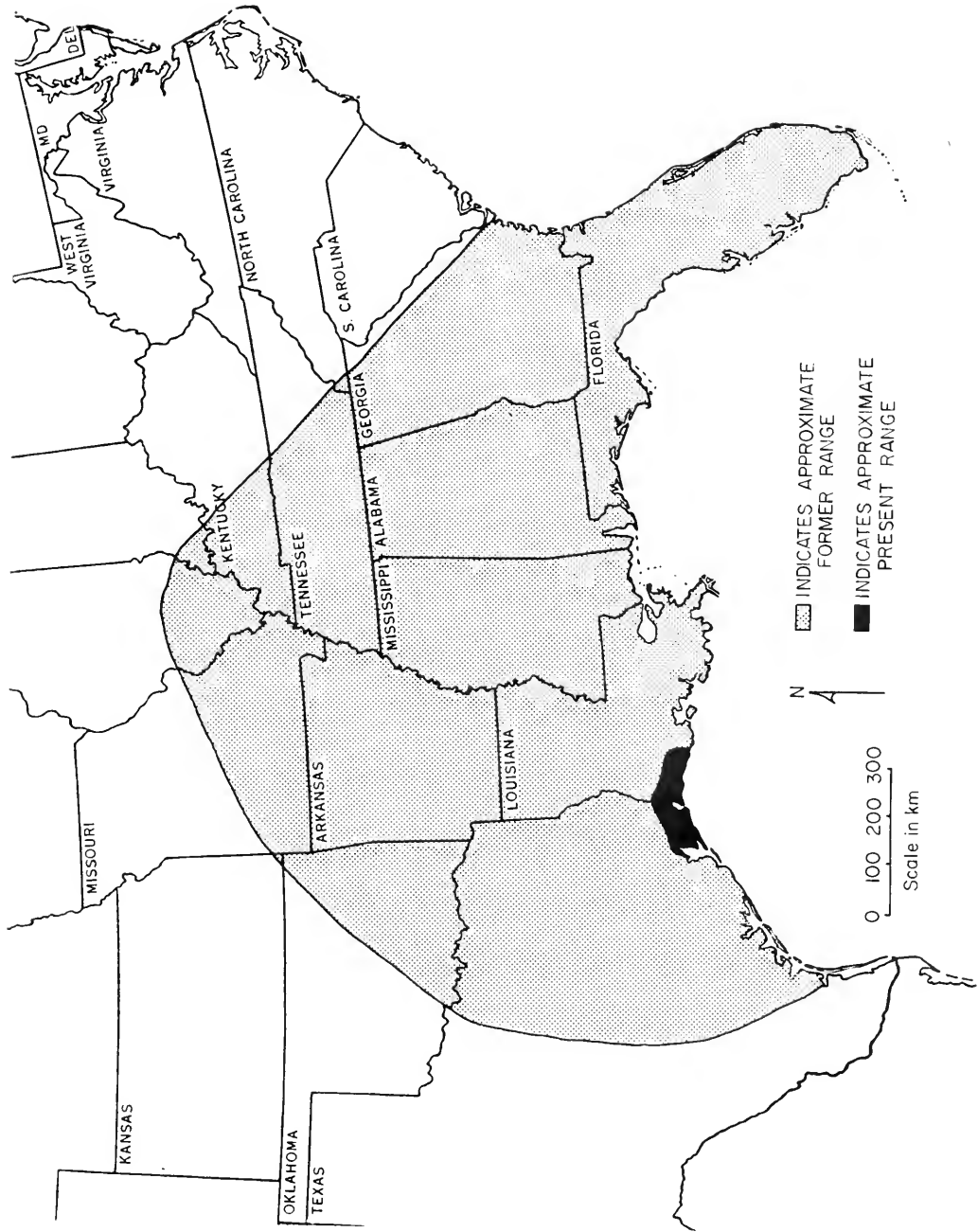
Texas: Chambers, Galveston, Jefferson.

HABITAT

Red wolves formerly inhabited dense mountain and bottomland forests, as well as coastal prairies and marshes (IUCN 1966, Pimlott and Joslin 1968, Lowman 1975). They are now restricted to coastal prairies and marshes with scattered pine islands (Riley and McBride 1972), although Nowak (1972) indicates that red wolves move to inland forests during the spring and summer months.

The primary habitat requirement appears to be heavy vegetative cover. Cover provided along bayous and in overgrown fallow fields supplies the primary resting and denning areas. Wolves forage out into open fields and marshes using access roads, dikes, canal levees, and cattle walkways (Carley 1975).

Photographs of the habitat may be found in Riley and McBride (1972).



Present day and former distribution of the red wolf in the U.S.

FOOD AND FORAGING BEHAVIOR

Prey includes a variety of invertebrates and vertebrates. Young and Goldman (1944) and Riley and McBride (1972) indicate that the marsh rabbit (*Sylvilagus aquaticus*), nutria (*Myocaster coypus*), and carrion are the major food items. Other foods consist of white-tailed deer (*Odocoileus virginianus*), rodents, domestic stock, waterfowl, fish, grasshoppers, beetles, and vegetation (Nowak 1972, Riley and McBride 1972).

Wolves feed primarily at night, foraging opportunistically for small prey alone or in small groups (Riley and McBride 1972). They typically travel in family groups.

SHELTER REQUIREMENTS

See nesting or bedding.

NESTING OR BEDDING

Historically, red wolves denned in hollow tree trunks, along stream banks, and old holes of other animals (Nowak 1972, Riley and McBride 1972, Lowman 1975). The dens were usually obscured by brush and vegetation, but afforded the occupants a view of the surrounding terrain.

Water tables are probably too high for ground-nesting in the coastal marshes where wolves still occur, and nesting in tall vegetation has been reported in these areas (C. Carley personal communication).

RITUAL REQUIREMENTS

The role of howling in the social behavior is not fully understood. The voice of the red wolf is described by Riley and McBride (1972) and McCarley (1978).

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

Nowak (1972) reported that the territory is generally circular with a diameter attaining 64 km. Carley (1975), using radio tracking, found that males range over an area of approximately 116 km² and females over a somewhat smaller area. Lowman (1975) reports that the home range of adult red wolves varies from 65 to 130 km².

POPULATION NUMBERS AND TRENDS

Numbers are reduced or extirpated over most of the range (Pimlott and Joslin 1968). McCarley (1962) recorded species extant in only a few places in western and southern Louisiana.

R. M. Nowak (personal communication) sums up the trend: Steady decline since the coming of

the white man; accelerated since large-scale hybridization began about 1920; pure populations apparently survived until about 1920. The Recovery Team (RWRT personal communication) estimates probably fewer than 50 pure red wolves in the wild.

McCarley and Carley (1979) assert that the red wolf will soon be extinct in the wild, and C. Carley (personal communication) states that the species will probably be extinct in the wild by 1981.

REPRODUCTION

Mating occurs in January and February with pups born in March, April, and May (Nowak 1972, Riley and McBride 1972, Lowman 1975). Litters range from 3 to 12 with an average of 6 or 7 (Nowak 1972, Lowery 1974).

Both parents participate in rearing the young (Riley and McBride 1972, Lowman 1975), and yearlings are often found in the vicinity of the dens, and may help in rearing young.

After the young reach 6 weeks of age, they spend considerable time away from the den in well-covered beds (Riley and McBride 1972, Lowman 1975). Most die before the age of 6 months, with hookworms reported to be the major cause. Full size is attained in 1 year; sexual maturity by 3 years (Nowak 1972, Lowman 1975). Life expectancy is about 5 years in the wild, and greater in captivity.

Red wolves are more sociable than coyotes but less so than gray wolves (*Canis lupus*). It is not unusual to find three or more wolves traveling throughout the range as a group (Riley and McBride 1972).

MANAGEMENT AND CONSERVATION

Depletion of the red wolf was first reported in 1962. The U.S. Fish and Wildlife Service confirmed this in 1968 and further determined that two subspecies, *Canis rufus rufus* and *C. r. gregoryi*, probably existed, but that *C. r. floridanus* (inhabiting the eastern part of the range) was extinct. More recently, *C. r. rufus* (western part of range) was deemed extinct also (Carley 1975).

Efforts by the U.S. Fish and Wildlife Service in 1969 involved removing depredating animals from private lands. This served two purposes: (1) established rapport with owners of remaining red wolf habitat; and (2) facilitated removal of hybrids and coyotes while relocating red wolves (Carley 1975).

In 1973, biologists were assigned to implement the Red Wolf Recovery Plan. Removal of depre-dating animals was continued, but red wolves captured were treated for various infirmities and released (often radio-tracked) or transferred to captive breeding centers. An effort was initiated to maintain a buffer zone between red wolves and coyotes. This was determined to be impossible because of the difficulty of maintaining such an extensive buffer zone and hybrids were already present (Carley 1975).

Carley (1975) asserts that red wolves can be preserved only by relocation. Exclusion of coyotes and hybrids from the remaining range is an insurmountable problem (Carley 1975).

Relocation experiments were initiated in late 1976 on Bulls Island, South Carolina. Although there have been numerous problems with the program, a pair was successfully relocated in January 1978. This island was chosen for a number of technical reasons, but with no intent to start a viable population (Department of the Interior 1972, 1977a, 1977b; R. M. Nowak personal communication). The experiment was successfully completed in November 1978, when the pair was recaptured and returned to the captive breeding program.

In 1977, there were 29 recognized pure adults and 13 young in a breeding pool in Point Defiance Zoo in Tacoma, Washington (R. M. Nowak personal communication).

The Recovery Team (RWRT 1973) provided a step-down plan for restoring the red wolf to non-endangered status. The four major objectives are "(1) to restore surviving red wolf subspecies in their present ranges to desirable population levels; (2) to maintain an adequate captive red wolf gene pool; (3) to reestablish surviving red wolf subspecies in additional locations within their historic range; and (4) to determine the location and abundance of each surviving red wolf subspecies population." Specific goals include stopping of unauthorized killing by man, developing a positive public attitude, preventing genetic contamination, developing landowner tolerance, improving and protecting red wolf habitat, controlling debilitating pathogens and parasites, and controlling detrimental effects of environmental contaminants (RWRT 1973).

A new Recovery Team was formulated in 1978.

AUTHORITIES

George R. Abraham (Recovery Team)
State Supervisor
U.S. Fish and Wildlife Service
271-273 Agriculture Center
Louisiana State University
Baton Rouge, LA 70803

Curtis Carley
Wildlife Biologist
U.S. Fish and Wildlife Service
Albuquerque, NM 87103

Russell Clapper
Refuge Manager
Anahuac National Wildlife Refuge
Anahuac, TX 77514

George Garris
Refuge Manager
Cape Romain National Wildlife Refuge
Awendaw, SC 29429

Joe L. Herring (Recovery Team)
Chief, Division of Game
Louisiana Wildlife and Fisheries Commission
Baton Rouge, LA 70804

Howard McCarley
Austin University
Department of Biology
Sherman, TX 75090

Ronald M. Nowak
Office of Endangered Species
U.S. Fish and Wildlife Service
Washington, D.C. 20240

Mary Anne Neville (Recovery Team)
Protected Species Coordinator
Georgia Department of Natural Resources
270 Washington Street
Atlanta, GA 30339

Dave Peterson (Recovery Team Leader)
U.S. Fish and Wildlife Service
900 San Marco Boulevard
Jacksonville, FL 32207

PREPARER'S COMMENTS

Investigators (McCarley 1962, Lawrence and Bossert 1967, Paradiso 1968, Pimlott and Joslin 1968, Nowak 1970, Paradiso and Nowak 1971) have raised questions concerning the taxonomic status of the red wolf. Paradiso and Nowak (1971) and Gipson et al. (1974), using a multi-

variate analysis of skull morphology, concluded that the red wolf was indeed a valid species.

There are numerous gaps in the knowledge of the biology of this species which must be attributed to its depleted numbers, secretive habits, and limited accessibility.

LITERATURE CITED/SELECTED REFERENCES

- Carley, C. J. 1975. Activities and findings of the red wolf recovery program from late 1973 to 1 July 1975. U.S. Fish Wildl. Serv. 211 pp.
- Freeman, R. C. 1976. Coyote \times dog hybridization and red wolf influence in the wild *Canis* of Oklahoma. M.S. Thesis. Oklahoma State Univ., Stillwater. 62 pp.
- Gipson, P. S., J. A. Sealander, and J. E. Dunn. 1974. The taxonomic status of wild *Canis* in Arkansas. Syst. Zool. 23(1):1-11.
- Goldman, E. A. 1937. The wolves of North America. J. Mammal. 18(1):37-45.
- Hall, E. R., and K. R. Kelson. 1959. The mammals of North America. Vol. 2. Ronald Press, New York. 547-1,083 pp.
- Harper, F. 1927. Mammals of the Okefenokee Swamp region of Georgia. Boston Soc. Natur. Hist. Proc. 38(7):191-396.
- Horan, J. 1977. Return of the red wolf. Defenders 52(1):16-19;
- IUCN (International Union for the Conservation of Nature and Natural Resources). 1966. Red data book. Morges, Switzerland.
- Lawrence, B., and W. H. Bossert. 1967. Multiple character analysis of *Canis lupus*, *latrans*, and *familiaris*, with a discussion of the relationships of *Canis niger*. Am. Zool. 7(2):223-232.
- Lowery, G. H., Jr. 1974. The mammals of Louisiana and its adjacent waters. Louisiana State Univ. Press, Baton Rouge. 564 pp.
- Lowman, G. E. 1975. A survey of endangered, threatened, rare, status undetermined, peripheral, and unique mammals of the south-eastern National Forests and grasslands. USDA For. Serv. Contract 38-2601.
- McCarley, H. 1962. The taxonomic status of wild *Canis* (Canidae) in the south-central United States. Southwest. Natur. 7(3-4):227-235.
- . 1978. Vocalizations of red wolves (*Canis rufus*). J. Mammal. 59(1):27-35.
- McCarley, H., and C. J. Carley. 1979. Recent changes in distribution and status of wild red wolves (*Canis rufus*). U.S. Fish and Wildl. Serv. Endangered Species Report 4. 8 pp.
- Mech, L. D. 1974. *Canis lupus*. Mammalian species 37. Am. Soc. Mammalogists. 6 pp.
- Neville, M. A. T. 1977. In South Carolina, another transplant runs into trouble. Natl. Wildl. 15(5):10-11.
- . 1978. Counterfeit wolves and lonely islands. Sierra Club Bull. 63(2):22-23.
- Nowak, R. M. 1967. The red wolf in Louisiana. Defenders Wildl. News 42(1):60-70.
- . 1972. The mysterious wolf of the south. Natur. Hist. 81:50-53, 74-77.
- . 1974. Red wolf, our most endangered mammal. Natl. Parks Conserv. Mag. Aug:9-12.
- . 1975. The cosmopolitan wolf. Natl. Rifle Assoc. Coserv. Yearb. 76-83.
- Ogilvie, P. W. 1970. Interim report on the red wolf in the United States. Int. Zoo. Yearb. (10):122-124.
- Paradiso, J. L. 1965. Recent records of red wolves from the Gulf Coast of Texas. Southwest Nat. 10(4):318-319.
- . 1968. Canids recently collected in east Texas, with comments on the taxonomy of the red wolf. Am. Midl. Natur. 80(2):529-534.
- Paradiso, J. L., and R. M. Nowak. 1971. A report on the taxonomic status and distribution of the red wolf. U.S. Fish Wildl. Serv. Spec. Sci. Rep. Wildl. 145. 36 pp.
- . 1972. *Canis rufus*. Mammalian Species 22. Am. Soc. Mammalogists. 4 pp.
- Pimlott, D. H., and P. W. Joslin. 1968. The status and distribution of the red wolf. Trans. N. Am. Wildl. Natur. Resour. Conf. 33:373-384.
- RWRT (Red Wolf Recovery Team). 1973. Red wolf recovery plan. Draft. U.S. Dep. Inter. Bur. Sport Fish. Wildl., Office Endangered Species and International Activities. 32 pp.
- Riley, G. A., and R. T. McBride. 1972. A survey of the red wolf (*Canis rufus*). U.S. Fish Wildl. Serv. Spec. Sci. Rep. Wildl. 162. 15 pp.
- Shaw, J. A., and P. A. Jordan. 1977. The wolf that lost its genes. Natur. Hist. 86(10):80-88.
- Soileau, C. 1977. Epitaph for a canine. Louisiana Conservationist 29(7-8):14-17.

- Stevens, J. T. 1977. Almost gone. *Texas Parks and Wildlife* 35(5):2-7.
- U.S. Department of the Interior. 1973. Threatened wildlife of the United States. Compiled by Office of Endangered Species and International Activities. Bur. Sport Fish. Wildl. Resour. Publ. 114. U.S. Gov. Printing Office, Washington, D.C. 239 pp.
- U.S. Department of the Interior. 1976. Red wolf released on Bulls Island, Cape Romain National Wildlife Refuge, South Carolina, and recaptured. U.S. Fish Wildl. Serv. News Release. 27 December 1976. 3 pp.
- U.S. Department of the Interior. 1977a. New red wolf pair to arrive at Cape Romain National Wildlife Refuge, South Carolina. U.S. Fish Wildl. Serv. News Release. 30 June 1977. 3 pp.
- U.S. Department of the Interior. 1977b. Substitute pair of red wolves shipped to Cape Romaine National Wildlife Refuge, South Carolina. U.S. Fish Wildl. Serv. News Release, 1 July 1977. 1 pp.
- Young, S. P., and E. A. Goldman. 1944. The wolves of North America. 2 parts. *Am. Wildl. Inst.*, Washington, D.C. 630 pp.

ACCOUNT PREPARED/UPDATED BY:

National Fish and Wildlife Laboratory
412 N.E. 16th Avenue, Room 250
Gainesville, FL 32601

Biological Services Program

FWS/OBS-80/01.2
MARCH 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States-

BLUNT-NOSED LEOPARD LIZARD



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

FWS/OBS-80/01.2
March 1980

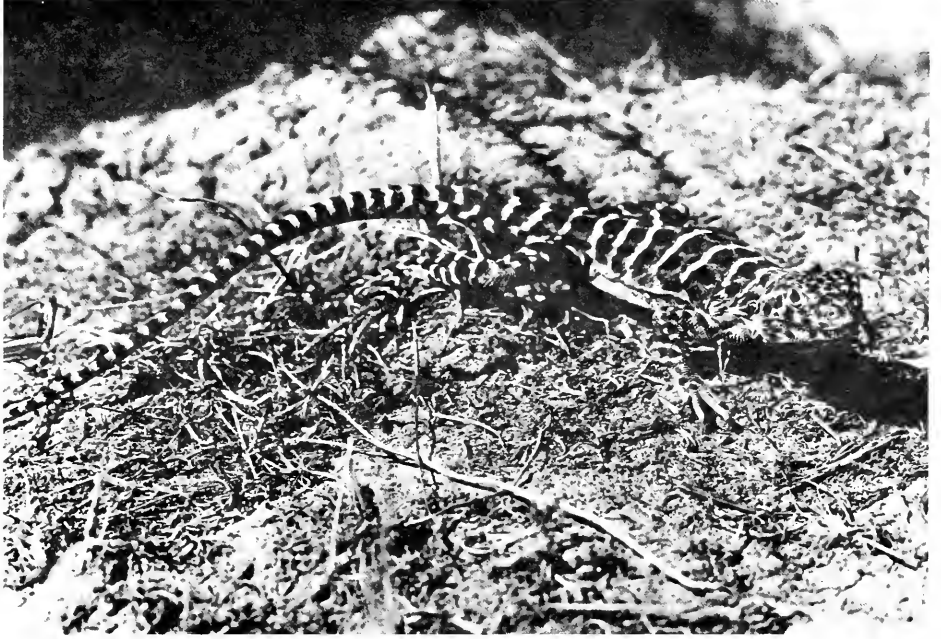
SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES

BLUNT-NOSED LEOPARD LIZARD

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: DAVE DICK, CALIF. DEPT. OF FISH AND GAME

BLUNT-NOSED LEOPARD LIZARD

Crotophytus (Gambelia) silus

KINGDOMAnimalia
 CLASS Reptilia
 ORDER Sauria
 FAMILY Iguanidae
 OTHER COMMON

NAMES Blunt-nose leopard lizard

DATE

Entered into SWISTo be determined
 Updates 9 November 1979

LEGAL STATUS

Federal Endangered (32 FR 4001, 11 March 1967).
 States Endangered: California (21 May 1977)

REASONS FOR CURRENT STATUS

This lizard has become increasingly difficult to find throughout most of its range because of agricultural development and urbanization. The few remaining areas of prime habitat, along the western side of the San Joaquin Valley, are undergoing rapid development following the recent completion of a major new aqueduct (the California Aqueduct) (Brode 1978, Bury 1972, Montanucci 1965, Snow 1972, U.S. Dep. Int. 1973). Off-road vehicle recreation is damaging the remaining habitat in some nonagricultural areas (Brode 1978). Overgrazing and agricultural pest control may be detrimental to *C. (G.) silus* populations (Anon 1978).

PRIORITY INDEX

Not assigned.

DESCRIPTION

A robust lizard with a long, slender, cylindrical tail, *C. (G.) silus* has a large head with a short, blunt snout; adults measure 89 to 127 mm in snout-to-vent length. The dorsal ground color is gray or brown, and the dorsum has broad, distinct whitish bands interspaced with dusky spots. The throat has dark gray blotches. Undersides of the tail and thighs are white to yellowish; during the breeding season, the males are salmon or rust color ventrally or all over the body except the head (Brode 1978; Bury 1972; Montanucci 1965, 1967, 1970; Snow 1972; Tollestrup 1979). Females have a breeding color consisting of a single, or, occasionally, a double row of red-orange spots on the flanks and sides of the face and a continuous wash of the same color on the undersurface of the tail and thighs. (Tollestrup 1979). Montanucci (1965, 1967, 1970) describes distinction in color, pattern, and size between valley floor, foothill, and ecotonal hybrid populations, but Tollestrup (1979) did not find such differences.

RANGE

The species occurs only in California. It was once found throughout the San Joaquin valley and adjacent foothills from about latitude 37° 31' north southward into San Luis Obispo County. It now occurs at scattered locations in the valley, east to the Sierra foothills, south to the Tehachapi Mountains, and along the east slopes of the Coast Range foothills, including the Carrizo Plain and lower Cuyama Valley (Brode 1978; Montanucci 1965, 1970; Snow 1972), at elevations below 600 m.

RANGE MAP

Known distribution is shown on the accompanying map (Anon 1978).

STATES/COUNTIES

California Fresno, Kern, Kings, Madera, Merced, San Benito, San Luis Obispo, Santa Barbara, Tulare, Ventura.

HABITAT

It prefers open habitat with scattered low

bushes, occurring on sparsely vegetated plains, alkali flats, low foothills, canyon floors, large washes, and arroyos; it is usually found on sandy substrates and sometimes on coarse, gravelly soil and hardpan (Montanucci 1965, 1970).

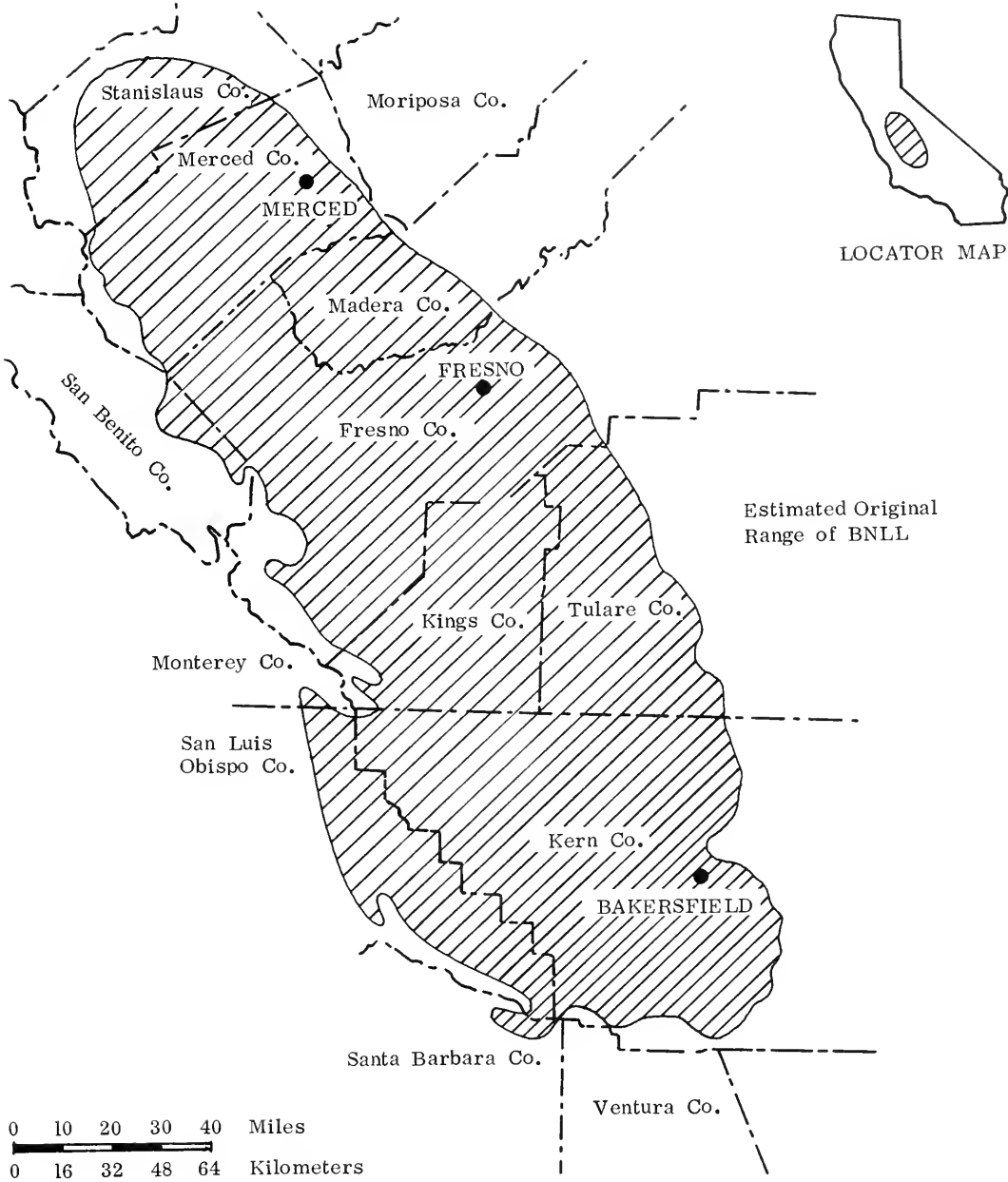
FOOD AND FORAGING BEHAVIOR

This lizard is an active predator and an opportunistic feeder, subsisting primarily on large insects and small lizards. Montanucci (1965) reports seasonal and regional variation in diet, depending on the availability of insect and lizard prey. Insects taken include locusts (*Trimerotropis californica*), grasshoppers (*Melanoplus* sp.), cicadas (*Okanagana triangulata*, *O. pallidula*), crickets (*Acheta assimilis*), and a wide variety of orthoptera, lepidoptera, and coleoptera species. Lizards eaten include *Uta stansburiana*, *Phrynosoma coronatum*, small *Sceloporus magister*, and *Cnemidophorus tigris*, as well as juveniles of its own species. Small amounts of vegetable matter are also taken (Montanucci 1965, 1967). Tollestrup (1979) found that *C. (G.) silus* feeds principally on grasshoppers, crickets, beetles, cicadas, flies, and spiders; no vertebrate prey was found in this large sample of stomachs (N = 142).

Foraging habits vary relative to habitat and available prey (Montanucci 1967). Lizards will leap into the air or into shrubbery in pursuit of insects. Stalking and pursuit are employed in hunting both insect and lizard prey. Montanucci (1965) reports that *C. (G.) silus* will dig up lizards (*Uta stansburiana*) that have taken refuge in holes or loose sand.

SHELTER REQUIREMENTS

Montanucci (1965) notes that population densities correlate to some extent with abundance of mammal burrows. Abandoned or occupied burrows of kangaroo rats (*Dipodomys* sp) and abandoned squirrel burrows (*Spermophilus* sp.), gopher burrows (*Thomomys bottae*), and badger dens (*Taxidea taxus*) are used for escape cover and permanent shelter. In areas where mammal burrows are scarce, adult *C. (G.) silus* construct shallow, simple chambered tunnels under exposed rocks or earthen banks. Immature lizards use rock piles, trash piles, brush, etc. for temporary cover (Montanucci 1965).



Distribution of the blunt-nosed leopard lizard.

NESTING OR BEDDING

Nesting habits of *C. (G.) silus* are almost identical to those of *Gambelia wislizenii* (see Parker and Pianka 1976). Females lay eggs in June and July, in burrows at about 50 cm depth. A chamber is excavated or enlarged, entrance tunnels sealed, and eggs are laid one at a time and lightly covered with sand or soil. The exit tunnel is then plugged from without.

RITUAL REQUIREMENTS

Males establish and defend home burrows, but appear to have overlapping home ranges (Montanucci 1965). The degree to which territoriality is exhibited is probably correlated with abundance and availability of food and cover; where mammal burrows are abundant, individual home ranges and home burrows are difficult to detect (Montanucci 1965). Recently, Tollestrup (1979) found that males defend home ranges, not just burrows.

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

Montanucci (1965) reported that several factors limit the distribution of *C. (G.) silus*:

1. Agricultural practices
2. Flooding
3. Chaparral
4. Steep or extensive rocky areas.

Tall grass may hamper foraging and rapid locomotion, and may account for the relative scarcity of *C. (G.) silus* on the east side of the San Joaquin Valley (Montanucci 1965). K. Tollestrup (pers. comm.) reported that tall grass improves foraging because insect abundance increases and it gives the lizards cover for escape from predators. Scarcity of *C. (G.) silus* in tall grass areas on the east side of the San Joaquin Valley is probably due to the fact that human settlements in this region and farming and grazing of the land date back many years. Also, in this area, it is common practice to plow and burn rangelands in the fall, which decreases or eliminates populations of *C. (G.) silus*. Entomologists working in Kern County reported finding leopard lizards killed by insecticides (DDT and Malathion) (Montanucci 1965).

POPULATION NUMBERS AND TRENDS

J. M. Sheppard (*in* Snow 1972) estimates a density of 300 to 400 lizards per square mile of optimum habitat near Maricopa, Kern County. Since it is unlikely that all habitats occupied are optimum, he considered the mean density of lizards to be 100/mi² (38.6/km² or 0.4/ha). Tollestrup (1979) estimated that there were 3.5 lizards per ha at Pixley National Wildlife Refuge, which is the highest known density. Populations of *C. (G.) silus* are low (0.5 to 1 per acre or about 1 to 2.5 per ha) under optimum conditions (Anon. 1978).

REPRODUCTION

The reproductive cycle varies slightly with environmental conditions. Males will often mate with several females. Mating occurs from late April to early June; clutches of 2 to 5 eggs are laid in June or July; some females may have two clutches per year (Montanucci 1965). Incubation time is estimated at about 57 days. Young (±2 to ±7 mm in snout-to-vent length) appear from July 30 through September. Sexual maturity in both sexes occurs between 9 and 18 months (Montanucci 1965, 1967; Tollestrup 1979).

MANAGEMENT AND CONSERVATION

Habitat for the blunt-nosed leopard lizard is rapidly being lost throughout its range. In the last 100 years, the natural wildlands of the San Joaquin Valley have decreased from 3 million ha to about 200,000 ha (Dick 1977). Suitable habitat (salt-brush desert scrub) on the west side of the valley is now being developed for agriculture, since completion of the California Aqueduct. Also, off-road vehicles have denuded parts of this region.

R. R. Montanucci (*in* Snow 1972) recommended the establishment of a national grassland preserve in the southwestern part of the San Joaquin Valley as the most rapid means of assuring partial protection of this species. Brode (1978) recommended protective management programs on the remnants of suitable lizard habitat on public lands (the Naval Petroleum Reserve near Taft, the Kern and Pixley National Wildlife Refuges, Los Padres National Forest, and National

Resources Land). These lands should be managed to maintain and enhance habitat suitable to the blunt-nosed leopard lizard. Both refuges recognize the importance of their lands to the survival of the lizard; the Pixley National Wildlife Refuge was used as a study area on the ecology of this species (Tollestrup 1979). Also near Pixley, the U.S. Forest Service will manage a tract of grassland comprising about 325 ha for this lizard (Brode 1978). Essential habitat on private land could be protected by agreement with land-owners.

The California Department of Fish and Game has conducted field surveys and initiated cooperative studies with the U.S. Forest Service, University of California at Berkeley, and several colleges to further determine the distribution and status of this lizard. A Blunt-Nosed Leopard Lizard Recovery Team has been formed to provide needed coordination of effort to protect this species (Anon. 1978, Brode 1978).

AUTHORITIES

John M. Brode (Recovery Team Leader)
California Department of Fish and Game
1701 Nimbus Road
Rancho Cordova, California 95670

Richard R. Montanucci
Department of Zoology
Clemson University
Clemson, South Carolina 29631

Kristine Tollestrup
Department of Biology
University of Chicago
1103 E. 57th Street
Chicago, Illinois 60637

PREPARER'S COMMENTS

Recent taxonomic changes for this lizard warrant explanation to prevent confusion and promote consistent use of currently accepted nomenclature. The relationships and systematic status of the lineages of crotaphytaform lizards (leopard and collared lizards) of North America have been undergoing revision by herpetologists as new data and techniques become available. Montanucci (1970) presented evidence of genetic and ecologic differentiation between the leopard lizards of the San Joaquin Valley and those of

more southern and eastern populations. This evidence supports the recognition of the blunt-nosed leopard lizard as a distinct species (*Gambelia silus*), rather than a subspecies of the longnose leopard lizard (*G. wislizenii*).

Montanucci et al. (1975) present biochemical evidence indicating that leopard lizards are sufficiently different from the closely related collared lizards (genus *Crotaphytus*) to be considered a separate genus (*Gambelia*).

LITERATURE CITED/SELECTED REFERENCES

- Anonymous. 1978. Blunt-nosed lizard recovery plan. Part I. (draft). 12 pp.
- Brode, J. 1978. Blunt-nosed leopard lizard (*Crotaphytus silus*). Pages 24-25 in *At the Crossroads: a report on California's endangered and rare fish and wildlife*. Calif. Dep. Fish Game Biannual Rep. 103 pp.
- Bury, R. B. 1972. Status report on California's threatened amphibians and reptiles. Calif. Dep. Fish Game, Inland Fisher. Rep. 72-2. 31 pp.
- Dick, D. 1977. Habitat disappearing for the leopard lizard. *Outdoor Calif.* 38(6):37-38.
- Montanucci, R. R. 1965. Observations on the San Joaquin leopard lizard *Crotaphytus wislizenii silus* Stejneger. *Herpetologica* 21(4):270-283.
- . 1967. Further studies on leopard lizards, *Crotaphytus wislizenii*. *Herpetologica* 23(2): 119-126.
- . 1970. Analysis of hybridization between *Crotaphytus wislizenii* and *Crotaphytus silus* (Sauria: Iguanidae) in California. *Copeia* 1970 (1):104-123.
- Montanucci, R. R., R. W. Axtell, and H. C. Dessaur. 1975. Evolutionary divergence among collared lizards (*Crotaphytus*), with comments on the status of *Gambelia*. *Herpetologica* 31(3):336-347.
- Parker, W. W., and E. R. Pianka. 1976. Ecological observations on the leopard lizard (*Crotaphy-*

tus wislizenii) in different parts of its range. *Herpetologica* 32(1):95-114.

Snow, C. 1972. Blunt nosed leopard lizard: *Crotaphytus silus*. Bur. Land Manage. Tech. Note 6601. 13 pp.

Tollestrup, K. 1979. The ecology, social structure, and foraging behavior of two closely related species of leopard lizards, *Gambelia silus* and *Gambelia wislizenii*. Ph. D. Thesis, Univ. Calif.

Berkeley.

U.S. Department of the Interior. 1973. Threatened wildlife of the United States. Bur. Sport Fish. Wildl. Res. Publ. 114. 289 pp.

PREPARED/UPDATED BY

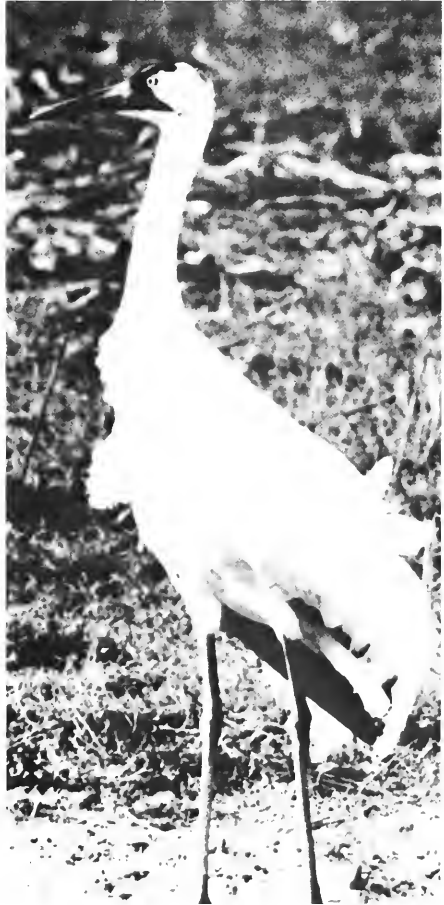
National Fish and Wildlife Laboratory,
1300 Blue Spruce Drive
Fort Collins, Colorado 80524

Biological Services Program

FWS/OBS-80/01.3
March 1980

**Selected Vertebrate
Endangered Species
Of the Seacoast of the
United States-**

THE WHOOPING CRANE



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

FWS/OBS-80/01.3
March 1980

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—

THE WHOOPING CRANE

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: W. F. KUBICHEK

WHOOPING CRANE

Grus americana Linnaeus

DATE

Entered into SWIS. to be determined
 Updates. 18 July 1978, 25 September 1978.

KINGDOM Animalia
 CLASS Aves
 ORDER. Gruiformes
 FAMILY Gruidae
OTHER COMMON
 NAMES. Great white crane

LEGAL STATUS

Federal: Endangered (32 FR 4001, 11 March 1967; 35 FR 8491, 2 June 1970).
 States: Endangered: Colorado, Idaho, Montana, Nebraska, New Mexico, Texas.

REASONS FOR CURRENT STATUS

There are only 75 whooping cranes in the wild and 27 in captivity (WCRT 1977). They once nested widely over northern North America; nesting is now restricted to a small area in the southern MacKenzie District and northeastern Alberta, Canada. Breeding habitat and wintering habitat have been reduced as a result of drainage, agriculture, the Gulf Intracoastal Waterway, and human settlements. Whooping cranes avoid areas of human disturbance even if the habitat is otherwise suitable (R. Erickson personal communication).

Cranes were hunted before legal protection was instituted. Losses were particularly acute on the Gulf Coast wintering grounds (Allen 1952). Accidental shooting probably still occurs when whooping cranes are mistaken for snow geese (*Chen hyperborea*) and sandhill cranes (*Grus canadensis*), both legal game in some areas (WCRT 1977).

Natural factors such as large nesting territories and a very low reproductive rate of one chick per year make recovery slow. The biannual migration covering over 3,800 km usually accounts for some mortality (Allen 1962). Stormy weather during migration poses a serious threat to the few remaining whooping cranes. The nonmigratory Louisiana population was reduced 50% during a hurricane in 1940 and never recovered (Allen 1952).

There remains the possibility of hazardous materials being spilled on the wintering grounds along the heavily industrialized Texas Gulf Coast.

PRIORITY INDEX

Not assigned.

DESCRIPTION

Whooping cranes are the tallest birds in North America. Males are almost 1.5 m high, with a wingspan of 2.4 m and an average weight of 7 kg. Females are slightly smaller, with an average weight of 6 kg. Weight can vary 25% seasonally, with the maximum reached in winter.

The adult plumage is velvety white except for the head and portions of the wings and feet. Forehead, crown, anterior part of occiput, lores, and cheeks are bare except for sparse black hair-like feathers. The skin in this area is warty or granulated, and a reddish color. The bill is a dull pink, proximally changing to dull brownish in the middle and dirty yellow on the tip. The alulae, 10 primaries, and 10 greater upper coverts are a

slatey black. The feet are black with flesh-colored pads.

Juvenal plumage is a variable mixture of white and buff or brown. The adult plumage is attained in about 1 year. The sexes are similar.

Vocalizations range from a purring call near young to a low groaning call when approached by humans, to a shrill, bugle-like 'kerloo! ker-lee-oo.' The latter is known as a unison call and is a definite indicator of pair bonding (R. Erickson personal communication).

Photographs appear in Allen (1952), McNulty (1966), Novakowski (1966), Walkinshaw (1973), Lowery (1974), Kuyt (1976a, 1976b), Muir (1976), numerous drawings appear in Allen (1952).

RANGE

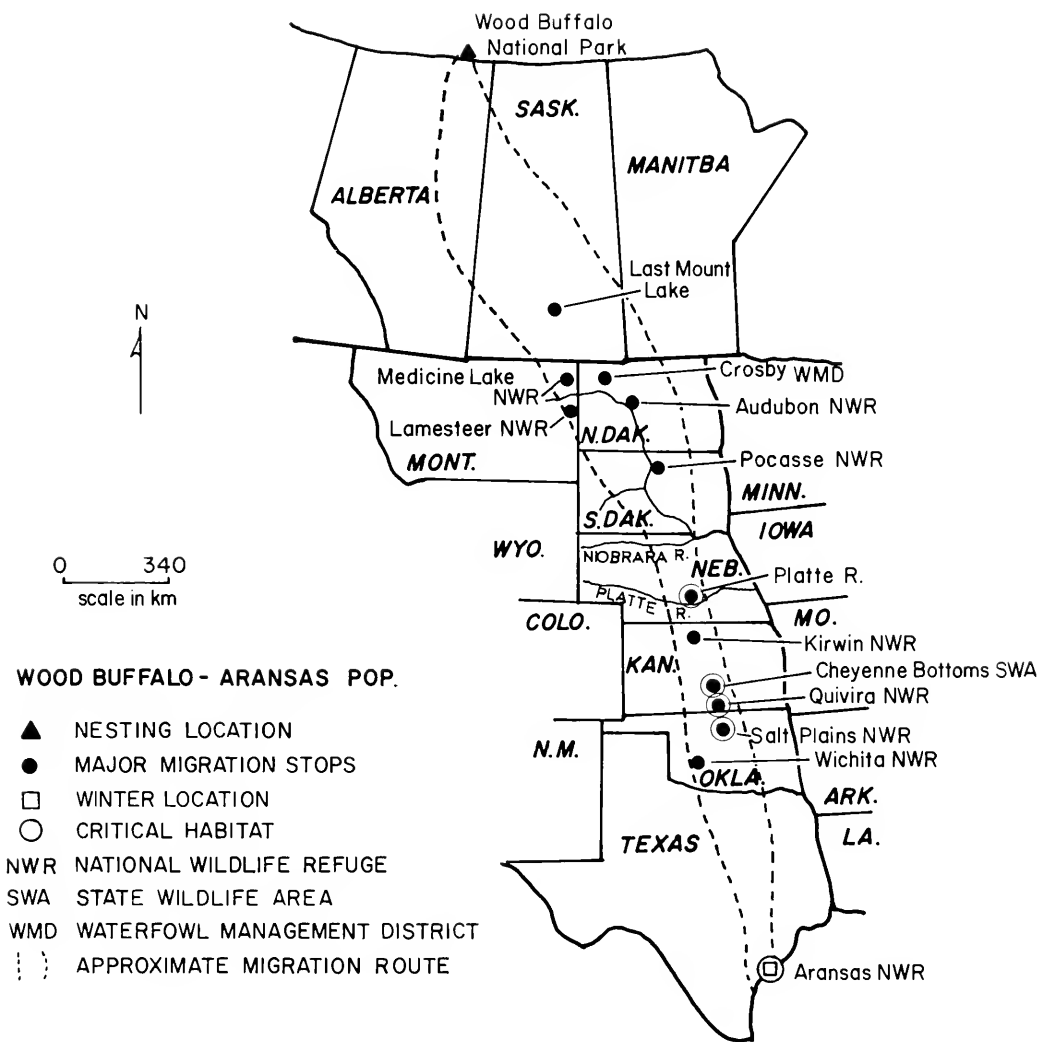
The natural population now nests only in Wood Buffalo National Park, southern MacKenzie District, and northeastern Alberta, Canada. It winters on the Gulf Coast of Texas, in Aransas National Wildlife Refuge and adjacent peninsulas and islands. Its migration route is a nearly straight-line path through east central Texas, central Oklahoma, central Kansas and Nebraska, western and central North and South Dakota, northeastern Montana, southeastern Saskatchewan, and northeastern Alberta.

An experimentally transplanted disjunct population will hopefully nest at Grays Lake National Wildlife Refuge, Idaho, and winter in the Rio Grande Valley of New Mexico. The migration route passes through southeastern Idaho, northeastern Utah, southwestern Wyoming, western Colorado, and north-central New Mexico (WCRT 1977).

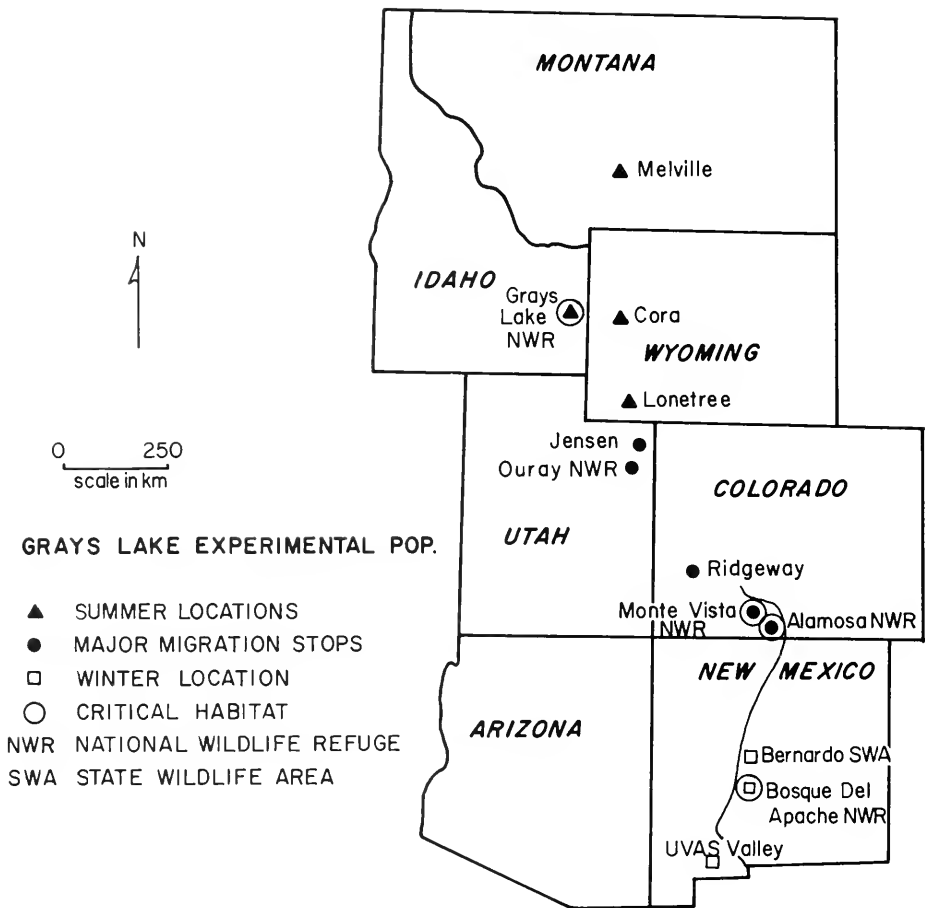
The crane formerly bred from its present range south through the prairie provinces and northern prairie states, including Illinois, Iowa, Minnesota, and North Dakota, and wintered from the Carolina coast to central Mexico. A geographically isolated breeding population, believed to be nonmigratory (now extirpated), formerly lived in southeastern Louisiana.

RANGE MAP

Wood Buffalo-Aransas population, Grays Lake Experimental Population and Critical Habitat from WCRT (1977) and Federal Register (43 FR 20938, 15 May 1978).



Map depicts the nesting and wintering locations of the Wood Buffalo-Aransas populations of the whooping crane and its migration route. Critical habitat is designated.



Map depicts summer and winter locations and migration stops for the Grays Lake experimental population of the whooping crane. Critical habitat is designated.

STATES/COUNTIES

Wood Buffalo-Aransas Population

Winter

Texas Aransas, Calhoun.

Known Migration Stops

Kansas Barton, Reno, Stafford.

Montana Roosevelt, Sheridan

Nebraska Adams, Blaine, Brown, Buffalo, Custer, Dawson, Franklin, Gosper, Hall, Harlan, Kearney, Keya Paha, Loup, Phelps, Rock, Sherman, Thomas, Valley, Webster.

North

Dakota Burke, Burleigh, Divide, Dunn, Emmons, McKenzie, McLean, Morton, Mountrail, Penville, Sioux, Ward, Williams.

Oklahoma Alfalfa, Comanche.

South

Dakota Campbell, Corson, Dewey, Haakon, Hughes, Potter, Stanley, Sulley, Walworth, Ziebach

Grays Lake Experimental Population

Winter

New

Mexico Luna, Socorro, Valencia.

Mexico Chihuahua.

Known Migration Stops

Colorado Alamosa, Canejos, Ouray, Rio Grand.

Utah Uintah.

Summer

Idaho Bonneville, Caribou.

Montana Sweet Grass.

Utah Uintah.

Wyoming Sublette, Uintah.

HABITAT

The nesting grounds are marshy areas with many potholes, which are generally shallow and have soft, muddy bottoms. The pH is usually between 7.6 and 8.3. Potholes are separated by land areas with black spruce (*Picea mariana*), tamarack (*Larix laricina*), and willows (notably *Salix candida*) forming the canopy. The understory includes dwarf birch (*Betula glandulosa*),

bearberry (*Arctostaphylos uva-ursi*), and several species of lichen. The ground is deeply carpeted with sphagnum moss. Emergent vegetation in the potholes used by cranes is mainly bulrush (*Scirpus validus*) (Novakowski 1966).

The Wood Buffalo-Aransas population winters on salt-marsh flats in coastal lagoons on the Gulf of Mexico. Allen (1952) differentiated three types used by cranes: (1) permanent pond, lake, ditch, or bayou open to bay tides at all seasons; (2) semipermanent ponds connected by narrow bayous to permanent water areas; (3) ephemeral ponds that offer superior feeding places. Typical vegetation includes salt grass (*Distichlis spicata*), saltwort (*Batis maritima*), glasswort (*Salicornia* sp.), sea ox-eye (*Borrhichia frutescens*), needle cordgrass (*Spartina spartinae*), and saltmarsh cordgrass (*Spartina alterniflora*) (Allen 1952). Cranes will occasionally forage into the oak (*Quercus*) brush region (Allen 1952), especially after a fire.

The major requirement for whooping crane habitat selection, particularly during migration, is an open expanse for nightly roosting. The birds typically use sand or gravel bars in rivers and lakes (43 FR 36588, 17 August 1989).

Historic habitat includes interior tall-grass prairies, sea-rim and brackish marshes, and higher interior grasslands (Allen 1952). Some of these habitat types are still used during migration.

FOOD AND FORAGING BEHAVIOR

Cranes are omnivorous, taking vegetation, insects, amphibians, reptiles, and small mammals (Bent 1926). The whooper is more aquatic than the sandhill crane and has a greater preference for animal foods (Allen 1952). Prey species are listed in Allen (1952) and Novakowski (1966).

Summer foods were studied by Novakowski (1966) and were determined to be primarily large nymphal or larval forms of insects, and crustaceans. Terrestrial foods such as berries were taken when abundant (Novakowski 1966).

A greater variety of foods are taken in the winter, and include grains, acorns, insects, marine worms, crustaceans, mollusks, fishes, amphibians, reptiles, and, very occasionally, birds (Allen 1952).

During migration, cranes feed while on mud flats and sandbars. Allen (1952) suggests that crustaceans, fishes, amphibians, and reptiles in the shallows compose the bulk of the diet. Recent data indicate that during fall migration, cranes often feed

in recently harvested grain fields, eating insects and wasted grain, especially corn.

SHELTER REQUIREMENTS

Not known.

NESTING OR BEDDING

Nests, 15 to 60 cm above the water, are made of rushes (*Scirpus validus*), sedge (*Carex* sp.), or cattail (*Typha latifolia*). Nests are restricted to areas with limited terrestrial accessibility, and are not usually reused in subsequent years; but a new nest is generally built in the same area (Kuyt 1976a). Allen (1952) describes in detail nests and their construction in historic breeding localities.

RITUAL REQUIREMENTS

Premigration behavior in December or January includes a restless shifting of habitual winter territories, increasing in frequency of dancing displays and circling flights which eventually result in actual movement northward (Allen 1952, WCRT 1977). Generally the cranes leave Aransas National Wildlife Refuge between the end of March and the middle of April. They arrive at Wood Buffalo National Park 18 to 28 days later (Allen 1956, WCRT 1977).

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

Climate plays a vital role in whooping crane survival. Extreme dryness has little effect on nesting success, but can force young and parents to travel farther in search of food (Novakowski 1966) and render nesting areas more accessible to terrestrial predators (E. Kuyt, personal communication). Departure of cranes on spring migration is assisted by strong prevailing southeast winds (WCRT 1977). However, a hurricane or large storm could interfere with migration (Allen 1952).

The average territory size is about 162 ha on the wintering ground. In the Sass River area, Wood Buffalo National Park, the radii of the nesting territories average 0.9 km. Rarely, however, are nests of two different pairs closer than 1.3 km, and when they are closer, nesting success is below average (Kuyt 1976a).

POPULATION NUMBERS AND TRENDS

The numbers have increased since a low of 21 birds in 1941-1942. The 1977 count of whooping cranes was 75 birds in the wild (Aransas Refuge - Wood Buffalo National Park had 69 birds, and experimental Rocky Mountain flock had 6) and

27 in captivity (Patuxent Wildlife Research Center had 22; International Crane Foundation, 3; and San Antonio Zoo, Texas, 2) (WCRT 1977).

The potential for population growth in the wild is quite low for many reasons (Stevenson and Griffith 1946). Major reasons are that only one young survives and there is high juvenile mortality during migration. Erickson (1961) suggests that although numbers have increased, there has not been an increase in rate of annual production per breeding pair. Thus, while the average annual production per pair has remained essentially the same, an increasing proportion of the older birds is returning to Aransas without progeny. Novakowski (1966) also suggests that early separation of young from adults during spring migration may account for high losses of young of the year.

Allen (1952) estimated that the historical (1870) population was about 1,500 birds.

REPRODUCTION

Usually two, smooth, buff eggs with dark blotches are laid in late April or early May. The incubation period is 29 days. Incubation is shared by both parents, with one parent generally inclined to spend more time on the nest (Allen 1952). Parents and young leave the nest site 2 to 3 days after hatching, and spend the summer traveling from pond to pond feeding (E. Kuyt, personal communication). The family unit is maintained through the winter, with the young gradually gaining more independence. Just before the migration, the parents begin to drive the young away, but do not separate entirely until enroute to the nesting grounds (Allen 1952, Novakowski 1966).

MANAGEMENT AND CONSERVATION

Early accounts of a superabundance of whooping cranes probably caused a delay in recognizing and responding to the decline in population. Many people probably misidentified the more numerous sandhill crane (Allen 1952).

Efforts to prevent whooping crane extinction have been considerable and have succeeded marginally in increasing the total numbers in the wild. The sequence of events is detailed in Allen (1952) and WCRT (1977).

The Migratory Bird Act of 1918 provided legal protection of migratory birds and paved the way for cooperation in whooping crane management between the United States and Canada. Aransas National Wildlife Refuge was established in 1937 to protect whooping cranes, waterfowl,

and other coastal Texas wildlife. The refuge lies between San Antonio Bay and Aransas Bay on the Texas Gulf coast, and in 1937 was the wintering ground for 60% of the whooping cranes (WCRT 1977).

The American Ornithologists' Union wrote a report in 1944 calling for the National Audubon Society and U.S. Fish and Wildlife Service to determine the status of whooping cranes, and to stop the trend toward extinction. The Wilson Society made the same request in 1944 (Allen 1952).

In 1945, the Cooperative Whooping Crane Project, involving the U.S. Fish and Wildlife Service and the National Audubon Society, was set up to investigate means to protect and restore the species.

Robert Allen's 1952 monograph, *The Whooping Crane*, a product of 39 months of study, outlined early management needs.

The nesting grounds were discovered in 1954 in Wood Buffalo National Park, which had been created in 1922 as a preserve and management area for bison.

The Cooperative Whooping Crane Project was replaced by the Whooping Crane Advisory Group, appointed by the Director of the Bureau of Sport Fisheries and Wildlife in 1956 to provide advice to the Bureau on the crane's problems.

The Standing Committee of the International Wild Waterfowl Association created the Whooping Crane Conservation Association in 1961. This association has both Canadian and United States membership and is privately funded. The association encourages artificial propagation to increase numbers, and promotes public education to protect the cranes on migration. The International Crane Foundation is another private organization whose goals are to conserve cranes worldwide (WCRT 1977), and also contributes to the whooping crane project.

Many efforts have been made to reverse the trend towards extinction. In 1946, food habit studies were initiated. Shortly afterwards, techniques for keeping abreast of population numbers were developed, e.g. monitoring flyways. Warning signs were posted on the Intracoastal Waterway, which bounds the Aransas Refuge. Oil drilling in the area of the refuge was handled in a cooperative spirit and cattle grazing was found not to compete with cranes (Allen 1952). Public education played a large role in reversing the downward trends (Walkinshaw 1973).

The role played by the Canadian Wildlife Service of the Canadian Department of Environment is equal in importance to that of the U.S.

Fish and Wildlife Service. This group has conducted surveys since 1954 to record events on the breeding grounds. Other important functions include (WCRT 1977):

1. Fire patrol and fire suppression
2. Prohibition of public access into or low-flying aircraft over the area.
3. Resistance to attempts by commercial interests to develop the breeding areas.
4. Conduct periodic censuses.

A migration monitoring program was established by the U.S. Fish and Wildlife Service in the fall of 1975 to :

1. Attempt to prevent exposure to disease outbreaks and other unusual hazards.
2. Alert key areas along flyways.
3. Provide information to be used to determine major stop-over areas.
4. Provide information for determining critical habitat.

The National Audubon Society has a network that is coordinated with the U.S. Fish and Wildlife Service program; and several States along the flyway assist in crane protection.

A recovery team was approved in November 1975, and has produced a draft Recovery Plan (WCRT 1977). The primary objective of their plan is to remove the whooping crane from its endangered status. The requirements necessary to reach this objective are:

1. Increase the Wood Buffalo—Aransas population to at least 40 nesting pairs.
2. Establish at least two additional, separate and self-sustaining populations consisting of at least 20 nesting pairs.

Additional research is advised on food habits and availability in relation to climatic conditions, spatial requirements, and territorial behavior in an expanding population. Additional data are also needed on the impact of increasing human activities in the habitat area.

The Canadian Wildlife Service and U.S. Fish and Wildlife Service removed 50 eggs from Wood Buffalo in 1967, 1968, 1969, 1971, and 1974 and attempted to hatch them at Patuxent Research Center, Maryland. As of 1975, 19 whoopers have been raised in this effort. The goal of producing second-generation captive birds for release has not yet been achieved (Kuyt 1976a).

In 1975, 14 eggs were taken from Wood Buffalo nests and transplanted to foster sandhill crane parents at Grays Lake National Wildlife

Refuge, Idaho. The goal of this effort is to establish an additional isolated population so that a single calamity could not destroy the entire population (Kuyt 1976a). Eggs were also transplanted in 1976 and 1977. As of 1977, six birds have been successfully raised and now migrate with the sandhill cranes (WCRT 1977).

Other management suggestions (Allen 1952) which have not been achieved include inclusion of Mustang Lake into the Aransas refuge, closure of it to fishing, and conversion of the lake to the predredged condition. Allen (1952) also suggested extending the boundaries of the refuge, and this has been accomplished in part by the National Audubon Society's leasing of lands adjacent to the refuge (WCRT 1977).

Critical Habitat was designated in 1978 (43 FR 20938; 15 May 1978) and includes these areas:

- | | |
|------------|---|
| Colorado | Monte Vista National Wildlife Refuge (all), and Alamosa National Wildlife Refuge (all). |
| Idaho | Grays Lake National Wildlife Refuge (all plus a 1.6-km perimeter). |
| Kansas | Quivira National Wildlife Refuge (all), Cheyenne Bottoms State Waterfowl Management Area (all). |
| Nebraska | A strip along the Platte River in Dawson, Gosper, Kearney, Buffalo, and Phelps Counties. |
| New Mexico | Bosque del Apache National Wildlife Refuge (part). |
| Oklahoma | Salt Plains National Wildlife Refuge (all). |
| Texas | Aransas National Wildlife Refuge (all), northeast to Pringle Lake, southeast to Gulf Intracoastal Waterway platform channel marker 25, and northwest to the refuge. |

Eight additional areas have been proposed as critical habitat (43 FR 36588; 17 August 1978):

- | | |
|--------------|--|
| Kansas | Kirwin National Wildlife Refuge. |
| Montana | Medicine Lake National Wildlife Refuge. |
| Nebraska | A section of the Nebraska River in Brown, Burleigh, Divide, Dunn, Emmons, McKenzie, McLean, Morton, Mountrail, Penville, Sioux, Ward, and areas in Campbell and Williams Counties. |
| South Dakota | Conson, Dewey, Haakon, Hughes, Potter, Stanley, Sully, Walworth, and Ziebach Counties. |

AUTHORITIES

David Blankinship (Recovery Team)
National Audubon Society
721 Pine Street
Rockport, TX 78382

Roderick Drewien
Bosque del Apache National Wildlife Refuge
Box 278
San Antonio, NM 87832

Ray Erickson (Recovery Team)
Assistant Director
Patuxent Wildlife Research Center
Laurel, MD 20810

Conrad Fjetland
c/o U.S. Fish and Wildlife Service
5796 Bickel Church Road
Pickerington, OH 43147

Harold D. Irby (Recovery Team)
Program Director
Migratory Game
Texas Parks and Wildlife Department
4200 Smith School Road
Austin, TX 78744

Ernie Kuyt
Canadian Wildlife Service
9942 108th Street
Edmonton, Alberta
T5K 2J5

Ross Lock (Recovery Team)
Non-Game Specialist
Nebraska Game and Parks Commission
2200 North 33rd Street
Lincoln, NE 68503

Dave Olsen (Recovery Team Leader)
Division of Wildlife Refuges
U.S. Fish and Wildlife Service
Department of the Interior
Washington, D.C. 20240

L. H. Walkinshaw
4691 Timberlane Road
Lake Wales, FL 33853

PREPARER'S COMMENTS

None.

LITERATURE CITED/SELECTED REFERENCES

- Allen, R. P. 1952. The whooping crane. Natl. Audubon Soc. Res. Rep. 2. New York.
- . 1954. Additional data on the food of the whooping crane. *Auk*. 71(2):198-199.

- . 1956. A report on the whooping crane's northern breeding grounds. Natl. Aud. Soc. Supple. Res. Rep. 3:60 pp.
- Archibald, G. W. 1976. Crane taxonomy as revealed by the unison call. Pages 225-251 in J. C. Lewis, ed. Proc. Intl. Crane Workshop. Oklahoma State Univ. Publ. and Printing. 355 pp.
- Bard, F. G. 1956. Whooping cranes in migration, 1956. Blue Jay 14 (2):39-42.
- . 1958. Whooping cranes, 1958. Blue Jay 16(1):11-14.
- Blankinship, D. R. 1976. Studies of whooping cranes on the wintering grounds. Pages 197-206 in J. C. Lewis, ed. Proc. Intl. Crane Workshop. Oklahoma State Univ., Publ. Printing. 355 pp.
- Bent, A. C. 1926. Life histories of North American marsh birds. Dover Publ., Inc., New York. 392 pp.
- Drewien, R. C. 1975 & 1976. Unpublished quarterly progress reports 1-8, whooping crane transplant experiment. Idaho Coop. Wildl. Res. Unit, Univ. Idaho, Moscow.
- Erickson, R. C. 1961. Production and survival of the whooping crane. U.S. Bur. Sport Fish Wildl. Serv. Rep. 29 pp.
- . 1966. Production and survival of the whooping crane. U.S. Fish Wildl. Serv. Admin. Rep.
- . 1975. Captive breeding of whooping cranes at the Patuxent Wildlife Research Center. Pages 99-114 in R. D. Martin, ed. Breeding Endangered Species in Captivity. Academic Press, New York. 420 pp.
- . 1976. Whooping crane studies at the Patuxent Wildlife Research Center. Pages 166-176 in J. C. Lewis, ed. Proceedings Intl. Crane Workshop. Oklahoma State Univ. Publ. Printing. 355 pp.
- . 1979. Whooping crane (*Grus americana*). In R. C. Erickson and Ruhr, eds. Crane research around the world. Cosponsored by U.S. Chapter of I.C.B.P., Intl. Crane Found., and U.S. Fish Wildl. Serv.
- Hahn, P. 1963. Where is that vanished bird. Royal Ontario Museum, Univ. Toronto, Toronto.
- Howard, J. A. 1954. Aransas, a national wildlife refuge. U.S. Dep. Inter., Fish Wildl. Serv. 11: 1-12.
- Kepler, C. B. 1976. Dominance and dominance-related behavior in the whooping crane. Pages 177-196 in J. C. Lewis, ed. Proc. Intl. Crane Workshop. Cosponsored by U.S. Chapter I.C.B.P., Intl. Crane Found., and U.S. Fish Wildl. Serv.
- Kuyt, E. 1968. Collection of whooping crane eggs from Wood Buffalo National Park. Trans Fed-Prov. Wildl. Conf. 32:30-35.
- . 1975. Nest site fidelity, productivity, and breeding habitat of whooping cranes, Wood Buffalo National Park, Northwest Territories, Canada. In Crane Res. Around the World, Internl. Crane Found.
- . 1976a. Whooping cranes: the long road back. Natur. Can. (Ottawa) 5(2):2-9.
- . 1976b. The continuing story of the whooping crane. Pages 109-111 in Canada's threatened species and habitats. Symposium on Canada's threatened species and habitats, Canadian Nature Federation and World Wildlife Fund, Ottawa, 20-24 May 1976.
- . 1976c. Recent clutch size data for whooping cranes, including a three-egg clutch. The Blue Jay 34(2):82-83.
- Lowery, G. H., Jr. 1974. Louisiana birds. Published for Louisiana Wildlife and Fisheries Commission by Louisiana State Univ. Pres. 651 pp.
- McNulty, F. 1966. The whooping crane; the bird that defies extinction. Dutton, New York. 190 pp.
- Muir, D. 1976. Whooping crane summer: filming the great white cranes. Natur. Can. (Ottawa) 5(2):25-32.
- Novakowski, N. S. 1966. Whooping crane population dynamics on the nesting grounds, Wood Buffalo National Park, Northwest Territories, Canada. Can. Wildl. Serv. Res. Rep. 1.20 pp.
- Pratt, J. J. 1961. Transactions of the whooping crane conservation conference. Modern Game Breeding, April 1961.
- Stevenson, J. O., and R. E. Griffith. 1946. Winter life of the whooping crane. Condor 48(4): 160-178.
- U.S. Department of the Interior. 1938-present. Whooping crane census. Informal reports by the refuge manager, Aransas National Wildlife Refuge, Austwell, Texas.

- U.S. Fish and Wildlife Service. A great white bird.
50-minute film, color. National Audiovisual
Center, GSA, Washington, D.C.
- WCRT (Whooping Crane Recovery Team). 1977.
Whooping crane recovery plan. Technical
review draft. U.S. Dep. Inter., Fish Wildl.
Serv. 136 pp.
- Walkinshaw, L. H. 1973. Cranes of the world.
Winchester Press, New York. 370 pp.

ACCOUNT PREPARED/UPDATED BY:

National Fish and Wildlife Laboratory
412 N.E. 16th Avenue, Room 250
Gainesville, FL 32601

Biological Services Program

FWS/OBS-80/01.4

March 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States- **LIGHT-FOOTED CLAPPER RAIL**



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—
LIGHT-FOOTED CLAPPER RAIL

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: SANFORD WILBUR

LIGHT-FOOTED CLAPPER RAIL
Rallus longirostris levipes Bangs (1899)

State: California - Endangered

KINGDOM Animalia
 CLASS Aves
 ORDER Gruiformes
 FAMILY Rallidae
 OTHER COMMON NAMES ... King Rail (part),
 California Clapper Rail (part), Southern Cali-
 fornia Clapper Rail, Bangs Rail, Light-footed
 Rail, Southwestern Clapper Rail, Los Angeles
 Clapper Rail (Grinnell and Miller 1944)

REASONS FOR CURRENT STATUS

Formerly common in all coastal marshes with-
 in its geographic range, but now, because of drain-
 age and/or filling of some marshes and pollution
 with chemicals and debris *R. l. levipes* is much more
 restricted in occurrence and fewer in numbers
 (Willett 1912, 1933, Grinnell et al. 1918, Stephens
 1919, Edwards 1922). It was not as well protected
 from hunters as the California clapper rail, and its
 range is being reduced by reclamation of marshes
 (Bent 1926).

DATES

Entered into SWIS. to be determined
 Update to be determined

Overharvesting may have occurred in some
 areas, but reduction in populations can be at-
 tributed almost entirely to loss of habitat. The
 area of the salt marsh between Santa Barbara and
 the Mexican Border is estimated to have been
 10,500 ha, while at present there are approxi-
 mately 3,440 ha (Speth 1971), much of which
 has been degraded by water pollution, water di-
 version, and restriction of tidal flow. Of the 4 ma-
 jor habitat areas, only Anaheim Bay appears to be

LEGAL STATUS

Federal: Endangered (42FR36427, 14 July
 1977). Protected Migratory Bird Treaty
 Act, (40 Stat. 755; 16 USC 703-711,
 3 July 1918) as amended 3 Dec. 1969.
 PL91-135.

relatively safe from future habitat destruction. Los Penasquitos has dried up and does not support rail, Upper Newport is "safe" under State management, and Tijuana Slough is vulnerable, but FWS plans to preserve it. Particularly hard hit were areas known to have supported large populations of rails such as San Diego Bay, reduced from 990 to 146 ha; Mission Bay, from 970 to 8.5 ha; and the Los Angeles-Long Beach area, from 2750 to 28 ha. Thus, entire populations have been exterminated (Recovery Team 1977).

PRIORITY INDEX

32

DESCRIPTION

Rallus longirostris levipes is a chicken-size bird with a gray-brown back, tawny breast, vertical dusky and white bars on its flanks, and a white patch under its short, upcocked tail; it has long legs, toes and bill and is a strong runner and a weak flyer. Although similar to *R. l. obsoletus*, it is slightly smaller; with a more slender bill and a back darker, browner or more olive (less grayish) in tone, with narrower and less black marking; its breast is a richer cinnamon color and the stripe over the eye more whitish, less rusty (Bangs 1899, Bent 1926, van Rossem 1929, Ridgway and Friedmann 1941).

The size of the adult male is: wing, 154.5 - 167 (av. 161.9) mm; tail, 62.5 - 69 (66.7); exposed culmen, 56-61 (58.9); tarsus, 53-60.5 (56.9); middle toe without claw, 50-54 (51.2). The adult female is: wing, 138 - 155.5 (147.3); tail, 57 - 67 (62.6); exposed culmen, 51.5-58 (54.2); tarsus, 47-51 (49.5); middle two without claw, 41-48 (44.9) (Oberholser 1937) Weight - male, av. 306 gm.; female, av 248 gm. (Ohmart and Smith 1973).

Its eggs are drab, cream-colored, and sparsely marked with purple 44.6 x 31.0 mm (Bent 1926).

The light-footed clapper rail has a confusing taxonomic history. Originally thought to be a King Rail (*Rallus elegans*) by Henshaw (1876); then the same as California Rail (*Rallus obsoletus*), which at that time was considered a distinct species by Belding (1883); then thought to be a separate species (*Rallus levipes*) by Bangs (1899); then a subspecies of the California Rail (*Rallus obsoletus levipes*) that was still considered a dif-

ferent species from either King or Clapper Rail by van Rossem (1929); then united with the King Rail as *Rallus elegans levipes* by Peters (1934); it was finally classified a clapper rail subspecies *Rallus longirostris levipes* (Oberholser 1937), which designation was accepted by Ridgway and Friedmann (1941), the American Ornithologists Union (1957), and subsequent authorities.

RANGE

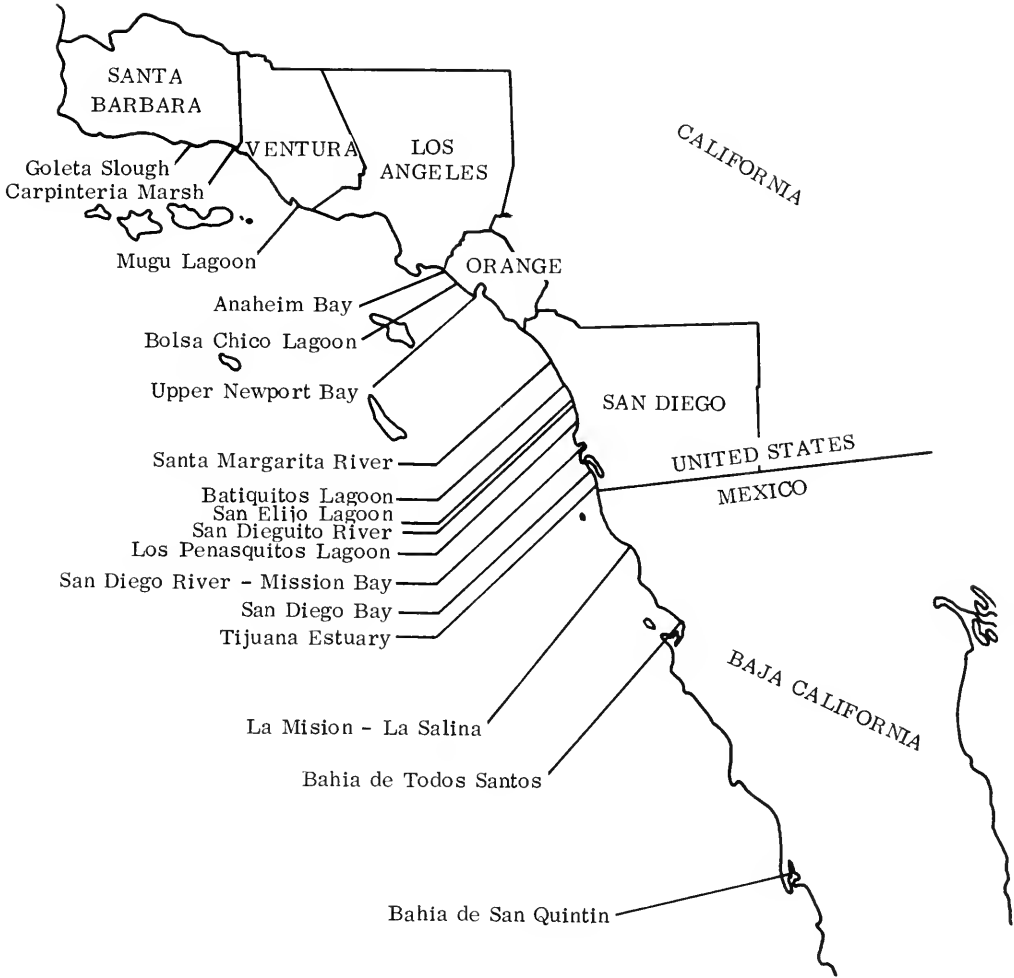
The light-footed clapper rail ranges the coastal salt marshes from Santa Barbara County, California, south to San Quintin Bay, Baja California 1977), which is the originally described range of Cooke (1914), Grinnell et al. (1918) and Bent (1926). Later evaluations (Grinnell and Miller 1944, American Ornithologists Union 1957) found no Santa Barbara records after 1875, so set the northern limits at Point Mugu and Hueneme, Ventura County. Confusion over distinction of *levipes* from another subspecies farther south in Baja California resulted in placing the southern breeding limit of *levipes* at Ensenada, Baja California (Friedmann et al. 1950, American Ornithologists' Union). Study of more adequate specimen samples extended the breeding range of *levipes* southward to San Quintin Bay (S. Wilbur ms.). Distribution is markedly interrupted because of discontinuous habitat (van Rossem 1929; Grinnell et al. 1918, Edwards 1922, Dawson 1924).

Areas that have recent records of light-footed clapper rails are: Santa Barbara Co. - Carpinteria Marsh (or El Estero or Sandyland Slough); Ventura Co. - Mugu Marshes (Pacific Missile Range); Orange Co. - Anaheim Bay marshes, Upper Newport Bay; San Diego Co. - Tijuana River estuary; Sweet Water Marsh; Otay River Slough; Marine Biology Study Area; San Diego River; Mission Bay; Los Penasquitos; San Elijo Lagoon (Wilbur 1974). Despite published reference to the contrary (Friedmann et al. 1950, American Ornithologists' Union 1957, van Rossem 1947), there is no evidence of migration or of wandering from home marshes after the breeding season (Wilbur and Tomlinson 1976).

RANGE MAP

The past and present distribution is shown on the following page.

LIGHT-FOOTED CLAPPER RAIL
Past and Present Distribution



Past and present distribution of the light-footed clapper rail.

STATES/COUNTIES

California: Orange, San Diego, Santa Barbara, Ventura.

HABITAT

The light-footed clapper rail is found in salt-water marshes traversed by tidal sloughs, where cordgrass (*Spartina foliosa*) and pickleweed (*Salicornia*) are the conspicuous plants. One nesting is recorded for an inland marsh grown to reeds in Los Angeles Co. (Willett 1906). In Tijuana Estuary, 22 of 34 nests were built in cordgrass. Nest density is greater in tall cordgrass (0.52 nests per ha. of habitat). Generally speaking, the highest densities of rails appear to be in those marshes with the most cordgrass (Jorgensen 1975). Clapper rails require a healthy tidal salt marsh environment with cordgrass or pickleweed for nesting and escape cover; abundant food in the form of crabs, clams and related invertebrates; and tidal flats interspersed with saltmarsh vegetation as a feeding area. These conditions prevail in coastal salt marshes that have a tidal prism adequate to preserve a normal salinity range and prevent stagnation. If suitable physical environment is available, other factors seem to have little influence. Predation by other animals is seldom a limiting factor, and rails seem to tolerate a high level of human occupancy of their habitat provided such use does not result in habitat degradation or loss of birds (Recovery Team 1977).

FOOD AND FORAGING BEHAVIOR

Striped shore crabs (*Pachygrapsus crassipes*) and purple shore crabs (*Hemigrapsus oregonensis*) are regularly eaten by the clapper rail. Remains found in pellets cast by rails incorporated fiddler crab (*Uca crenulata*), beach hopper (*Orchestoidea* sp.), California hornshell (*Certhidea californica*), and a gastropod (*Melampus olivaceus*). Probably (like other clapper rails) the light-footed clapper rail eats various bivalve molluscs such as clams of the genus *Macoma* (Jorgensen 1975).

SHELTER REQUIREMENTS

Dense growth of either pickleweed or cordgrass for nesting and escape cover (Recovery Team) is required by the clapper rail.

NESTING OR BEDDING

The clapper rail's nest is a loose arrangement of plant stems on high ground in a salt marsh, well concealed in dense or tall vegetation, usually *Spartina*. One nest measured 28 by 18 cm on the outside, with a cavity 13 cm across and 1.3 cm deep (Bent 1926, Edwards 1922). Nests are also frequently placed in cordgrass (*Spartina*). Those in *Spartina* most often are placed directly on the ground, while those in cordgrass are elevated 10 to 45 cm. Nests are constructed of whatever vegetation is available at the site and are placed so as to be well concealed. The nests are buoyant and will float with the tide (Jorgensen 1975).

RITUAL REQUIREMENTS

Probably pairs are spaced by aggressive territorial defense as in other subspecies of clapper rails.

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

None other than those mentioned elsewhere.

POPULATION NUMBERS AND TRENDS

Estimates now indicate a total population of about 250 birds on the basis of work in Santa Barbara and Ventura counties (V. Basham, unpublished), at Anaheim Bay (B. Massey, C. Collins, J. Lindell), and at Tijuana Estuary (Jorgensen 1975). Total population estimates are distributed as follows: Santa Barbara County, Carpinteria, 10; Orange County, Anaheim Bay, 40-50; Upper Newport Bay 40-50; San Diego County, Los Penasquitos Lagoon 5, Mission Bay 8, San Diego River 5, San Diego Bay area 40-50, Tijuana Estuary 75-85; Baja California (occur but population size undetermined); Bahia de Todos Santos, La Mision and La Salina may have rails also (Recovery Team 1977).

REPRODUCTION

The young of the clapper rail are able to swim on the day of hatching.

Nesting occurs from mid-March to 1 July, with extreme dates for complete clutches 18 March to 31 July. Egg dates (56 records) are from 18 March to 11 June (Bent 1926).

Most egg laying occurs from early April to early May, with 3 to 11 eggs per clutch, usually 5 to 9. The incubation period averages 23 days (Jorgensen, 1975).

Both sexes are believed to incubate (Bent 1926). At Tijuana Estuary 86% of 28 active nests successfully hatched at least 1 egg. There were losses due to eggs being washed away by high tides and failure to hatch for unknown reasons. Chicks were found dead in several nests apparently from drowning, although young are said to be able to swim at day of hatching (Bent 1926). Nests have been destroyed by rats. At least some re-nesting occurs and some pairs may raise second broods.

MANAGEMENT

A recovery team was appointed and a recovery plan prepared in January 1977. The light-footed clapper rail is endangered because its range is limited to a relatively small remnant of suitable marsh habitat, and this remnant continues to decrease. Arresting the decline of the rail population requires stopping all loss and degradation of existing habitat. Even then, population will remain threatened because each segment is so small it could easily be eradicated by pollution, disease, predation, or other local catastrophes.

The recovery plan proposed by the Light-Footed Clapper Rail Recovery Team includes: (1) protecting all existing habitat; (2) increasing its carrying capacity and stability, thereby increasing the size of each population unit; and (3) creating and stocking new habitat. The objective of the recovery plan is to develop and maintain a breeding population of at least 400 pairs of light-footed clapper rails well distributed geographically. This can be done by preserving and restoring approximately 1620 ha. of tidal saltmarsh habitat in 15 or more coastal marshes. Additionally, efforts should be made to have occupied salt marsh habitat preserved in Baja California.

An action program to achieve these objectives includes: (1) preserving and increasing existing populations by preserving existing habitat, preventing development or degradation, increasing amount of habitat, and reducing effect of other limiting factors; (2) reestablishing former rail populations by restoring tidal flow to previously inhabited marshes, restoring cordgrass-pickleweed vegetation by planting if it fails to volunteer, and

transplanting rails to new sites; (3) monitoring rail populations to determine progress of management and status of the populations; and (4) carrying on a program of education and planning advice directed toward preservation of rail habitat (Recovery Team 1977). Saving Tijuana Marsh is the chief priority for recovery of the light-footed clapper rail (Sanford Wilbur pers. comm.).

AUTHORITIES

Sanford R. Wilbur
U.S. Fish and Wildlife Service
1190 E. Ojai Avenue
Ojai, California 93023

Ronald M. Jurek
California Dept. of Fish and Game
1416 9th Street
Sacramento, California 95814

Ronald Hein
California Department of Fish and Game
Long Beach, California 90840

Charles T. Collins
Department of Biology
California State University at Long Beach
Long Beach, California 90840

R. Guy McCaskie
1310 14th Street
Imperial Beach, California 92032

PREPARER'S COMMENTS

Because of the very small populations and limited suitable habitat that appears to be rapidly diminishing, the light-footed clapper rail appears to be in extreme jeopardy. Only vigorous efforts to preserve a number of unpolluted salt marshes with free-flowing tidal currents will be effective in saving this subspecies from extinction.

LITERATURE CITED/SELECTED REFERENCES

- American Ornithologists' Union. 1957. Check-list of North American birds. 5th ed. Baltimore, Md. AOU. 641 pp.
- Bangs, O. 1899. A new rail from southern California, Proc. New Eng. Zool. Club 1:45-46.
- Belding, L. 1883. Catalogue of a collection of birds made at various points along the western coast of Lower California, north of Cape St.

- Eugenis. Proc. U.S. Nat. Mus. 5:527-532.
- Bent, A. C. 1926. Life histories of North American marsh birds. U.S. Nat. Mus. Bull. 135:272.
- Cooke, W. W. 1914. Distribution and Migration of North American rails and their allies. U.S. Dept. of Agric. Bull. 128:50 pp.
- Dawson, W. 1924. Birds of California. Vol. 3. p. 1533.
- Edwards, H. A. 1922. Some notes on the Light-footed Rail. Oologist 39:60-61.
- Frey, H. W., R. F. Hein, and J. L. Spruill. 1970. Report on the natural resources of Upper Newport Bay and recommendations concerning the Bay's development Calif. Dept. Fish and Game. 68 pp.
- Friedmann, H., L. Griscom and R. T. Moore. 1950. Distributional Checklist of the birds of Mexico. Pac. Coast Avifauna 29:202 pp.
- Grinnell, J. 1898. Birds of the Pacific slope of Los Angeles County. Pasadena Acad. Sci. Pub. 2.
- . 1915. A distributional list of the birds of California. Pac. Coast Avifauna 11. 217 pp.
- Grinnell, J. and A. H. Miller. 1944. The distribution of the birds of California. Pac. Coast Avifauna 27:128.
- Grinnell, J., H. C. Bryant, and T. I. Storer. 1918. The Game birds of California. p. 289.
- Henshaw, H. W. 1876. Report on the ornithology of the portions of California visited during the field season of 1875. Ann. Rep. Geographic Survey west of the 100th Meridian. Appendix H8 of Appendix JJ. pp. 224-278.
- Jorgensen, P. D. 1975. Habitat preference of the Light-footed Clapper Rail in Tijuana Marsh, California. M.S. thesis, San Diego State University. 115 pp.
- Light-footed Rail Recovery Team. 1977. Light-footed Clapper Rail recovery plan. Office of Endangered species, U.S. Fish and Wildlife Service, Wash., D.C.
- McCaskie, G. 1972. Southern Pacific Coast Region. Am. Birds 26:903.
- Mudie, P., B. Browning and J. Speth. 1974. The natural resources of Los Peñasquitos Lagoon and recommendations for use and development. Calif. Dept. Fish and Game, Coastal wetlands Series no. 7. 75 pp.
- Oberholser, H. C. 1937. A revision of the Clapper Rails (*Rallus longirostris* Boddaert) Proc. U.S. Nat. Mus. 84:313-354.
- Ohmart, R. D. and R. W. Smith. 1973. North American Clapper Rails (*Rallus longirostris*) literature survey, with special consideration being given to the past and current status of *yuman-sis*. Report in fulfillment of Bur. Reclamation contract 14-06-300-2409.
- Peters, J. 1934. Check-list of birds of the world. Vol. 2. Cambridge, Harvard University Press. p. 159.
- Ridgway, R. and H. Friedmann. 1941. Birds of North and Middle America. Part IX. Bull. U.S. Nat. Mus. 50:75.
- Romero, P. D. 1972. Anaheim Bay study, July 1970 to June 1971. Calif. Dept. Fish and Game. 22 pp.
- Sams, J. R. and K. Scott, Jr. 1959. Birds of San Diego County, California. San Diego Soc. Nat. Hist. Occas. Pap. No. 10.
- Sexton, C. W. 1972. Clapper Rails at Upper Newport Bay, California. Unpub. Ms. U. of Calif. at Irvine.
- Speth, J. W. 1971. The status of coastal wetlands in southern California. Paper presented at annual meeting, Western Section of The Wildlife Society. 19 pp.
- Speth, J., R. Fordice, R. Hein, and P. Giguere. 1970. The natural resources of Golata Slough and recommendations for use and development. Calif. Dept. Fish and Game. 42 pp.
- Stephens, F. 1919. An annotated list of the birds of San Diego County, California. Trans. San Diego Soc. Nat. Hist. 3:1-40.
- U.S. Fish and Wildlife Service. 1973. Threatened Wildlife of the United States. U.S. Dept. of Interior, Resource Pub. 114. 289 pp.
- van Rossem, A. J. 1929. The status of some Pacific Coast Clapper Rails. Condor 31:213-215.
- . 1947. Comments on certain birds of Baja California, including descriptions of three new races. Proc. Biol. Soc. Wash. 50:51-58.
- Warner, D. S. and R. W. Dickerman. 1959. The status of *Rallus elegans tenuirostris* in Mexico.

- Condor 61:49-51.
- Wilbur, S. R. 1974. The status of the Light-footed clapper Rail. Amer. Birds 28:868-870.
- Wilbur, S. R. and R. E. Tomlinson. 1976. The literature of the Western Clapper Rails. USFWS Spec. Sci. Rep. - Wildlife. 194. 31 pp.
- Willett, G. 1906. The Southern Clapper Rail breeding on fresh water. Auk 23:432.
- . 1912. Birds of the Pacific slope of southern California. Pac. Coast Avifauna 7. 122 pp.
- . 1933. A revised list of the birds of southwestern California. Pac. Coast Avifauna 21: 52.

Biological Services Program

FWS/OBS-80/01.5
March 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States- **SAN CLEMENTE LOGGERHEAD SHRIKE**



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

FWS/OBS-80/01.5
March 1980

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—

SAN CLEMENTE LOGGERHEAD SHRIKE

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



PHOTO OF CLOSELY RELATED SUBSPECIES

CREDIT: HERBERT CLARKE

SAN CLEMENTE LOGGERHEAD SHRIKE
Lanius ludovicianus mearnsi Ridgway

KINGDOM Animalia
 CLASS Aves
 ORDER Passeriformes
 FAMILY Laniidae
 OTHER COMMON

NAMES. California shrike, island shrike,
 San Clemente shrike, Mearns' shrike,
 Santa Barbara Island Shrike.

DATE

Entered into SWIS. To be determined
 Update To be determined

LEGAL STATUS

Federal: Endangered: FR 42 40685, 11 Aug.
 1977. p. 40685.
 States: Protected by California law.

REASONS FOR CURRENT STATUS

Destruction over large areas of the dense,
 brushy vegetation required for shrike territory

headquarters has undoubtedly reduced the number of possible wintering and breeding areas considering the aggressive territorial behavior of the birds. This has reduced the reproductive potential of *L. l. mearnsi* to the point where it has almost the lowest ratio (30%) of immatures to adults, of any subspecies except *L. l. anthonyi*, another island race (Miller 1931).

PRIORITY INDEX

None assigned.

DESCRIPTION

The San Clemente loggerhead shrike is a medium-sized bird, slightly smaller than a robin, gray above, white below and on the rump, with a black mask over the eyes. Black wings and tail, each have patches of white. Of all the subspecies of *L. ludovicianus*, *mearnsi* is the most isolated and is among the most sharply characterized (Miller 1931).

Overall length is 224 mm (av. of 10 adults) (Mearns 1898). It is similar to *L. l. anthonyi* of Santa Cruz Island, but the upper tail coverts are abruptly white; there is more white on the scap-

ulars, the white spot at the base of the primaries is larger, and the underparts of the body much less strongly tinged with gray. In the white upper tail coverts and the greater extent of white on posterior scapulars and at the base of the primaries, it is similar to *L. l. gambeli*, but the gray of the upper parts is very much darker (quite as dark as *L. l. anthonyi*), with much less white at the base of primaries and on the lateral rectrices (Ridgway 1904).

L. l. mearnsi may be readily distinguished from *nelsoni* by its much darker upper parts, more conspicuously white rump, shorter wing, smaller amount of white on primaries, and much smaller bill.

Measurements: Wing length, av. 97.64 mm; white on primaries 53.8% of wing length; tail length av. 100.28 mm; white tip on outer tail feather 28.1% of tail length; bill length, av. 27.60 mm; middle toe av. 13.20 mm; hind toe av. 9.92 mm. The only race with which *mearnsi* intergrades is *anthonyi* to the north (Miller 1931).

RANGE

This shrike is a permanent resident on San Clemente Island, off southwestern California (American Ornithologists' Union 1957).

RANGE MAP

The range map on the following page shows the location of San Clemente Island, this shrike's total range.

STATES/COUNTIES

California: Los Angeles.

HABITAT

San Clemente Island, the southernmost of the California Channel Islands, is approximately 34 km long and 2.4 to 6.4 km wide. The nearest island, Santa Catalina, is about 34 km north. The nearest point on the mainland is about 80 km to the northeast.

Goats were introduced not later than 1827, and by 1840 had formed a dense population. By 1877, large numbers of sheep grazed there also (Raven 1963).

The island has been under jurisdiction of the U.S. Navy since 1934, when all ranching presumably terminated.

The topography is dominated by a plateau

with a steeply sloping east side and gently sloping west side, covered with introduced grasses except in places completely denuded by goats. Trees and shrubs grow only on the bottoms and sides of the canyons. On the east side, ironwood (*Lyonothamus*), island oak (*Quercus tomentella*), and lemonade bush (*Rhus integrifolia*) are the most abundant species. The west side canyons are mostly denuded, but have some growth of toyon (*Heteromeles*), lemonade bush, and island cherry (*Prunus ilicifolia lyonii*) (Stewart and Clow 1974). Shrikes are found in washes, ravines and mesas, where there are either scattered tall bushes such as toyon and wild cherry, or low thorny scrub and cactus patches (Grinnell and Miller 1944).

The presence or absence of thorny bushes seems to have little effect on determining the habitat of American shrikes (presumably including *L. l. mearnsi*). Impaling devices are so varied as to be available in some form in almost any type of habitat except entirely barren areas (Miller 1931).

SHELTER REQUIREMENTS

Dense tall brush or low tree growth is essential for roosting and nesting in each territory, whether breeding or wintering (Miller 1931).

NESTING AND BEDDING

In each territory there is a headquarters where the roosting place or, if a breeding territory, the nest is located. The headquarters provides good lookout perches, feeding facilities, and some sort of brushy growth for shelter at night. The requisite for roosting places seems to be some support above the ground within a screen of overhanging branches. Roosts are marked by conspicuous fecal deposits.

For nesting, shrikes prefer dense bushes or small, thickly grown trees at medium heights, rarely less than 1 m or more than 7 m off the ground (Miller 1931). Howell (1917) speaks of nests of *mearnsi* placed about 0.6 m from ground in a "certain kind of thorny bush." This statement applies to the more barren parts of San Clemente. Where there are canyons on the island, Grinnell (1897) and Howell (1917) reported this shrike nesting in bushes on the steep canyon sides. Typical nests described by Grinnell (1897) and Linton (1908) were composed of dry twigs, weed stems, and grasses, thickly lined with rootlets and sheep's wool, and well concealed in thick bushes.



Total range of the San Clemente loggerhead shrike

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

In regions where nesting sites are scarce, considerable modification of the winter and fall feeding territories probably takes place when they are converted into breeding territories. Presumably in reorganizing breeding territories into fall and winter feeding areas, one or the other of the adults keeps possession of the nesting locality, while the other members of the family seek territories unoccupied by shrikes, and which, in some cases, may be suitable only for winter and fall occupancy. Size and shape of territories depends on the vegetative types present, the concentration of food supply, the provision of nest sites, the local abundance of the species and local physical barriers (Miller 1931), as well as on the age, sex, and physical condition of the bird.

POPULATION AND TRENDS

No more than 16 individuals were seen from 1-5 and 8-9 May 1974 (Stewart and Clow 1974). Specific records were: 2 May (4); 4 May (5-6); 5 May (1 feeding fledgling) (Stewart and Clow 1974).

Formerly, *L. l. mearnsi* was rated by some authors as "fairly common," but the total population has always been small (Grinnell and Miller 1944). Long ago, it was considered tolerably common; that is, 2 or 3 could be generally seen during an hour's walk, but they were very shy and hardest to secure of any bird on the island (Grinnell 1897; Mearns 1898). They were reported fairly well distributed over the whole island, but extremely shy by Linton (1908). In especially favored little canyons, several pairs would congregate. Two pairs were found breeding not 100 m apart, while a third was found within 0.4 kilometers (Howell 1917).

Causes of shrike mortality on San Clemente are unknown, although some, particularly of nestlings and juveniles, is undoubtedly caused by predatory birds and mammals. Percentage of first year birds in samples of winter and spring populations is only about 36%, by far the smallest percentage of all races except *anthonyi*, another island form (most races have 50% or more immatures). This indicates a relatively poor reproductive rate in the island populations. It may indicate a lower population loss than mainland birds, but it also shows the vulnerability of island birds to any change in mortality rate or reproductive

potential (Miller 1931).

FOOD AND FORAGING BEHAVIOR

Shrikes hunt quite late in the evening and early in the morning, at least in warm weather. They are opportunists, living on the most abundant and readily obtainable supply of animal food, including all kinds of insects and other arthropods, small reptiles, birds, and mammals that they can capture. One was observed carrying a young house finch with the adult house finch in pursuit on 5 May 1974 (Stewart and Clow 1974). If there is an infestation of a particular kind of insect, shrikes will concentrate on that food (Miller 1931).

The method of hunting is to perch on objects from 6 in (15.24 cm) to 6 ft (1.83 m) above the ground where prey may be seen clearly. Occasionally the bird hops about in search of animals. If prey is not secured from a certain post within a minute or two, it moves on to another part of the territory. Passive hunting has been noted commonly during a large part of the day at times other than when feeding young. A less common method of feeding is capturing insects in the air (Miller 1931).

Dead prey is impaled on a thorn, twig, splinter, or other sharp structure, or eaten almost immediately, depending on its size. If the shrike is hungry when large prey is impaled, it eats all it can—as much as 7 g at one feeding. Then the remainder is left hanging for later feedings, which usually continue until the last morsel is eaten. The practical value to shrikes of impaled food older than a few days is slight, as dry or spoiled food is not eaten (Miller 1931).

REPRODUCTION

A set consists of five or six eggs. Eggs vary from dull white to either light neutral gray or buff, covered with small spots of neutral gray, yellowish brown and amber, with occasional fine black scrawlings near the large end.

Several sets have been found in March, and young are commonly found out of the nest at the end of March, indicating that eggs are present in February. Incubation usually starts with the laying of the next-to-last egg; it is performed solely by female. The male feeds the female during incubation, either on or off the nest. Incubation lasts about 16 days. Twenty days is the normal time for young to remain in nest. Parents con-

tinue to feed young until about the 35th day (Miller 1931).

Some birds raise two broods in one season. A female whose mate was killed did not find a new mate while feeding young older than 16 days (Miller 1931).

It is not certain whether the male seeks the territory of the female or vice versa for breeding, but probably the former (Miller 1931).

Specific instances of finding nests with eggs or young have been described by Bent (1950:182), Linton (1908), and Howell (1917).

MANAGEMENT

The only practical action to take for the benefit of the San Clemente loggerhead shrike would be to remove or confine all of the livestock, (particularly goats) on the island, to permit the regrowth of dense patches of tall brush. This must be accomplished over considerable areas to permit adequate spacing of territories—at least 100 m apart for each individual bird at all times of the year. Replanting of native woody species of plants in clumps for territorial headquarters would hasten rehabilitation. Until livestock can be removed, exclosures to protect woody plants from overbrowsing might help.

AUTHORITIES

Robert M. Stewart
William C. Clow
Point Reyes Bird Observatory
Box 321
Bolinas, Calif. 94924
Lee Jones
Dept. of Zoology
University of California
Los Angeles, Calif. 90024
Jan Larson
Naval Ocean Systems Center
Code 4105
San Diego, Calif. 92152

PREPARER'S COMMENTS

It would appear that the widespread destruc-

tion of dense patches of tall brush spaced widely enough to accommodate this shrike's aggressive territorial behavior and requirements for nesting and observation perches is the main reason for its poor reproduction and evident decline. Correction of overbrowsing by livestock, particularly goats, is the only hope for survival.

LITERATURE CITED/SELECTED REFERENCES

- American Ornithologists' Union. 1957. Check-list of North American Birds, 5th Ed. Baltimore, Md. Amer. Ornith. Union.
- Bent, A. C. 1950. Life histories of North American wagtails, shrikes, vireos, and their allies. U.S. Nat. Mus. Bull. 197:180-182.
- Grinnell, J. 1897. Report on the birds recorded during a visit to the islands of Santa Barbara, San Nicolas, and San Clemente, in the spring of 1897. Pasadena Acad. Sci. Publ. 1:1-21.
- Grinnell, J. and A. H. Miller. 1944. The distribution of the birds of California. Pac. Coast Avifauna 27.
- Howell, A. B. 1917. Birds of the islands off the coast of southern California. Pac. Coast Avifauna 12:88.
- Linton, C. B. 1908. Notes from San Clemente Island. Condor 10:82-86.
- Mearns, E. A. 1898. Description of two new birds from the Santa Barbara Islands, Southern California. Auk 15:258-264.
- Miller, A. H. 1931. Systematic revision and natural history of the American shrikes (*Lanius*). Univ. Calif. Publ. Zool. 38:11-242.
- Raven, P. H. 1963. A flora of San Clemente Island, California. Aliso 5:289-347.
- Ridgway, R. 1904. The Birds of North and Middle America. U.S. Nat. Mus. Bull. 50, pt. 3:252.
- Stewart, R. M. and W. C. Clow. 1974. Part I. San Clemente Island. *in* The status of the Song Sparrow and Bewick's Wren on San Clemente Island and Santa Barbara Island, California. by R. M. Stewart, J. Smail, W. C. Clow and R. P. Henderson. Report to Endangered Species Off. U.S. Fish and Wildl. Serv. by Point Reyes Bird Observatory.

Biological Services Program

FWS/OBS-80/01.6

March 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States-

THE PINE BARRENS TREEFROG



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

FWS/OBS-80/01.6

March 1980

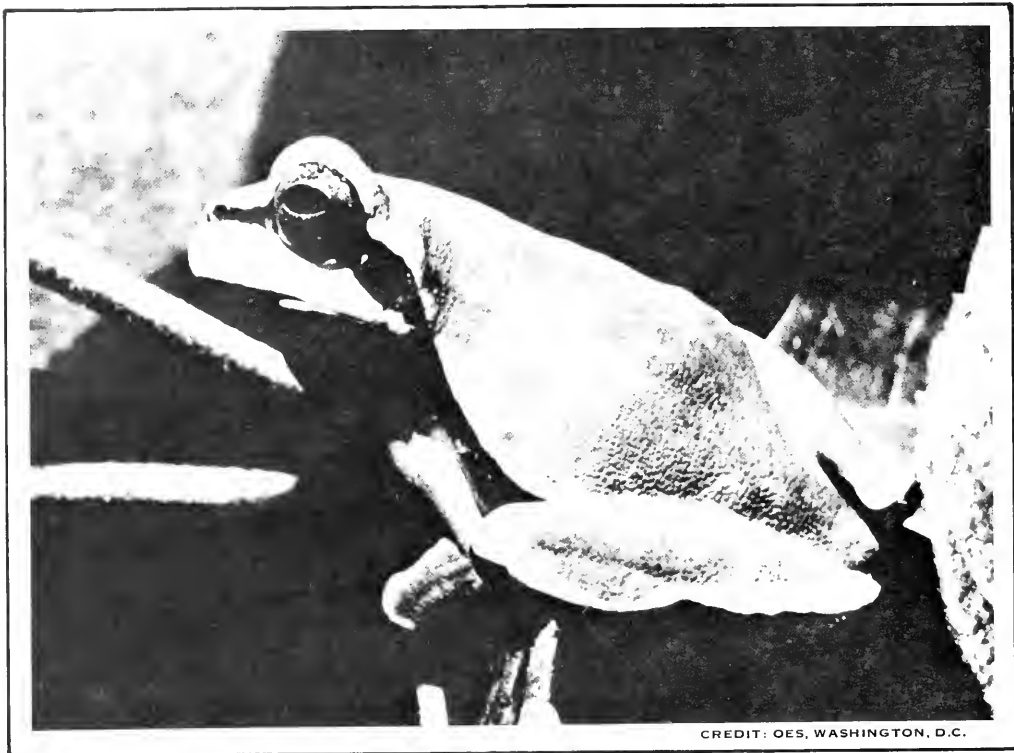
SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES -

THE PINE BARRENS TREEFROG

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: OES, WASHINGTON, D.C.

PINE BARRENS TREEFROG

Hyla andersonii Baird

States: Endangered: Florida, South Carolina.
Threatened: New Jersey.

KINGDOMAnimalia
CLASSAmphibia
ORDER..... Salientia (Anura)
FAMILYHylidae
OTHER COMMON

NAMES..... Anderson treefrog

DATE:

Entered into SWIS.....To be determined

Updates.....14 October 1976

5 April 1977

1 June 1979

LEGAL STATUS

Federal: Endangered (Florida population only)
(43 FR 18109; 5 Apr. 77).

REASONS FOR CURRENT STATUS

The species occurs in small, isolated populations scattered along Atlantic and Gulf Coastal Plains (relict distribution). Many of these sites are undergoing rapid alteration, including drainage, development and agricultural modifications. The resultant loss of habitat constitutes the most serious threat to the Pine Barrens treefrog.

PRIORITY INDEX

Not assigned.

DESCRIPTION

The animal is green dorsally with a narrow yellow or white stripe along the dorsolateral edge. Belly is white. A lavender or plum-colored band extends along the sides from the nostrils to the hind limbs. Axilla and normally concealed undersides of hind limbs are light orange or orange spotted. Adults are 30 to 50 mm (snout-vent length).

Illustrated in color in Dickerson (1969), Leviton (1972), Conant (1975), Means and Longden (1976), and Means (1976b). Black and white photographs in Wright and Wright (1949). Eggs illustrated by Livezey and Wright (1947). Noble and Noble (1923) illustrated the tadpole stages. Gosner and Black (1967) and Means and Longden (1976) provide audiospectrograms of the breeding call.

RANGE

The species distribution has three principal foci: 1) the Pine Barrens of central New Jersey; 2) the upper Coastal Plain and parts of the lower Coastal Plain of North and South Carolina; and 3) Okaloosa, Santa Rosa and Walton counties in the western Florida Panhandle. A single specimen from Richmond County, Georgia, and the holotype from Anderson, South Carolina, may represent a fourth distributional center. There is no indication that the distribution is continuous between New Jersey and Florida.

Although individual populations have been extirpated and total numbers have no doubt been reduced, the geographic distribution has probably changed little in historic times.

RANGE MAP

Known distribution is presented on an accompanying map.

STATES/COUNTIES

Florida	Okaloosa, Santa Rosa, Walton.
Georgia	Richmond (?).
New Jersey	Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Middlesex, Monmouth, Ocean, Salem.

N. Carolina	Bladen, Cumberland, Duplin, Harnett, Hoke, Johnston, Jones, Lee, Lenoir, Moore, Onslow, Pende, Richmond, Sampson, Scotland, Wayne.
-------------	--

Pennsylvania Delaware (?)

S. Carolina Chesterfield.

HABITAT

Only the breeding habitat is known. Chorusing Pine Barrens treefrogs usually associate with evergreen shrubs in sphagnaceous seepage bogs on hillsides below pine-oak ridges. In New Jersey and North Carolina, Atlantic white cedar (*Chamaecyparis thyoides*) is a dominant tree species (Wright and Wright 1949). Means and Longden (1976) note the absence of cedar but the constant dominance of titi trees (*Cliftonia* and *Cyrilla*) in Florida localities. The breeding habitat can best be characterized as shrubby bogs.

Means and Longden (1976) describe the habitat of the Pine Barrens treefrog in Florida, and Means (1976b) provides photographs of Florida breeding localities. Habitat photographs for New Jersey and North Carolina are in Noble and Noble (1923) and Wright (1932).

FOOD AND FORAGING BEHAVIOR

Noble and Noble (1923) reported that the food habits are not specialized. The treefrogs eat anything of small size moving in their vicinity, including grasshoppers, beetles, and ants. Tadpoles feed on algae (Gosner 1959).

SHELTER REQUIREMENTS

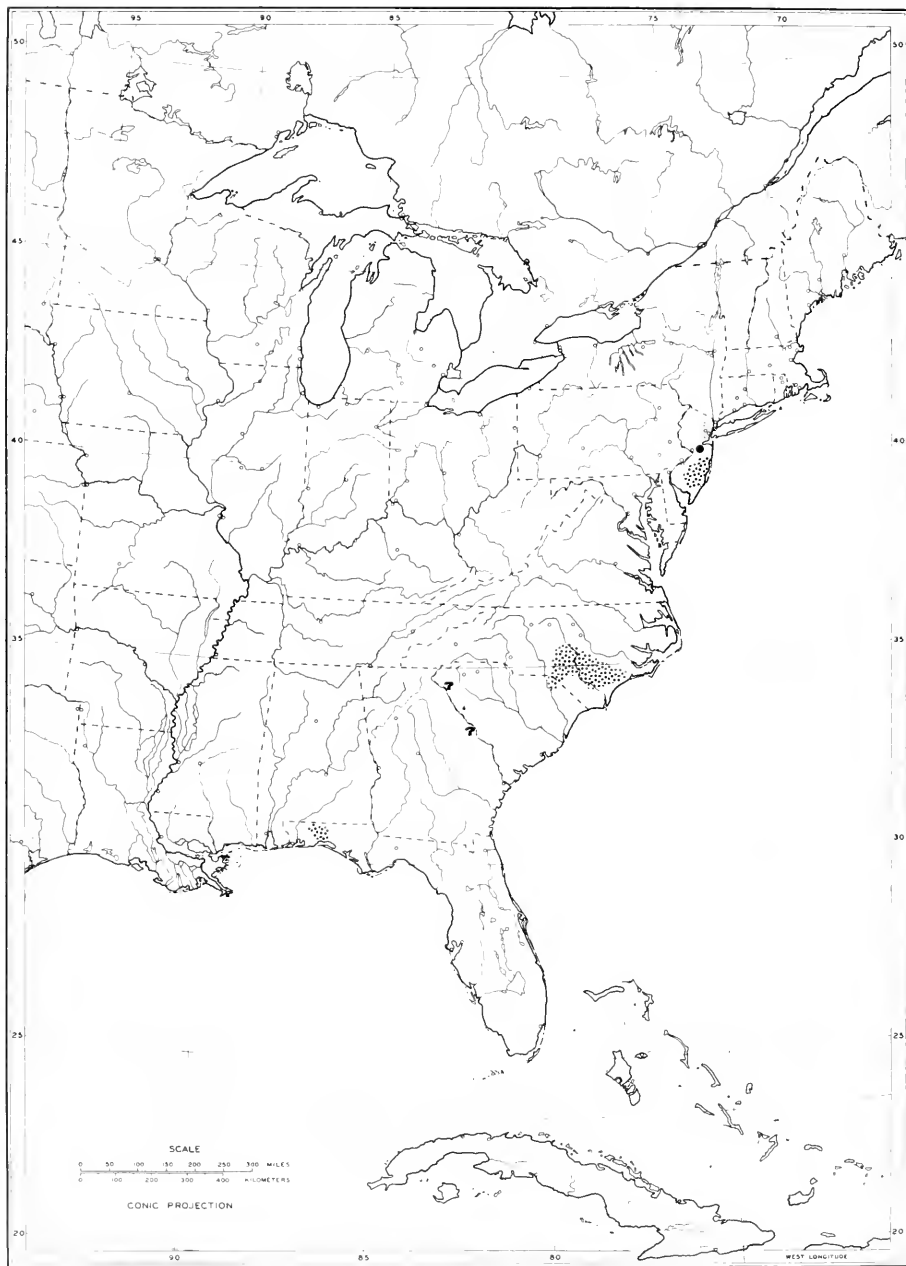
Nothing is known about specific requirements. Probably like other small treefrogs, they use small crevices or the undersides of leaves during the day, and forage at night.

NESTING OR BEDDING

Spawning occurs in sphagnaceous shrub bogs (see Habitat, above).

RITUAL REQUIREMENTS

Males call during the breeding season from low bushes and occasionally from the ground.



The range of the Pine Barrens treefrog is indicated by shading on this map.

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

Little is known about the species beyond its specialized and unique breeding habitat described above.

POPULATION NUMBERS AND TRENDS

No population estimates are reported. Means (1976b) reported that since 1972, two known breeding sites have been rendered unsuitable because of clearing for improved pasture. A. J. Bullard (personal communication) reported some North Carolina breeding localities also have recently been destroyed.

Since the discovery of the Pine Barrens treefrog in Florida (Christman 1970), some 47 breeding congregations have been located in three West Florida counties (P. Moler, personal communication). These are all small seepage bogs, and none has been found to contain more than a dozen calling frogs, with most having fewer than four (P. Moler, personal communications).

REPRODUCTION

Treefrogs breed from May (April in Florida) to August. Eggs are laid singly on the bottom or attached to sphagnum (Wright and Wright 1949). Eggs hatch in 3 days and may number up to 200 or more per female. Tadpoles transform during the summer and frogs probably reach sexual maturity in 1 year.

Nothing is known concerning natural longevity or survival rates, although a captive survived 7 years (A. J. Bullard, personal communication).

MANAGEMENT AND CONSERVATION

No management or conservation measures have been instituted other than legal protection against taking, possessing or molesting the species. The relict, disjunct habitat should be protected from development.

Many of the known breeding localities in Florida are located within Eglin Air Force Base and Blackwater River State Forest. Means (1976b) suggests purchase of some of the remaining breeding localities in Florida to prevent habitat destruction.

Critical Habitat has been designated in Okaloosa County, Florida (42 FR 58754; 11 Nov. 77): (1) NW¼ Sec. 35, T4NR22W; (2) NE¼ Sec. 27, T4NR22W; (3) SW¼ Sec. 26, T5NR23W; (4) NW¼ Sec. 34, T4NR23W; (5) NW¼ Sec. 32, T4NR22W; (6) NW¼ Sec. 12, T4NR22W; (7) NE¼ Sec. 11, T4NR22W.

AUTHORITIES

A. J. Bullard, Jr.
103 Smith Chapel Road
Mt. Olive, NC 28365

D. Bruce Means
Tall Timbers Research Station
Route 1, Box 160
Tallahassee, FL 32303

Paul Moler
Wildlife Research Lab.
Florida Game & Fish Water Fish. Comm.
Gainesville, FL 32601

PREPARER'S COMMENTS

The disjunct distribution of the Pine Barrens treefrog makes it of considerable interest from an evolutionary and biogeographic point of view; it is the least known treefrog in the United States. There is a pressing need for basic distributional and biological information.

LITERATURE CITED/SELECTED REFERENCES

- Bullard, A. J. 1965. Additional records of the treefrog, *Hyla andersonii*, from the coastal plain of North Carolina. *Herpetologica* 21 (2):154-155.
- Christman, S. P. 1970. *Hyla andersonii* in Florida. *Quart. J. Florida Acad. Sci.* 33(1):80.
- Conant, R. 1975. A field guide to reptiles and amphibians of eastern and central North America. 2nd ed. Houghton Mifflin Co., Boston. 429 pp.
- Dickerson, M. C. 1969. The frog book. Dover Publ. Inc., New York. 253 pp.

- Gosner, K. L. 1959. Systematic variations in tadpole teeth with notes on food. *Herpetologica* 15(40):103-120.
- Gosner, K. L. and I. H. Black. 1967. *Hyla andersonii* Baird. *Cat. Am. Amphib. Reptiles*. 54.1-54.2.
- Leviton, A. 1972. Reptiles and amphibians of North America. Doubleday and Co., New York. 250 pp.
- Livezey, R. L., and A. H. Wright. 1947. A synoptic key to the salientian eggs of the United States. *Am. Midl. Natur.* 37(1):179-222.
- . 1976a. Pine barrens treefrog. *In* Hillestad, H. O., D. B. Means, and W. W. Baker, eds. *Endangered and threatened vertebrates of the southeastern United States*. Tall Timbers Res. Stn., Misc. Publ. 4.
- . 1976b. Endangered species: Pine barrens treefrog. *Florida Natur.* 49(5):15-20.
- . 1979. Pine Barrens treefrog. Pages 3-4 *in* R. W. McDiarmid ed., *Rare and endangered biota of Florida*, Vol. 3, Amphibians and reptiles. Univ. Presses of Florida, Gainesville.
- Means, D. B., and C. T. Longden. 1976. Aspects of the biology and zoogeography of the pine barrens treefrog (*Hyla andersonii*) in northern Florida. *Herpetologica* 32(2):117-130.
- Noble, G. K., and R. C. Noble. 1923. The Anderson treefrog (*Hyla andersonii* Baird): Observations on its habits and life history. *Zoologica* 11(18):416-455.
- Wright, A. H. 1932. Life-histories of the frogs of Okefenokee Swamp, Georgia. Macmillian Co., New York. 497 pp.
- Wright, A. H., and A. A. Wright. 1949. Handbook of frogs and toads of the United States and Canada. Comstock Publ. Assoc. Cornell Univ. Press, Ithaca, N.Y. 640 pp.

ACCOUNT PREPARED/UPDATED BY:

National Fish and Wildlife Laboratory
412 N.E. 16th Ave., Room 250
Gainesville, FL 32601

Biological Services Program

FWS/OBS-80/01.7
March 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States-

THE RED-COCKADED WOODPECKER



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

FWS/OBS-80/01.7

March 1980

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—

THE RED-COCKADED WOODPECKER

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: BILL JULIAN

RED-COCKADED WOODPECKER

Picoides borealis Vieillot

KINGDOMAnimalia
 CLASSAves
 ORDER Piciformes
 FAMILY Picidae
 OTHER COMMON NAMESnone

DATE

Entered into SWIS. to be determined
 Updates..... 17 October 1976, 1 March 1977

LEGAL STATUS

Federal: Endangered (35 FR 16047, 13 October 1970).
 States: Endangered: Florida, Georgia, Mississippi, South Carolina, Tennessee, Texas. Extirpated: Missouri.

REASONS FOR CURRENT STATUS

The primary reason for the current status of the red-cockaded woodpecker is a decrease in quantity and quality of suitable habitat, primarily due to the short-term-rotation timber management currently being practiced in the Southeast. Short-term-rotation prevents the development of mature, diseased pine trees that are necessary for roosting and nesting.

PRIORITY INDEX

Not assigned.

DESCRIPTION

The red-cockaded woodpecker is small, 18 to 20 cm long, with a wingspan of 35 to 38 cm. The cap and nape are black, surrounding a large, white cheek patch. Wings and back are black, horizon-

tally barred with white. Underparts are whitish with dark spots on the flanks. The adult male has a small red streak, the 'cockade,' on each side of the black cap, but this is rarely visible except when the bird is displaying. The most distinguishing field mark is the black cap and nape surrounding the large white cheek patch.

The species is illustrated in Robbins et al. (1966). Black and white photos appear in Murphy (1939) and Jackson et al. (1976b).

RANGE

Present range (nonmigratory species) includes the following areas: Alabama, southern Arkansas, Florida, Georgia, Cumberland Plateau region of Kentucky, Louisiana, southeastern Maryland, Mississippi, eastern North Carolina, southeastern Oklahoma, South Carolina, eastern Tennessee, eastern Texas, and southeastern Virginia.

Former range included the entire States of Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, Missouri, New Jersey, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia (Jackson 1971).

In the Southeast, there are 76.7 million ha of commercial forest in major pine types. Approximately 10.4 million ha, of which 0.9 million ha are in public ownership, are suitable for red-cockaded woodpeckers (Czuhai 1971).

RANGE MAP

Known distribution is indicated by shading. Dots represent populations on publicly owned or managed lands; large dots represent at least 10 clans, while small dots represent 1 to 9 clans.

STATES/COUNTIES

Alabama Baldwin, Bibb, Calhoun, Chilton, Clay, Cleburne, Covington, Escambia, Hale, Jefferson, Lawrence, Macon, Perry, Shelby, St. Clair, Talladega, Tuscaloosa, Winston.

Arkansas Ashley, Calhoun, Clark, Columbia, Hempstead, Lafayette, Monroe, Ouachita, Polk, Scott, Union.

Florida Alachua, Baker, Bay, Brevard, Charlotte, Citrus, Clay, Columbia, Duval, Franklin, Glades, Gulf, Hernando, Highlands, Lee, Leon, Levy, Liberty,

Marion, Martin, Okaloosa, Okeechobee, Osceola, Palm Beach, Pasco, St. Johns, Santa Rosa, Wakulla, Walton.

Georgia Appling, Baldwin, Brantley, Charlton, Chattahoochee, Clarke, Clinch, Decatur, Floyd, Glynn, Grady, Harris, Jasper, Jenkins, Jones, Pierce, Putnam, Screven, Tattnall, Telfair, Thomas, Toombs, Turner, Ware, Washington, Wilkes.

Kentucky Laurel, McCreary.

Louisiana (Parishes) Allen, Beauregard, Bienville, Bossier, Caddo, Calcasieu, Catahoula, Claiborne, Grant, La Salle, Morehouse, Natchitoches, Ouachita, Rapides, St. Tammany, Tangipahoa, Union, Vernon, Washington.

Maryland Dorchester, Worcester (?).

Mississippi Choctaw, Copiah, Franklin, Harrison, Hinds, Jackson, Jones, Lafayette, Lauderdale, Leake, Madison, Marion, Noxubee, Oktibbeha, Pearl River, Scott, Smith, Stone, Wayne, Wilkinson, Winston.

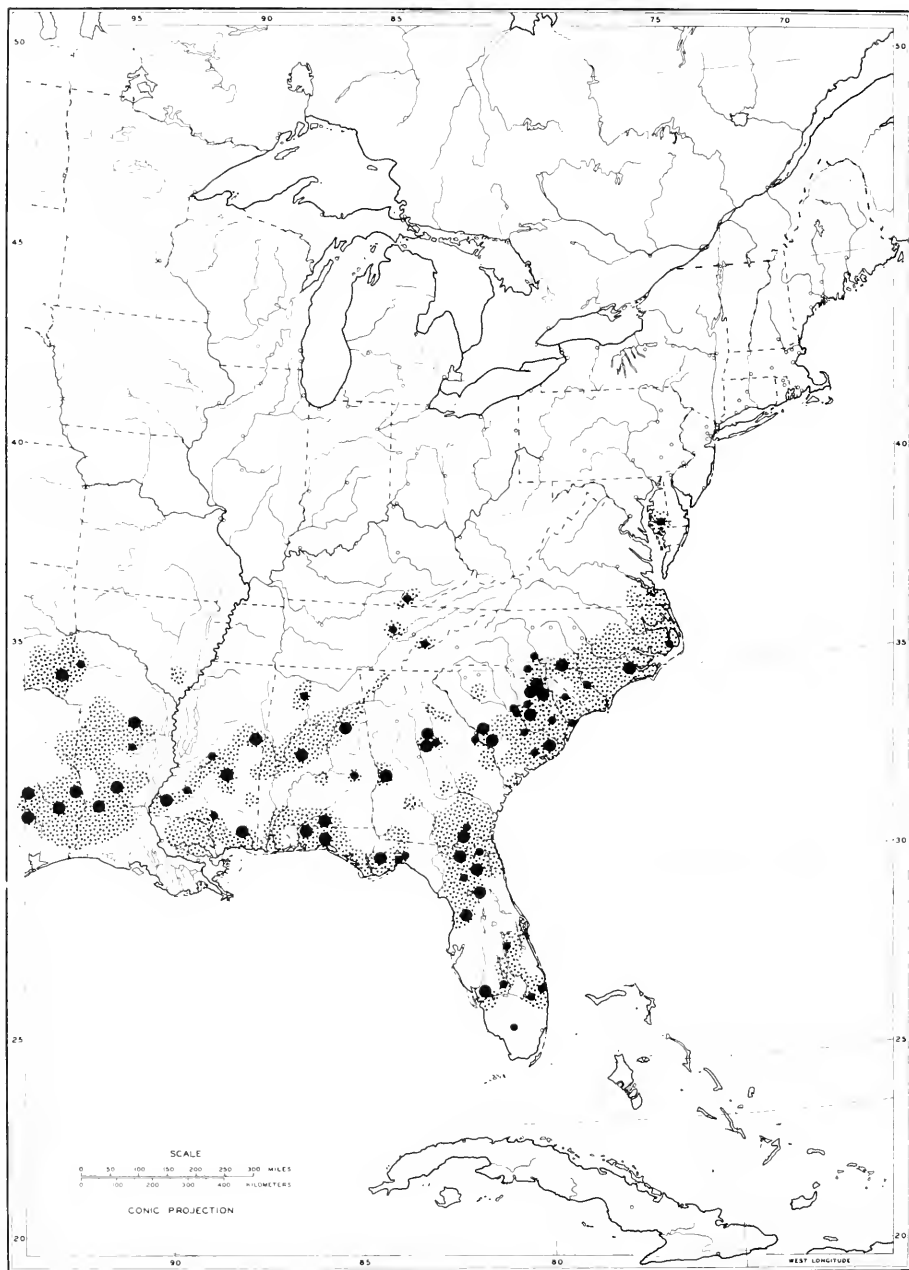
North Carolina Beaufort, Bertie, Bladen, Brunswick, Cumberland, Gates, Harnett, Hertford, Hoke, Hyde, Jones, Montgomery, Moore, Northampton, Onslow, Pamlico, Perquimans, Pitt, Richmond, Wake, Wayne.

Oklahoma Bryan, Latimer, Le Flore, McCurtain, Pittsburg, Pushmataha.

South Carolina Aiken, Barnwell, Beaufort, Berkeley, Calhoun, Charleston, Chesterfield, Clarendon, Colleton, Darlington, Dillon, Dorchester, Edgefield, Florence, Georgetown, Hampton, Horry, Laurens, Lee, Lexington, Orangeburg, Richland, Sumter, Williamsburg.

Tennessee Blount, Campbell, Cumberland, Morgan.

Texas Angelina, Cass, Cherokee, Hardin,



Shading on this map depicts the present range of the red-cockaded woodpecker in southeastern United States. Dots represent populations on public lands, small dots, 1-9 clans; large dots, 10 or more clans.

Houston, Jasper, Montgomery, Nacogdoches, Newton, Polk, Sabine, San Augustine, San Jacinto, Shelby, Trinity, Tyler, Walker.

Virginia Prince Georges (?), Southampton (?), Surry, Sussex (?).

HABITAT

Mature to over-mature southern pines are the best habitat for roosting and nesting. Longleaf (*Pinus palustris*), loblolly (*Pinus taeda*), shortleaf (*Pinus echinata*), slash (*Pinus elliottii*), and pond (*Pinus rigida*) pines are used, depending on locality (Thompson and Baker 1971). Younger pines (10 to 21 cm d.b.h.) sometimes are used for foraging, especially after an unusually hot burning of the area which results in killed and weakened trees which offer high-grade feeding areas (Beckett 1974). Fire, an essential element of this habitat, prevents thick understory. Red-cockaded woodpeckers are discouraged by dense stands of pine saplings and thick hardwood understories.

Although over-mature pines are required for nesting and roosting, the red-cockaded woodpeckers will forage in a variety of habitat types depending on food availability and proximity to cavity-tree sites.

The Florida Game and Fresh Water Fish Commission (1976) and Nesbitt et al. (1978), have studied fall habitat usage in a Florida flatwoods community. Percent of total foraging time spent in each habitat type was:

Pond/slash pine flatwoods	43.8
Longleaf pine flatwoods	38.2
Slash pine plantation	9.4
Bayhead/pond borders, cypress domes and others.	6.5
Roosting areas.	2.2

FOOD AND FORAGING BEHAVIOR

The red-cockaded woodpecker feeds chiefly on wood-boring insects, ants, beetles, grubs, grasshoppers, crickets, and caterpillars (Murphy 1939). Analysis of 99 stomach content samples from the Southeast revealed a diet of 84% insects and 16% plant material (Beal 1911). Plant fruits eaten include (Murphy 1939, Ligon 1970, Baker 1971a):

Wax myrtle	(<i>Myrica cerifera</i>)
Magnolia	(<i>Magnolia grandiflora</i>)
Poison ivy	(<i>Rhus radicans</i>)
Wild grape	(<i>Vitis</i> sp)
Pokeberry	(<i>Phytolacca americana</i>)
Blueberry	(<i>Vaccinium</i> spp.)

Wild cherry	(<i>Prunus serotina</i>)
Black gum	(<i>Nyssa sylvatica</i>)

Woodpeckers prey on the corn earworm (*Helicovera armigera*) when corn fields are nearby. (Baker 1971a).

Foraging on a tree trunk it uses the bill and/or feet to pry off pieces of bark, exposing insects. One technique involves backing down the tree, flaking off bark with the feet while catching prey with the bill.

SHELTER REQUIREMENTS

Roosting requires a cavity in a living pine tree. A sample of 259 cavity trees in east central Mississippi ranged from 40 to 116 years in age, with a mean of 75.9 years (Jackson 1977). Usually the tree is infected with red heart (*Fomes pini*), a fungus disease which weakens the heartwood (Affeltranger 1971). Jackson (1977) suggests a cavity can provide an infection site for red heart disease. After the heartwood is weakened, an excavation can be completed. A tree may have several roosting cavities.

The distinguishing characteristic of a cavity tree is the flow of sap that glazes the tree around the opening. Birds initiate and maintain sap flow by pecking out chunks of bark and cambium, forming 'resin wells.' Active sap flow may prevent predators and/or competitors from entering the roost cavity (Ligon 1970, Dennis 1971, Jackson 1974).

NESTING OR BEDDING

The adult male's roost cavity is used for nesting. The bottom of the gourd-shaped cavity is covered with chips and debris; sap often smears onto the eggs (Murphy 1939).

RITUAL REQUIREMENTS

Mating behavior, as observed by Crosby (1971a): the female landed near the male and raised her tail. The male mounted from her left side, fell, separated, and resumed feeding after 3 seconds.

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

Clan (see Reproduction) home-range requirements depend on three variables: clan size, habitat type, and season. Crosby (1971b) followed two color-marked adult pairs in north central Florida during the spring. This study produced an average estimate of 17.2 ha per adult pair. Baker (1971b), observing color-marked individuals in north Flo-

rida, estimated home range of an eight-bird clan to be 65.6 ha during the summer.

Lay and Russell (1970) divided known areas by the number of clans present to estimate home ranges of 26.7 ha and 67.7 ha per clan in two eastern Texas forests. Beckett (1974) used the same technique to estimate 86.2 ha per clan in a South Carolina forest.

Skorupa and McFarlane (1979) compared summer and winter home range requirements of two adult pairs. Results indicated a 112% and 71% increase in winter forage range requirements. Fall home range requirements in central Florida were determined by the Florida Game and Fresh Water Fish Commission (1976) and Nesbitt et al. (unpublished). A bird in each clan was equipped with a miniature radio transmitter. Results indicated an average home range of 69.8 ha.

POPULATION NUMBERS AND TRENDS

Estimates of total population range from 3,000 to 10,000 (U.S. Department of the Interior 1973).

The number of colonies (groups of cavity trees) on public lands is between 2,800 and 3,600; of these, an estimated 2,500 are active (see Management and Conservation).

Subpopulations exist on ecological islands of suitable habitat. The fractioning of distribution results in reduced gene flow between subpopulations, as well as reduced ability to disperse into and occupy suitable habitats that might become available in the future (Jackson 1976).

Colonies were surveyed in 10 southeastern States in 1969-70. Thompson (1976) reported the status of 312 colonies resurveyed in 1973-74. Only 271 remained active, a 13.3% loss, at an annual loss rate of 3.5%. For the 4-year period, losses on Federal, State, and private lands were, respectively, 8.7%, 27.3%, and 22.9%. The largest factor in this reduction was timber harvest.

Clearcutting and short-term-rotation timber management have virtually eliminated the species from Kentucky, where Jackson et al. (1976b) found red-cockaded woodpeckers at only two locations.

As trends continue toward short-term timber rotation throughout the Southeast, the species will become increasingly endangered.

REPRODUCTION

The species nests during April, May, and June. Clutch size is usually two to four eggs. The incubation period is approximately 10 days; duration

of the nestling stage is about 27 days (Jackson et al. 1976a, W. W. Baker personal communication).

Usually one or two young are fledged. Longevity and survival rates are not known.

A family unit is called a 'clan,' and consists of two pair-bonded adults, the young of the year, and sometimes several 'helpers' that are young of previous years.

MANAGEMENT AND CONSERVATION

A Recovery Team has been appointed and a draft recovery plan submitted to the U.S. Fish and Wildlife Service for review.

Jackson (1976) suggests that properly managing interstate highway right-of-ways might reunite fragmented populations.

The following tabulation presents population estimates of species numbers on publicly owned or managed lands. Unless otherwise noted, all data were obtained by personal communication with the listed observers. (Key: NF = National Forest; NWR = National Wildlife Refuge; SF = State Forest; SP = State Park; WMA = Wildlife Management Area.)

State	Location, estimate, and reference
Alabama	Conecuh NF; 22 colonies; O. Stewart Talledega NF; 30 colonies; O. Stewart Tuskegee NF; 3 colonies; O. Stewart W. B. Bankhead NF; 6 colonies; O. Stewart Felsenthal NWR; 20-30 colonies; J. Howe
Arkansas	Ouachita NF; no estimate available.
Florida	Apalachicola NF; 227 known; 647 estimated; D. Bethancourt Aucilla WMA; present; no estimates. S. Stafford Austin Cary Memorial Forest (Univ. of Florida); present; exact number not known; D. Hirth Big Cypress Swamp; 1 clan; J. Kern Blackwater River SF; approx. 25 colonies; J. Bethea Camp Blanding; 20-25 active colonies; J. Schatz Cary SF; approx. 6 colonies; J. Bethea Eglin Air Force Base; approx 55 colonies; W. Alford,

	Fisheating Creek WMA; at least 2 active colonies; T. Breault	Marion County WMA; present, exact no. not known. W. Turcotte.
	Johnathan Dickinson SP; 1 active colony; J. Stevenson	Natchez Trace Pkwy.; 1 active colony; W. Turcotte
	J. W. Corbett WMA; 20-30 birds; N. Eichholz	Noxubee NWR. 71 colonies; T. McDaniel
	Nassau WMA; present, number not known; S. Stafford	North Carolina
	Ocala NF; 30 colonies known, 48 estimated; D Bethancourt	Blanden Lakes SF; at least 2 colonies; S. Taylor
	Osceola NF; 32 known active colonies 50 estimated; pers. observation.	Crotan NF; 3-35 active colonies; B. Sanders
	Saint Marks NWR. 3 active colonies; J. White	Fort Bragg; over 100 active colonies; B. Sanders
	Secil Webb WMA; more than 20 active colonies; L. Campbell	Mattamuskeet NWR; 6 colonies; J. Roberts
	Three Lakes WMA; at least 5 colonies; R. McCracken	Pee Dee NWR; Present, exact no. not known; J. Hollowman
	Withlacoochee SF; approx. 27 colonies; J. Bcthea	Uwharrie NF; 1-3 active colonies; B. Sanders
Georgia	Baldwin SF; present, exact no. not known; J. Hammond	Oklahoma
	Dixon Memorial SF; present, exact no. not known; J. Hammond	McCurtain County; 48-53 active colonies (Wood 1975).
	Ft. Benning; at least 80 colonies; J. Medcaff	South Carolina
	Fort Gordon; 4 birds (est.); H. Fordham	Carolina Sandhills NWR; over 90 colonies; M. Hurdle
	Oconee NF; 24 active colonies; T. Richards	Cheraw SP; 16 colonies; R. Hendrick
	Okefenokee NWR; 33 colonies; J. Eadia	Francis Marion NF; 500 active colonies (est.) D. Urbston
	Piedmont NWR; 70 colonies; S. Pagans	Givhans Ferry SP; at least 1 colony; R. Hendrick
	Daniel Boone NF; 2 or 3 active colonies; W. Williams.	Harbison SF; 3 colonies; J. Tiller
Louisiana	D'Arbonne NWR; present, exact no. not known; J. Howe	Huntington Beach SP; 1 colony; R. Hendrick
	Kisatchie NF; 354 colonies; R. Wilson	Lee SP; at least 1 colony; R. Hendrick
	Fort Polk; at least 200 colonies; R. Aycock	Little Pee Dee SP; 5 colonies; R. Hendrick
Maryland	Blackwater NWR; 20 birds (est.) B. Julian	Manchester SF; 50 colonies; J. Tiller
Mississippi	Bienville NF; 101 colonies; G. Sirmon	Sand Hills SF; 55 colonies; M. Hurdle
	Copiah County WMA; present, exact no. not known. W. Turcotte	Santee NWR; 4 colonies; C. Strickland
	DeSoto NF; 88 colonies; G. Sirmon	Santee State Resort; 3 colonies; R. Hendrick
	Homochitto NF; 84 colonies; G. Sirmon	Savannah River Plant, U.S. Dept. of Energy; 14 colonies; D. Roth.
		Sesquicentennial SP; at least 2 colonies; R. Hendrick
		Sumter NF; 15 active colonies; D. Urbston
Tennessee		Tennessee
		Catoosa WMA; 6 colonies; B. Yambert
		Great Smoky Mountains NP; sightings in Cade's Cove area; J. Collier
Texas		Texas
		Angelina NF; min. 46 colonies, max. 60; D. Oates

Davy Crocket NF; min. 245 colonies;
max. 291; D. Oates
Sabine NF; min. 104 colonies, max.
120; D. Oates
Sam Houston NF; min. 87 colonies,
max. 225; D. Oates

Robert W. McFarlane
Savannah River Ecology Lab
P.O. Drawer E
Aiken, SC 29801

Richard L. Thompson
Florida Management Biologist
Fish and Wildlife Service
P.O. Box 190
Tallahassee, FL 32302

AUTHORITIES

W. Wilson Baker (Recovery Team)
Tall Timbers Research Station
Route 1, Box 160
Tallahassee, FL 32303

Ted Beckett
Magnolia Gardens
Route 4
Charleston, SC 29407

Vernon Carter (Recovery Team)
Regional Forester
Fish and Wildlife Service
17 Executive Park Drive, N.E.
Atlanta, GA 30329

Thad Cherry (Recovery Team)
Wildlife Research Supervisor
Weyerhaeuser Company
P.O. Box 1391
New Bern, NC 28560

Melvin Hopkins (Recovery Team)
National Forests in North Carolina
P.O. Box 2750
Asheville, NC 28802

Jerome A. Jackson (Recovery Team Leader)
Department of Zoology
Mississippi State University
P.O. Box Z
Mississippi State, MS 39762

Daniel W. Lay
Texas Parks and Wildlife Department
Box 4608, SFA
Nacogdoches, TX 75961

Michael R. Lennartz
Department of Forestry
Southeastern Forest Experiment Station
Clemson University
Clemson, SC 29631

Teddy E. Lynn, Jr.
International Paper Company
Georgetown Woodlands Region
Georgetown, SC 29440

PREPARER'S COMMENTS

Cavities produced by red-cockaded woodpeckers are used by other species, including the honey bee (*Apis mellifera*), rat snake (*Elaphe obsoleta*), red-bellied woodpecker (*Melanerpes carolinus*), red-headed woodpecker (*Melanerpes erythrocephalus*), white-breasted nuthatch (*Sitta carolinensis*), tufted titmouse (*Parus bicolor*), eastern bluebird (*Sialia sialis*), common flicker (*Colaptes auratus*), pileated woodpecker (*Dryocopus pileatus*), great crested flycatcher (*Myiarchus crinitus*), screech owl (*Otus asio*), wood duck (*Aix sponsa*), starling (*Sturnus vulgaris*), gray squirrel (*Sciurus carolinensis*), fox squirrel (*Sciurus niger*), and flying squirrel (*Glaucomys volans*) (Baker 1971b, Jackson et al. 1976a).

The fragmentation of nesting habitat, and thus of the woodpecker's distribution, may be leading to reduced gene flow between populations and a loss of ability to colonize new habitat that may develop.

Subjects needing further investigation include seasonal variation of food habits and home range requirements, causes of high nestling mortality (relative to other woodpeckers), pesticide levels and their significance, and reintroduction techniques.

LITERATURE CITED/SELECTED REFERENCES

- Affeltranger, C. 1971. The red heart disease of southern pines. Pages 96-99 in R. L. Thompson, ed. The ecology and management of the red-cockaded woodpecker. Proc. Symp. Okefenokee Natl. Wildl. Refuge, Folkston, Georgia. May 26-27. U.S. Bur. Sport Fish. Wild. and Tall Timbers Res. Stn., Tallahassee, Florida. 188 pp.
- Baker, W. W. 1971a. Observations on the food habits of the red-cockaded woodpecker. Pages 100-107 in R. L. Thompson, ed. The ecology and management of the red-cockaded woodpecker. Proc. Symp. Okefenokee Natl. Wildl.

- Refuge, Folkston, Georgia. May 26-27. U.S. Bur. Sport Fish. Wildl. and Tall Timbers Res. Stn., Tallahassee, Florida. 188 pp.
- . 1971b. Progress report on life history studies of the red-cockaded woodpecker at Tall Timbers Research Station. Pages 44-59 in R. L. Thompson, ed. The ecology and management of the red-cockaded woodpecker. Proc. Symp. Okefenokee Natl. Wildl. Refuge, Folkston, Georgia. May 26-27. U.S. Bur. Sport Fish. Wildl. and Tall Timbers Res. Stn., Tallahassee, Florida. 188 pp.
- Beal, F. E. L. 1911. Food of the woodpeckers in the United States. U. S. Dep. Agric. Biol. Survey Bull. 37:1-64.
- Beckett, T. A. 1974. Habitat acreage requirements of the red-cockaded woodpecker. EBBA News 37:3-7.
- Crosby, G. T. 1971a. Ecology of the red-cockaded woodpecker in the nesting season. M.S. Thesis. Univ. of Florida, Gainesville. 45 pp.
- . 1971b. Home range characteristics of the red-cockaded woodpecker in north central Florida. Pages 70-73 in R. L. Thompson, ed. The ecology and management of the red-cockaded woodpecker. Proc. Symp. Okefenokee Natl. Wildl. Refuge, Folkston, Georgia. May 26-27. U.S. Bur. Sport Fish. Wildl. and Tall Timbers Res. Stn., Tallahassee, Florida. 188 pp.
- Czuhai, E. 1971. Synoptic review of forest resources and use within the range of the red-cockaded woodpecker. Pages 108-124 in R. L. Thompson, ed. The ecology and management of the red-cockaded woodpecker. Proc. Symp. Okefenokee Natl. Wildl. Refuge, Folkston, Georgia. May 26-27; U.S. Bur. Sport Fish. Wildl. and Tall Timbers Res. Stn., Tallahassee, Florida. 188 pp.
- Dennis, J. V. 1971. Utilization of pine resin by the red-cockaded woodpecker and its effectiveness in protecting roosting and nesting sites. Pages 78-86 in R. L. Thompson, ed. Proc. Symp. Okefenokee Natl. Wildl. Refuge, Folkston, Georgia. May 26-27. U.S. Bur. Sport Fish. Wildl. and Tall Timbers Res. Stn., Tallahassee, Florida. 188 pp.
- Florida Game and Fresh Water Fish Commission. 1976. Red-cockaded woodpecker. Pages 79-87 in Cross Florida Barge Canal restudy report: endangered, threatened, rare, special concern, status undetermined, and biologically sensitive species. U.S. Fish Wildl. Serv. unpublished. 267 pp.
- Jackson, J. A. 1971. The evolution, taxonomy, distribution, past populations and current status of the red-cockaded woodpecker. Pages 4-29 in R. L. Thompson, ed. The ecology and management of the red-cockaded woodpecker. Proc. Symp. Okefenokee Natl. Wildl. Refuge, Folkston, Georgia. May 26-27. U.S. Bur. Sport Fish. Wildl. and Tall Timbers Res. Stn., Tallahassee, Florida. 188 pp.
- . 1974. Gray rat snakes versus red-cockaded woodpeckers: predator prey adaptations. Auk 91(2):342-347.
- . 1976. Rights-of-way management for an endangered species—the red-cockaded woodpecker. Pages 247-252 in Proc. Symp. Environmental Concerns in Rights-of-Way Management. Mississippi State Univ.,
- Jackson, J. A., W. W. Backer, V. Carter, T. Cherry, and M. L. Hopkins. 1976a. Recovery plan for the red-cockaded woodpecker. 23 pp.
- Jackson, J. A., and R. L. Thompson. 1971. A glossary of terms used in association with the red-cockaded woodpecker. Pages 187-188 in R. L. Thompson, ed. The ecology and management of the red-cockaded woodpecker. Proc. Symp. Okefenokee Natl. Wildl. Refuge, Folkston, Georgia. May 26-27. U.S. Bur. Sport Fish. Wildl. and Tall Timbers Res. Stn., Tallahassee, Florida. 188 pp.
- Jackson, J. A., R. Weeks, and P. Shindala. 1976b. The present status and future of red-cockaded woodpeckers in Kentucky. Kentucky Warbler 52(4):73-80.
- Lay, D. W., and D. N. Russell. 1970. Notes on the red-cockaded woodpecker in Texas. Auk 87(4):781-786.
- Ligon, J. D. 1968. Sexual differences in foraging behavior in two species of *Dendrocopos* woodpeckers. Auk 85(2):203-215.
- . 1970. Behavior and breeding biology of the red-cockaded woodpecker. Auk 87(2):255-278.
- Murphey, E. E. 1939. Red-cockaded woodpecker. Pages 75-79 in A. C. Bent, ed. North American woodpeckers. Dover Publication, Inc. New York.
- Nesbitt, S. A., D. T. Gilbert, and D. B. Barbour. 1978. Red-cockaded woodpecker fall move-

- ments in a Florida flatwoods community. *Auk* 95(1):145-151.
- Robbins, C. S., R. Braun, H. S. Zim, and A. Singer. 1966. A guide to field identification. *Birds of North America*. Golden Press, New York. 340 pp.
- Skorupa, J. A., and M. W. McFarlane. 1979. Seasonal variation in foraging territory of red-cockaded woodpeckers. *Wilson Bull.* 88(4): 662-665.
- Thompson, R. L. 1976. Changes in status of red-cockaded woodpecker colonies. *Wilson Bull.* 88(3):491-492.
- Thompson, R. L., and W. W. Baker. 1971. A survey of red-cockaded woodpecker nesting habitat requirements. Pages 170-186 *in* R. L. Thompson, ed. *The ecology and management of the red-cockaded woodpecker*. Proc. Symp. Okefenokee Natl. Wildl. Refuge, Folkston, Georgia. May 26-27. U.S. Bur. Sport Fish. Wildl. and Tall Timbers Res. Stn., Tallahassee, Florida. 188 pp.
- U.S. Department of the Interior. 1973. Threatened wildlife of the United States. Compiled by Office of Endangered Species and International Activities, Bur. Sport Fish. Wildl. Resour. Publ. 114. U.S. Gov. Printing Office, Washington, D.C. 289 pp.
- Wood, D. A. 1975. Status, habitat, home range, and notes on the behavior of the red-cockaded woodpecker in Oklahoma. M.S. Thesis. Oklahoma State Univ. 60 pp.

ACCOUNT PREPARED/UPDATED BY:

National Fish and Wildlife Laboratory
412 N.E. 16th Avenue, Room 250
Gainesville, FL 32601

Biological Services Program

FWS/OBS-80/01.8
March 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States-

IVORY-BILLED WOODPECKER



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—

IVORY-BILLED WOODPECKER

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: LAURA DIXON, U.S. FISH AND WILDLIFE SERVICE

IVORY-BILLED WOODPECKER

Campephilus principalis principalis (Linnaeus)
Campephilus principalis bairdii Cassin

KINGDOM Animalia
 CLASS Aves
 ORDER Piciformes
 FAMILY Picidae
 OTHER NAMES American Ivory-billed
 Woodpecker, Kent, Ivory-bill, Pearly-
 bill, Log-god, Log-cock, White-back
 Woodpecker, Poule de Bois, Grand
 Pique-bois, Lord-god, Cuban Ivory-
 billed Woodpecker, Carpentero Real.

DATE

Entered into SWIS. to be determined
 Updates. to be determined

LEGAL STATUS

Federal: Endangered: (42 FR 36428, 14 July
 1977).
 States: Endangered: North Carolina; Pro-
 tected by Migratory Bird Treaty Act
 of 3 July 1918 (40 Stat. 755; 16
 U.S.C. 703-711) as amended 3 Decem-
 ber 1969. Public Law 91-135. South
 Carolina; Georgia; Florida; Alabama;

Mississippi; Texas; Arkansas (black List, extinct or near extinction).

REASONS FOR CURRENT STATUS

C. p. principalis is probably very close to extinction because of the scarcity of suitable habitat (U.S. Fish and Wildlife Service 1973). Ivory-bills disappeared when the mature forests they inhabited were cut over, and the larger timber essential for providing adequate food supply was removed. In many cases, their disappearance almost coincided with logging operations; in other cases there was no close correlation, but there are not records of ivory-bills remaining very long after cutting of forests. Their disappearance in the Suwannee River region of Florida is believed to have been due to excessive collecting rather than logging (Tanner 1942). Herbert Stoddard and Whitney Eastman shared the conviction that ivory-bills were reduced to near extinction by gun pressure, but that with large land holdings coming into possession of ranchers and timber companies, the bird had a better chance of survival (Eastman 1958). Some shooting for sport or curiosity is known to have occurred, particularly before passage of protective laws. Although direct killing by man is not as important as loss of habitat by logging in reducing their numbers, it could be important locally when only a very few are left (Tanner 1942).

C. p. bairdii, the Cuban Ivory-billed Woodpecker was once widely distributed in Cuba, but is now limited to remote areas in Oriente Province. Land clearing during the speculative sugar boom of the early 1900's and later lumbering activities extirpated it from its former range. By far the major predator is man, as these woodpeckers are prized as food by the natives (Lamb 1957).

PRIORITY INDEX

75

DESCRIPTION

C. p. principalis is a very large (crow-sized) woodpecker, 50 cm long, with 46 cm wingspan. Its shape is long and slender, with a long tapering tail (Audubon 1842, Tanner 1942). Both sexes are mostly glossy blue-black, with tail and primaries duller black. There is a narrow white stripe on each side of neck, starting below the eye and continuing down to the folded secondaries, which are conspicuously white, as are all but 5 of the outermost primaries and the under-wing coverts. This makes a large white patch on the rear half of

the wing, narrowing toward the tip. The nasal plumes and anterior edge of lores are white. The crest is red in the male, black in the female. The iris is pale, clear lemon-yellow. Tarsi and toes are light gray. The bill is large and ivory-white (Ridgway 1914, Tanner 1942). The best field identification character is the large white patch on the wing, conspicuous when the bird is perched. Call notes are a nasal "kent, kent" (Tanner 1942).

Measurements.- Adult male (15): wing, 240-263 (255.8 mm); tail, 147-160.5 (154.4); culmen, 63-72.5 (68.2); tarsus, 42.5-46 (44.2); outer anterior toe, 30-34 (32.1). Adult female (11): wing, 240-262 (256.4 mm); tail, 151-166 (159.5); culmen, 61-67.5 (64.3); tarsus, 40.5-44 (42.6); outer anterior toe, 30-33.5 (31.7) (Ridgway 1914).

The eggs are pure china-white, exceedingly glossy, and more pointed than most woodpeckers. Measurements (13 eggs) 34.5 x 23.6 to 36.8 x 26.9 (av. 34.8 x 25.2 mm) (Bendire 1895).

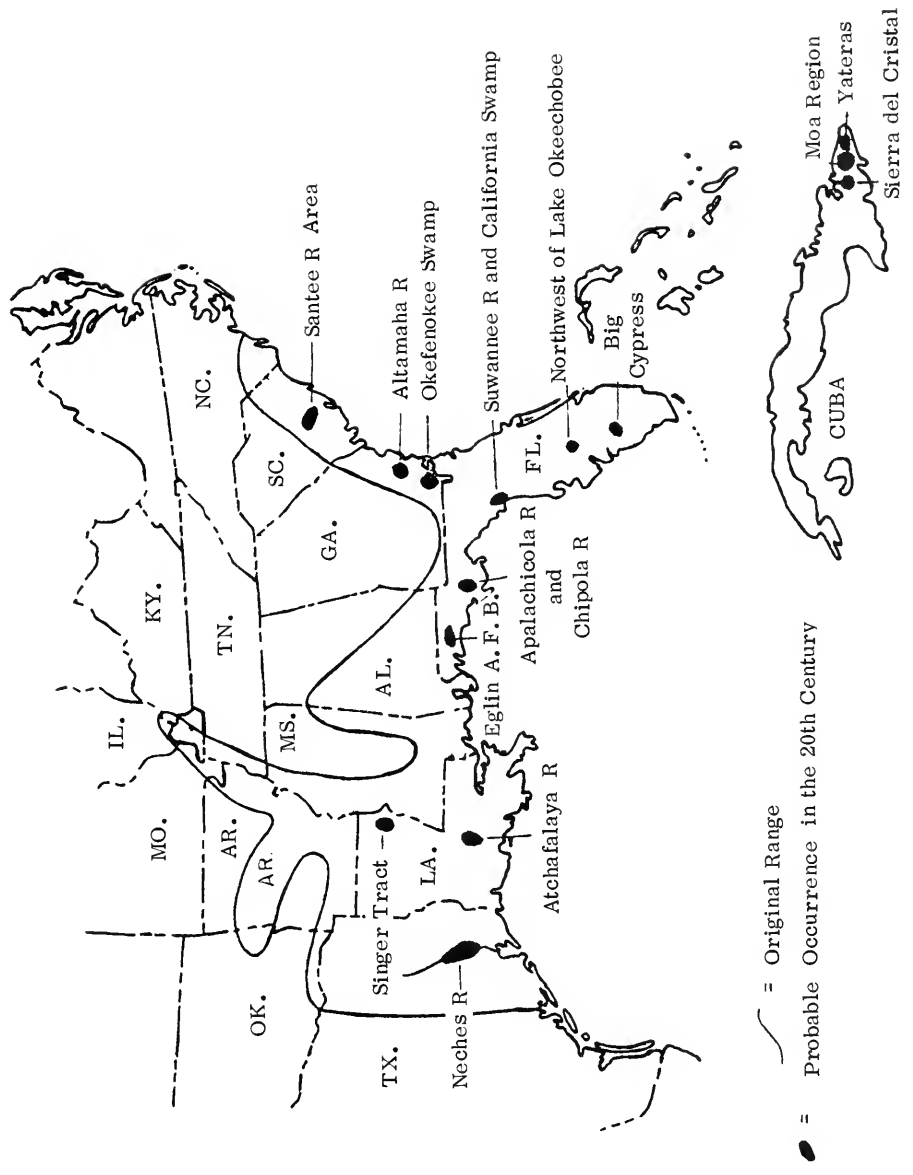
C. p. bairdii is similar to *C. p. principalis* but slightly smaller; the bill is decidedly smaller; nasal tufts much smaller; and white stripe on side of head continues nearly to the base of the bill.

Measurements.- Adult male (2): wing, 236-250 (243 mm); tail, 137-154 (145.2); culmen, 59-61 (60); tarsus, 40-42 (41); outer anterior toe, 30.5-31.5 (31). Adult female (2): wing, 240-255 (247.5 mm); tail, 159.5-165.5 (162.5); culmen, 58-60 (59); tarsus, 41; outer anterior toe, 30.5-31.5 (31) (Ridgway 1914).

RANGE

C. p. principalis formerly was a resident in the bottomlands and swampy forests of southeastern United States from northeastern Texas, southeastern Oklahoma, northeastern Arkansas, southeastern Missouri, southeastern Illinois, southern Indiana and southeastern North Carolina, southward to the Brazos River, Texas, the Gulf Coast and southern Florida (A.O.U. 1957, Bent 1931, Tanner 1942). There are probably a few still in southeastern Texas, Louisiana, Florida and South Carolina (Dennis Unpubl.).

C. p. bairdii was formerly distributed widely in Cuba, but is now apparently confined to northeastern Oriente Province (from the *pinares* of Mayari eastward); it was seen at an elevation of approximately 213 m in 1942 (Bond 1950). Records in the 20th century come only from northern Oriente Province in the extreme eastern part of Cuba. The Sierra del Cristo region apparently had ivory-bills until at least 1920 (Dennis 1948). A few pairs were thought by Barbour to be in the Sierra de Nipe near Mayari (1943); Abelardo



● = Original Range
 ● = Probable Occurrence in the 20th Century

Original range of the ivory-billed woodpecker and its probable occurrence in the 20th century

Moreno *in* Lamb (1957) found three ivory-bills in the Sierra de Moa region east of Sierra del Cristal.

RANGE MAP

(Adapted from Tanner 1942, Dennis 1967, Lamb 1957).

STATES/COUNTIES: (from Tanner 1942)

North Carolina: New Hanover.

South Carolina: Chesterfield, Clarendon, Berkeley, Georgetown, Charlestown, Barnwell, Allendale, Beaufort.

Georgia: Tattnall, Pierce, Ware.

Florida: Liberty, Gulf, Wakulla, Leon, Jefferson, Taylor, Dixie, Suwannee, Levy, Baker, Clay, Alachua, Putnam, Marion, Citrus, Sumpter, Volusia, Seminole, Hernando, Sumpter, Lake, Polk, Orange, Osceola, Brevard, Pinellas, Clearwater, Hillsborough, Manatee, Highlands, Okeechobee, Desoto, Charlotte, Collier, Lee.

Mississippi: Monroe, Clay, Hancock, Harrison, Jackson, Warren, Bolivar.

Alabama: Hale, Dallas, Wilcox, Pike, Marengo.

Louisiana: Morehouse Parish, West Carroll Parish, East Carroll Parish, Madison Parish, Franklin Parish, Tensas Parish, Concordia Parish, West Feliciana Parish, St. Martin Parish, Iberville Parish, Iberia Parish, Lafourch Parish.

Illinois: White.

Missouri: Stoddard.

Kentucky: Fulton.

Arkansas: Mississippi, Jackson, Poinsett, Phillips.

Oklahoma: Atoka, Bryan.

Texas: Cooke, Jasper, Harris, Brazoria.

HABITAT

C. p. principalis resides in swampy forests, especially the large bottomland river swamps of the coastal plain and Mississippi Delta and the cypress swamps of Florida. It was most abundant in the lower bottoms of the Mississippi River, the rivers of South Carolina and Georgia, and in Florida

swamps and swampy hammocks. Habitats were divided by Tanner (1942) into three main regional types: (1) Bottomlands of the Mississippi Delta; (2) River bottoms outside the Mississippi Delta; (3) the Florida region.

The Mississippi Delta, the alluvial flood plain of the Mississippi River, stretches from the junction of the Ohio and Mississippi to the Gulf of Mexico, and is from 64 to 130 km wide. Ivory-bill distribution was evidently limited to the higher parts of the "first bottoms," which were rarely covered with water more than a few months of the year. The soil is a moderately well-drained alluvial clay. The forest is a sweet gum-oak association with dominant trees being sweet gum, bottomland red oak and green ash. Associated with them are willow oak, water oak, overcup oak, American elm, cedar elm, hackberry, water hickory, and pecan. Ivory-bills fed mostly upon sweet gum and bottomland red oak.

The river bottoms outside the Mississippi Delta are the floodplains of the larger rivers of the southeastern United States, flowing either into the Atlantic or Gulf of Mexico. The soil is alluvial clay that is usually flooded annually. Ivory-bills have been observed in those bottomlands in both oak-sweet gum and cypress-tupelo forests but were most common in oak-sweet gum. These habitats differ from those of the Mississippi Delta primarily in their smaller area, but also in the predominance of laurel oak and water oak. Dominant forest species on dryer sites of these bottoms are sweet gum, laurel oak and water oak and associated with their dominants are overcup oak, cow oak, water hickory, green ash and American elm. West of the Mississippi Delta in eastern Texas, the sweet gum-oak association consists of sweet gum and willow oak as dominants, with overcup oak, water hickory, green ash, black gum and cedar elm as important associates. Loblolly and longleaf pine woods border all of these river swamps, but ivory-bills rarely feed in them.

Ivory-bill habitats in the Florida region vary considerably, although cypress is a dominant tree in all of them, a condition not found in ivory-bill habitat outside of the Florida region. Another difference is that ivory-bills in Florida, unlike elsewhere, frequently feed in the pine woods bordering the swamp. Many ivory-bills are recorded in swamps along the small rivers of central and southern Florida where the predominant trees are baldcypress, red maple, laurel oak, black gum, with some sweet gum and cabbage palmetto. Ivory-bills frequently nested in cypress

trees, but only occasionally fed upon them. In the Mississippi Delta region, they nested only in various species of hardwood trees (at least in the Singer Tract), in parts of the woods where the ground was at least partly covered with water during the nesting season (Tanner 1942).

A characteristic of all habitats used by ivory-bills is that other species of woodpeckers, such as the pileated and red-bellied woodpeckers, reach their greatest abundance there also. The most likely places to look for ivory-bills are bottom-land forests where big sweet gums and oaks are abundant, where there are many dead and dying trees, and where other woodpeckers are abundant. The many dying and dead trees in old age stands of timber contain the wood-boring insects eaten by the woodpeckers. The sweet gum-oak bottom-land forests supply the best feeding conditions on the Mississippi Delta. The wood-boring insects are most abundant in wood 2 or 3 years dead from storm, fire, logging, or disease. These conditions occur most often in large, old forests, and their elimination or isolation has made it increasingly difficult for ivory-bills to find sufficient food and to move from one area to another in search of a variable food supply that has always been more or less eruptive and undependable (Tanner 1942). Virgin hardwood is not a necessity and pines are more important than Tanner thought in the Neches River Valley (Dennis 1967).

The ivory-bill is a nomadic "disaster species," moving into areas where trees have been killed by fire, storms, insect attack, or flooding (Dennis 1967). Observations in Texas and Florida by Herbert Stoddard and John Dennis convinced them that old age or virgin hardwood forests are not essential as long as there are large numbers of recently dead trees to supply the type of wood-boring grubs preferred by ivory-bills. They thought that dead pine trees, including recently cut slash, were frequently used (Dennis 1967).

C. p. bairdii. Gunchach (1876) found Cuban ivory-bills in the high country of Pinar del Rio and also in low country along river bottoms similar to the habitat of the American ivory-bill, near Guantanamo in eastern Cuba. During the last half of the 19th century, Cuban ivory-bills were found mainly in high country in pine forests on deep lateritic soil. They feed in both hardwoods and pines, but nest and roost almost exclusively in old pine trees (*Pinus cubensis*) (Lamb 1957). The lateritic soil, composed of small, hard nodules of iron ore, drains very quickly and completely, so that it can support pine forest up to about 300 m

elevation. Above that, hardwood becomes dominant. Most of the pine land has been lumbered, but the birds have managed to adapt to changing habitat, living in large dead pines that are still standing and feeding on dead pines and dead hardwoods, both of which are infested with wood-boring beetles. They roost and nest only in pines, and large enough pines are becoming rare.

FOOD AND FORAGING

C. p. principalis. Audubon (1842) mentions grapes, persimmons and blackberries as food of ivory-bills, in addition to beetles and their larvae. Allen and Kellogg (1937) found ivory-bills digging trenches in rotten wood, as pileated woodpeckers do, to get at the large wood-boring beetle larvae. More often, they scaled off bark from recently dead trees or from dead branches of living trees to get at insects and larvae hidden beneath. Most feeding was in dead pines at the edges of swamps. They sometimes fed on the ground like flickers.

The most common feeding behavior is to knock the bark off recently dead trees with side-wise blows or quick flicks of the bill to uncover and eat the borers that live between the bark and the sapwood. When feeding the young, they hold grubs in the back of the bill while continuing to scale bark for additional food. Grubs 2.5 to 5 cm long are used to feed young. Ivory-bill workings for food show as bare places on recently dead limbs of trees where the bark has been scaled off clean for a considerable extent. Pileated woodpeckers do some scaling, but it is usually confined to smaller limbs and to those longer dead. They obtain most of their food by digging in the wood, while ivory-bills obtain theirs by scaling the bark. Extensive scaling of bark from a tree so recently dead that the bark is still tight, with a brownish or reddish color of the exposed wood showing that the work is fresh, is one good indication of the presence of ivory-bills (Tanner 1942). However, they do also chisel into the wood, making somewhat conical holes. In the Singer Tract, Louisiana, most feeding was on sweet gum, Nuttall's oak, and hackberry, over 30 cm in diameter.

Wandering and ranges of ivory-bills are probably controlled by abundance of food. They require an unusually large supply of certain wood-boring insects which make up most of their diet and which is abundant only in occasional localities for a comparatively short period. Birds remain in one locality as long as the food lasts, then move, sometimes for considerable distances, until they

find another area with an adequate food supply (Tanner 1942).

Contents of three ivory-bill stomachs from Louisiana and Texas summarized by Cottam and Knapper (1939) (including those reported by Beal 1911) were as follows: 46% of combined content was of animal origin, 45.33% being long-horned beetles (Cerambycidae), and 0.67% of engraver beetles (*Tomiscus* sp.); 54% was of vegetable origin, 14% being seeds of *Magnolia grandiflora*, 27% of *Carya*, 12.67% of seeds of poison ivy (*Rhus radicans*), and 0.33% being fragments of unidentified gall. In three stomachs from a Carolina region, Wilson (1811) found large quantities of large grubs fitting the description of some larger larval Cerambycids. In two stomachs from Louisiana, Goss (1859) found one large *Cerambyx* and the stones of cherries. In debris from an ivory-bill nest in the Singer Tract, Louisiana, soon after the young had left, Tanner (1942) found 1 fragment of Elatrid larva; 21 mandibles of Cerambycid larvae; 1 mandible of a Scarabaeid beetle larva, and a few fragments of adult insects, probably Coleoptera. E. A. McIlhenny (*in* Bendire 1895), said they fed on acorns. Alexander Sprunt, Jr., *in* Tanner (1942), saw ivory-bills feeding on black gum and tupelo berries. Probably, the seasons when fruits or seeds are eaten are from late summer to early winter when they are most easily available; stomachs with large percentages of vegetable food were taken in November. Ivory-bills drink water from hollows in trees (Tanner 1942).

C. p. bairdii. Their feeding habits are about equally divided between pine and hardwood forests, and they have been seen feeding on both types of tree. They feed both by scaling bark and by digging holes in wood, with the majority of feeding signs of the scaling type. There are no records of the actual food eaten, but presumably it consists of larvae of wood-boring beetles like those preferred by American ivory-bills. Such insects were found in trees used by the Cuban ivory-bills.

SHELTER REQUIREMENTS

C. p. principalis nests and roosts in holes in large dead or living trees, usually hardwoods.

C. p. bairdii requires holes in large dead pine stubs for both nesting and roosting.

NESTING OR BEDDING

C. p. principalis. Allen and Kellogg (1937)

quote Audubon who believed the nesting hole is always made in the trunk of a live tree, generally an ash or hackberry, and at great height. However, they noted that there were records of nesting in live cypress, partly dead oaks, a dead royal palm stub, and an old and nearly rotten white elm stump, indicating as great a variety as nest sites of the pileated woodpecker. Beyer (1900) found a nest as low as 8 m in a living over-cup oak. Allen and Kellogg (1937) found a nest in Florida 10 m up in a live cypress and three nests in Louisiana in oak and one in a red maple. Nest trees were very large. One nest was in a dead pin oak stub about 16 m high; the entrance hole was 13 cm high and 11.4 cm wide; depth of nest cavity, 47 cm, and diameter 20 cm at egg level (Allen and Kellogg 1937). In Florida, height of nests from the ground averaged 15 m (Tanner 1942) with extremes of at least 8 m (Hoyt 1905) and 20 m (Ridgway 1898). In Louisiana, nests averaged 15.5 m and ranged from 12 to 21 m from ground, all in dead trees or dead parts of living trees where wood was a bit punky but still quite hard. The average depth of all reliably measured nest cavities is 48 cm (Tanner 1942). Nesting and roosting holes of ivory-bills have oval or irregular entrances measuring about 13 cm vertically and 10 cm across, or about 2.5 cm larger than pileated woodpecker entrance holes (Tanner 1942).

Ivory-bills do not use old nesting holes, but excavate new ones usually in different trees. One roosting hole has never been seen occupied by more than one bird even by a young one still in the company of its parents. For at least 2 weeks after leaving the nest, young roost in the open in trees while the parents roost in holes. The birds emerge from their roosting holes much later in the morning than other woodpeckers. Then pairs and young join together for their daily feeding flights (Tanner 1942).

C. p. bairdii nest and roost almost exclusively in holes in old pines. Only one instance of a roost hole in a hardwood has been reported. Nesting and roosting sites were found in 16 pine trees which contained 33 holes dug by ivory-bills (Lamb 1957). Dennis (1948) found a nest about 10 m from the ground in a dead pine stub. The opening was approximately 10.2 by 10.2 cm, forming a rough square. Old holes found by Lamb (1957) were all considerably lower than 10 m, averaging about 6 m above ground. The pine stubs used were never over 8 m tall. In the virgin forest

area, holes were closer to 9 m from ground and one was nearly 18 m. Measurements of a female's roost entrance were 15.6 cm (width) by 24.1 cm (height); inside diameter of the cavity was 25.4 cm and depth of cavity from entrance to bottom was 32 cm.

RITUAL REQUIREMENTS

A pair of *C. p. principalis* was observed by Allen and Kellogg (1937) to clasp bills, evidently as part of courtship behavior. Tanner (1942) observed a similar event. He also described soft conversational notes by both members of a pair when they exchanged places on the nest. The drumming display consists of a double tap instead of the multiple taps or drum-roll of other North American woodpeckers (Tanner 1942).

POPULATION NUMBERS AND TRENDS

C. p. principalis. Earlier accounts gave no accurate or definite statements of abundance, but indicated that it never was common. An exception was Audubon (1842) who said it was "very abundant along the Buffalo Bayou (near Houston?), Texas." Audubon's "very abundant" may have meant compared with ivory-bills in other localities, where Audubon usually described the species as quite rare (Tanner 1942). Arthur T. Wayne and his hunters collected 5 ivory-bills in California Swamp, 97 km (58 mi) south of Old Town, Florida and saw 4 more several days after the fifth one was collected. The following year, 1893, five more were collected from that swamp. Later observations indicate that those 10 birds were practically all that were present in that area of 154 km². In vicinity of the Wacissa River, Florida, in 1894 Wayne collected 19 ivory-bills and some persisted there until about 1937. On that basis, Tanner (1942) estimated that there were probably about 12 pairs in that 188 km² swampy area, or 1 pair per 16 km². Wayne (1910) stated that he saw 200 ivory-bills in Florida during the years 1892 to 1894. In the Singer Tract of about 300 km² of virgin forest in Louisiana, in 1934, there were about 7 pairs, or 1 pair per 43 sq km. Total population in all areas in 1939 was estimated at about 24 individuals (Tanner 1942).

The greatest distance a pair traveled from the

roosting area in Singer Tract in breeding season was 2 km (Tanner 1942). Birds of the Singer Tract appeared to be sedentary, with ranges up to 6 km or more across. However, birds in other areas appear to wander considerable distances, probably in response to the availability of food (Tanner 1942) near the nesting site.

Bark-stripping from recently dead pines, possibly the work of ivory-bills, was seen along Menard, Big Sandy, and Village Creeks; along the Neches River north and northwest of Beaumont; and near Votaw and Silsbee, Texas, in December 1973 (Orie L. Loucks, Prof. of Botany, U. of Wisconsin *in lit.* 17 March 1975).

On 22 May 1976, one ivory-bill was reported near the mouth of Wolf Creek, flying across Magnolia Ridge Road north of Beaumont, Texas (William B. Mounsey, University of the Wilderness ms. report, 4 Sept. 1976).

There were repeated reports of sightings of ivory-bills in swamps along the Congaree and Wateree Rivers, South Carolina, during the period 1966-67; John V. Dennis (Unpubl.) believed these to be valid in part.

Herbert Stoddard saw a pair in beetle-killed pines near Thomasville, Georgia, probably in 1958 (J. V. Dennis ms. 1976). On 3 and 4 March 1950, Eastman reported seeing a male and female ivory-bill on the Chipola River in northwestern Florida, and in April 1950 Dennis heard one near the same place (Dennis 1967, J. V. Dennis ms. 1976).

On 28 Aug. 1966, Bedford P. Brown J. and Jeffrey R. Sanders, Chicago bird watchers, heard the distinctive call notes and saw 2 female ivory-bills on Boiling Creek, a tributary of the Yellow River at the Elgin Air Force Base in northwestern Florida; they reported the sighting to J. V. Dennis, who tried unsuccessfully to find the birds again (Dennis 1967, Dennis 1976).

A feather from a cavity of a wind-blown tree northwest of Lake Okeechobee, Florida, around 1965, was identified by Alexander Wetmore and John Aldrich as that of an ivory-bill. However, the white patch on the feather was stained brown, indicating it had been in the tree hole a long time (J. W. Aldrich pers. comm., Agey and Heinzman 1971).

Near the Neches River north of Beaumont, Texas, above Dam B Reservoir, in April 1966, one was seen by Mrs. Olga Hooks Lloyd, bird watcher of Beaumont, and again in the same area

on 10 December 1966, one was seen by John Dennis; there are also several other probable records from the Neches River Valley (Dennis 1967).

A sound recording of ivory-bill call notes was made at Stanford Preserve on Village Creek, north of Beaumont, Texas, 25 February 1968 by Helen and Peter Isleib of Cordova, Alaska, and John V. Dennis. The recording is now in possession of the National Geographic Society. Isleib found bill marks on bark-stripped trees nearby which measured the same as the tip of ivory-bill's bill rather than that of a pileated woodpecker, according to Alexander Wetmore (Peter Isleib pers. comm.). The sound recording was analyzed by Peter Paul Kellogg (*in lit.* 14 February 1969) at Cornell University Library of Natural Sounds and by John W. Hardy, Bioacoustics Laboratory, Florida State University, and both thought it sounded very much like the call of an ivory-bill, although Hardy (1975) believed that one of the call notes of a blue jay was possible.

On 22 May 1971, 2 ivory-bills were sighted and one was photographed in the Atchafalaya River swamp west of Baton Rouge, La. by an unidentified dog trainer. The beginnings of a hole and fresh chips on the ground under the place the bird was photographed were found (George H. Lowery, Jr. pers. comm., Stewart 1971).

James Tanner and Paul Sykes in 1968 searched the same areas in the Neches River valley, Texas, where John Dennis and others reported evidence of ivory-bills in 1966, with negative results with respect to sightings, sound or indication of feeding (Sykes 1968, Tanner *in lit.* 6 March 1968).

C. p. bairdii. Dennis (1948) found 3 Cuban ivory-bills, 2 of them a mated pair that were incubating, in April 1948, in the Sierra de Moa, Oriente Province, Cuba, and heard of another group of 6 being seen there in 1941.

Lamb (1957) found 4 pairs in the Moa region and found another area supporting 2 pairs farther inland at a higher elevation, between the Moa and Punta Gorda Rivers, but with identical habitat (pine forest). In summary, Lamb (1957) estimated the number of Cuban ivory-bills extant in July of 1956 as 6 pairs or 12 individuals, all between the watersheds of the Moa-Cubana Rivers to the west and the Punta Gorda River to the east, along the north coast of Oriente Province, and in the extreme headwaters of the Calcutura River, a large tributary of the Moa River, and in the headwaters of the Jaquani River, a tribu-

tary of the Toa River, and on the divide between the Toa and Moa Rivers. The population density was computed as about 40.2 km² per pair, and the smallest area estimated for a single pair was 19.3 km². Observations were made during March, June, and early July.

More recent sightings include 2 south of Cupeyal in late 1967, a female northwest of Cupeyal in February 1968, and a female at Yateras in May 1972. All are in the Moa-Guantanamo region, Oriente Province. Certainly no more than 8 pairs still exist and probably fewer than 6 (L. S. Varona 1974, and O. H. Garrido 1974 *in King* 1978).

REPRODUCTION

C. p. principalis. In the Florida region, most nests have been in living or dead cypress, but also in bay and cabbage palm (Tanner 1942). Thompson (1896) said ivory-bills nested in long-dead pine trees in the Okefenokee Swamp region. In northern Louisiana, Tanner (1942) found nests in red maple, sweet gum, and Nuttall's oak. In the same region, Beyer (1900) found nests in American elm and overcup oak. In southern Louisiana, McIlhenny *in Bendire* (1895) said birds built in cypress or tupelo, preferably partly dead. Audubon (1842) thought they preferred hackberry trees for nesting.

The presence of eggs has been recorded on the following dates: Florida (4 records), 4 March to 19 April; Louisiana (5 records), 6 March to 19 May; Georgia (2 records) 6 and 10 April; Texas (2 records) 11 April and 3 May (Arthur Allen *in Bent* 1939). Time of nesting is evidently irregular. Scott (1881) collected an incubating female in Florida 20 January 1880. Scott (1888) found a nest containing a one-third grown young 17 March 1887. Ridgway (1898) collected a male that left the nest hole on 15 February 1898. Hoyt (1905) noted that nesting began in the latter part of January and eggs were laid by 10 February. Tanner *in Bent* (1939) noted young leaving the nest on 30 March 1937 in Louisiana, and apparently the same pair had young in the last week in February 1938. In contrast, there are 10 records of April nesting, 5 for May and 1 (Beyer 1900) of a young just out of nest in July. The later records might represent second attempts at nesting. Florida birds, in general, start nesting earlier than those in Louisiana (Bent 1939). There is no correlation between the erratic timing of nesting and

weather, except possibly the amount of sunshine. They have tended to nest earlier in cloudy winters. No correlation with food supply has been found, but the possible effects are not discounted (Tanner 1942).

According to McIlhenny *in* Bendire (1895), the female does all work of excavating the nesting cavity, but Audubon (1842) states that both birds work at excavating. Thompson (1896) also reports that both sexes excavate.

Although Bendire (1895) said there were 5 eggs per clutch and only 1 brood per season, Arthur Allen *in* Bent (1939) found the number of eggs normally not more than 3, and 1 or 2 of those often infertile. Frequently, if nesting is successful at all, it results in a single young rather than 2 or 3. Tanner (1942) figures that the average number of eggs per set is 2.9 with a range of 1 to 4, and that early nests had fewer eggs than later ones. He said the period of incubation and length of time young stay in the nest is unknown. In the Singer Tract, the male incubated every night and the female most of the time during the day. They exchanged places about eight times a day, with no regularity in the setting time except when the female relieved the male in the morning and just before he took his place for the night. Both sexes share about equally in feeding the young in the nest and for a while after they leave the nest. Young follow parents on feeding trips and gradually learn to obtain food for themselves after about 4 weeks, but still receive food from adults after 2 to 2.5 months (Tanner 1942). Hoyt (1905) states that after young leave the nest in April, they remain with their parents until the mating season in December. Some young stay with parents even after another family is fledged the following nesting season. All aggregations of ivory-bills are probably family groups of one or more years production. Tanner (1942) says the average number of young per brood leaving the nest is 2.11 with a survival success of 50%. He says there is no data on survival of young to breeding age nor length of time an adult can live and successfully breed. The important difference between nesting of ivory-bills and other species is that it lays fewer eggs. A pair may go through a season without any attempt at nesting. It probably takes at least 2 years to reach breeding age. Possibly the quantity of food or lack of synchronization of the reproductive cycles of a mated pair may determine whether nesting will occur. The lower rate of reproduction

accentuates the danger inherent in the small size of the population. The most likely serious predators on nesting ivory-bills are barred owls, raccoons, and nest mites.

Ivory-bill pairs usually nest well separated from each other (about 4.8 km apart in the Singer Tract), and, at least occasionally, nest in the same area year after year. There are no records of birds protecting territory from trespass by another ivory-bill (Tanner 1942).

C. p. bairdii. Incubation is shared by both sexes (Dennis 1948). Feeding and brooding are thought to be shared by both sexes (Lamb 1957). Causes of nesting failure are always traceable to human interference, although crows are thought by natives to be predators on nests (Lamb 1957).

MANAGEMENT AND CONSERVATION

C. p. principalis. The only way of preserving the ivory-billed woodpecker is to preserve in their entirety any areas that can be found where the birds still exist. A suitable area would be about 6 to 8 km² of good habitat for each pair. Possibly some timber may be selectively cut, leaving dead and dying trees. The quantity of food may be artificially increased by progressively killing enough trees at a time to supply a large number of wood-boring insect larvae (Tanner 1942, Paul Sykes *in lit.* 1968). Dennis (1967) found that trees killed by girdling do not attract as many wood-boring insects as those killed by flooding and suggested limited inundation and cutting of pine slash as a means of increasing ivory-bill food supply.

In October 1974, a bill was passed by Congress creating a preserve of 34,000 ha of potential ivory-bill habitat in the Big Thicket area of southeastern Texas (Dennis ms. 1976).

Public information is an important part of ivory-bill management as with other endangered species. Only an interested and sympathetic public can save the bird from such threats as big dams, wholesale clearing of bottomland timber, and drainage of favorable habitat (Dennis 1967).

In 1967, the U.S. Corps of Engineers halted the timber management plan at Dam B Reservoir on Neches River, Texas, in deference to ivory-bills. Federal and state wardens in area were alerted and public appeal received positive and gratifying response (Harry Goodwin *in lit.* to Roland Clement 19 December 1967).

The U.S. Fish and Wildlife Service adopted a policy of informing the public of locations of reported ivory-bill sightings as opposed to restriction of such information advocated by Herbert Stoddard and some other knowledgeable people (Letter from Director, Fish and Wildlife Service to E. V. Komarek of 12 September 1967, memorandum to Secretary of Interior from Director, Fish and Wildlife Service of 20 July 1967; Letter of 1 July 1967 from John Dennis to George M. Sutton).

C. p. bairdii. Establishment of refuges in areas where birds are still known to exist in the most important step in management, for without preservation of habitat, fast disappearing due to lumbering, the bird cannot survive. Further effort to locate existing birds is needed to pinpoint prospective refuge areas (Lamb 1957). Plans were made to erect nesting boxes as an experiment to substitute for suitable dead pine stubs which were disappearing. Whether this was done, and if so what happened, is unrecorded (Lamb 1957). Forest reservations have been established at Cuepyal and Jaguane under auspices of the Academy of Sciences since 1963. Each reservation is watched and no further exploitation of timber is being permitted, although much of the larger timber has already been removed (Lamb 1957; Fisher et al. 1969).

The ivory-billed woodpecker is protected under the Protected Migratory Bird Treaty Act, 40 Stat. 755: 16 WSC 703-74, 3 July 1918; as amended 3 December 1969. PL 91-135.

AUTHORITIES

James T. Tanner
Dept. of Zoology
University of Tennessee
Knoxville, Tennessee 37916

John V. Dennis
3 Joy Street
Nantucket, Massachusetts 02554

Paul W. Sykes
P.O. Box 2077
Delray Beach, Florida 33444

PREPARER'S COMMENTS

From the evidence presented, I believe that a few ivory-bills still exist in the United States, but they are so nomadic that it will continue to be

difficult to verify the occasional sighting. Nevertheless, every effort should be made to locate nesting pairs and to take measures to preserve nesting habitat in those locations. Then additional feeding areas should be artificially created near such locations. - J. W. Aldrich.

LITERATURE CITED/SELECTED REFERENCES

- A. O. U. 1950. Report of the AOU Committee on bird protection, 1949. Auk. 67:320.
- . 1957. Check-list of North American birds. American Ornithologists' Union, Baltimore. 691 pp.
- Agey, H. N. and G. M. Heinzman. 1971. The Ivory-billed woodpecker found in Central Florida. Florida Nat. 42: 46-47 and 64.
- Allen, A. A. and P. P. Kellogg. 1937. Recent observations on the Ivory-billed Woodpecker. Auk. 54:164-184.
- Arthur, S. C. 1918. The birds of Louisiana. Bull. La. Dept. Cons.5:53.
- Audubon, J. J. 1842. The birds of America. Vol. 4:214-226.
- Avery, W. C. 1890. Birds observed in Alabama. Amer. Field 34:608.
- Barbour, T. 1943. Cuban ornithology. Mem. Nuttall Ornith. Club 9:129 pp.
- Baynard, O. E. 1913. Breeding birds of Alachua County, Florida. Auk. 30:245.
- Beal, F. E. L. 1911. Food of the Woodpeckers of the United States. Bull. U.S. Bur. Biol. Serv. 37:62-63.
- Bendire, C. E. 1895. Life histories of North American birds. U.S. Nat. Mus. Spec. Bull. 3:42-45.
- Bent, A. C. 1939. Life histories of North American woodpeckers. U.S. Nat. Mus. Bull. 174:1-12.
- Beyer, G. E. 1900. The Ivory-billed Woodpecker in Louisiana. Auk. 17:97-99.
- Bond, J. 1936. Birds of the West Indies. Acad. Nat. Sciences, Philadelphia.
- Bond, J. 1950. Check-list of birds of the West Indies. Acad. Nat. Sciences of Philadelphia.
- Bryant, H. 1859. Birds observed in eastern Florida

- south of St. Augustine. Proc. Boston Soc. Nat. Hist. 7:11.
- Clarke, S. C. 1885. The Ivory-billed Woodpecker in Florida. Forest and Stream 24:367.
- Cooke, W. W. 1914. Some winter birds of Oklahoma. Auk 31:480.
- Cory, C. B. 1886. The birds of the West Indies, including the Bahama Islands, the Greater and Lesser Antilles, excepting the islands of Tobago and Trinidad. Auk. 3:373-374.
- Cottam, C. and P. Knappen. 1939. Food of some uncommon North American birds. Auk 56: 162.
- Covington, J. D. 1922. The winter birds of Biloxi, Mississippi region. Auk 39:545.
- Dennis, J. V. 1948. Last remnant of Ivory-billed Woodpecker in Cuba. Auk 65:497-507.
- Dennis, J. V. 1967. The Ivory-billed Woodpecker –its present status and proposals for its preservation. U.S. Dept. Interior, Bur. Sport Fisheries and Wildlife, Spec. Rep. Washington, D.C.
- Dennis, J. V. 1967a. The ivory-bill flies still. Audubon Mag. 69:38-45.
- Eastman, W. 1958. Ten-year search for the Ivory-billed Woodpecker. Atlantic Naturalist 13: 216-228.
- Fisher, J., N. Simon and J. Vincent. 1969. Wildlife in danger. New York, Viking Press.
- Gosse, P. H. 1859. Letters from Alabama. London pp. 91-93 (in Tanner 1942).
- Greenway, J. C. 1958. Extinct and vanishing birds of the World. Amer. Comm. for Internat. Wildlife Protection, New York, N.Y. Special Pub. 13:357-360.
- Gundlach, J. 1876. Contribucion a la Ornitologia Cubana. Habana.
- Hardy, J. W. 1975. A tape recording of a possible Ivory-billed Woodpecker. Amer. Birds 29: 647-651.
- Hasbrouck, E. M. 1891. The present status of the Ivory-billed Woodpecker (*Campephilus principalis*) Auk 8:174-186.
- Howe, R. H. and L. King. 1902. Notes on various Florida birds. Contrib. N. A. Ornith. 1:30.
- Howell, A. H. 1907. Birds of Alabama. U.S. Bur. Biol. Surv. pp. 159-162.
- Howell, A. H. 1911. Birds of Arkansas. Bull. Bur. Biol. Surv. 38:45-46.
- Howell, A. H. 1932. Florida bird life. New York pp. 313-315.
- Hoyt, R. D. 1905. Nesting of the Ivory-billed Woodpecker in Florida. Warbler (ser. 2) 1:52-55.
- King, W. B. 1978 (in press). (Revised) Red data book (Aves). I.C.B.P., Survival Service, Morges, Switzerland.
- Kline, H. A. 1886. Ivory-billed Woodpecker. Forest and Stream 26:163.
- Lamb, G. R. 1957. The Ivory-billed Woodpecker in Cuba. Research Rept. No. 1, Pan-American Sect. Intnat. Comm. Bird Preservation.
- McIlhenny, E. A. 1941. The passing of the Ivory-billed Woodpecker. Auk 58:582-584.
- Merriam, C. H. 1874. Ornithological notes from the south. Amer. Nat. 8:88.
- Murphy, R. C. 1929. A second topotype of *Campephilus principalis*. Auk 46:376.
- Nice, M. M. 1931. The birds of Oklahoma. Pub. Univ. Okla. 3:116.
- Oberholser, H. C. 1938. The bird life of Louisiana. Bull La. Dept. Cons. 28:38-382.
- Pindar, L. O. 1925. Birds of Fulton County, Kentucky. Wilson Bull. 37:86.
- Ridgway, R. 1898. The home of the ivory-bill. Osprey 3:35-36.
- Ridgway, R. 1914. The birds of North and Middle America. U.S. Nat. Mus. Bull. 50, pt. 6.
- Ridgway, R. 1915. Bird-life in southern Illinois. Bird-Lore 17:194.
- Scott, W. E. C. 1881. On birds observed in Sumpter, Levy and Hillsboro Counties, Florida. Bull. Nuttall Ornith. Club 6:14-21.
- Scott, W. E. C. 1888. Supplementary notes from the Gulf coast of Florida, with a description of a new species of marsh wren. Auk 5:183-188.
- Scott, W. E. C. 1889. A summary of observations on the birds of the Gulf coast of Florida. Auk 6:251.

- Stewart, J. R., Jr. 1971. Central Southern Region. American Birds 25:868.
- Sykes, P. W., Jr. 1968. Report on the search for the Ivory-billed Woodpecker (*Campyphilus principalis principalis*) in eastern Texas, January 1968. Administrative report, Fish and Wildlife Service.
- Tanner, J. T. 1942. The Ivory-billed Woodpecker. Nat. Audubon Soc. Research Rep. No. 1, New York.
- Thompson, J. M. 1896. An archer's sojourn in the Okefinoke. Atlantic Monthly 77:486-491.
- Thompson, M. 1889. A red-headed family. Oologist 6:23-29.
- U.S. Fish and Wildlife Service. 1973. Threatened wildlife of the United States. U.S. Dept. of Interior, Resource Pub. 114, G.P.O. Washington, D.C.
- Wayne, A. T. 1910. Birds of South Carolina. Contrib. Charleston Mus.:87-88.
- Wetmore, A. 1943. Evidence for the former occurrence of the Ivory-billed Woodpecker in Ohio. Wilson Bull. 55:127.
- Williams, R. W., Jr. 1904. A preliminary list of the birds of Leon County, Florida. Auk 21: 455.
- Wilson, A. 1811. American Ornithology. Philadelphia Vol. 4:20-26.
- Yell. 1885. The big woodpecker. Forest and Stream 24:107.

Biological Services Program

FWS/OBS-80/01.9
March 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States-

THE OCELOT



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

FWS/OBS-80/01.9
March 1980

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—

THE OCELOT

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: CHARLES E. MOST

OCELOT

Felis pardalis Linnaeus

KINGDOMAnimalia
 CLASSMammalia
 ORDER.....Carnivora
 FAMILY.....Felidae
 OTHER COMMON

NAMES. leopard cat, ocelote, tiger cat,
 tigrillo

DATE

Entered into SWIS..... to be determined
 Updates..... 31 May 1978

LEGAL STATUS

Federal: Endangered (non-U.S. populations
 only) (44 FR 43705, 25 July 1979).
 States: Endangered: Massachusetts, Texas.

REASONS FOR CURRENT STATUS

Habitat destruction and degradation from brush-clearing operations are primarily responsible for the ocelot's population status (Culbertson and Schmidly 1974, Davis 1974). Population declines are also affected by predator control activities and persecution. Serious population declines in Central and South America are due to pet and fur trade exploitation (IUCN 1972, Paradiso 1972).

PRIORITY INDEX

Not assigned.

DESCRIPTION

Medium-sized (0.8 to 1.2 m long) spotted cat with moderately long tail. Females average smaller than males. Ground color is grayish to cinnamon dorsally, paler on sides; underparts and inside of limbs are whitish; dark markings form streaks that

run obliquely down sides; areas enclosed by black-bordered spots are more intense than ground color. There are two black stripes on the cheeks; the tail is spotted and ringed with black. Young have coloration similar to adults, but darker. Photographs appear in Davis (1974) and Guggisberg (1975).

RANGE

Extremely rare to nonexistent in Arizona (Cockrum 1960). In Texas, the ocelot occupies the lower Rio Grande Valley south of a line from Eagle Pass to just north of Corpus Christi (Hock 1955, Culbertson and Schmidly 1974, Davis 1974). There has been one record each from the Trans-Pecos (Schmidly 1977) and northern Texas (Davis 1951), but these are thought to be released or escaped captives (W. C. Brownlee and R. McBride personal communication). In Mexico, the species occurs in eastern Coahuila, along the Rio Sabines vicinity of the Sierra de San Marcos, and south and east of Saltillo (Baker 1956, IUCN 1972). It is also present in suitable habitat in Central and South America (IUCN 1972).

The ocelot's former distribution included central and eastern Texas, into southern Arkansas and western Louisiana, and south into Mexico east of the highlands. Ocelots were also found from central Arizona south into the Sonoran and west slopes of the Sierra Madre. There are no records from Mexico City (C. Conway personal communication). The Mexican highlands form a barrier between the race of ocelot that occurs in Texas (*F. p. albescens*) and that which occurs (or occurred) in Arizona (*F. p. sonoriensis*) Goldman (1925). The ocelot was also distributed transcontinentally throughout Central and South America as far south as Uruguay and northern Argentina (Goldman 1943, Hock 1955, Hall and Kelson 1959, IUCN 1972, Guggisberg 1975).

RANGE MAP

Shading refers to present range (Cockrum 1960, Davis 1974, Brownlee 1978, R. McBride personal communication); dots indicate sightings and/or kills within the last century.

STATES/COUNTIES

Arizona Cochise, Pima, Santa Cruz.
Texas Cameron, Hidalgo, Kenedy, Willacy.

HABITAT

Ocelots inhabit tropical and subtropical forests ranging from low swamp to upland oak forests (Hall and Kelson 1959, IUCN 1972). In the northern part of their range they inhabit dense, nearly impenetrable chaparral thickets (Davis 1974); they also use second-growth forests and partially cleared lands (IUCN 1972).

FOOD AND FORAGING BEHAVIOR

Ocelots hunt mostly at night, but it is not unusual for them to be seen in the daytime (Calahane 1947, Hall and Kelson 1959, Denis 1964). Their food habits are not well known; they are reported to feed on small and moderate-sized mammals, birds, monkeys, tree lizards, and, occasionally, domestic fowl (Hall and Kelson 1959, Denis 1964, Davis 1974).

SHELTER REQUIREMENTS

Ocelots take refuge in caves in rock bluffs, hollow trees, or dense parts of thickets (Davis 1974).

NESTING AND BEDDING

The den site is usually a cave in a rocky bluff, hollow tree, or the dense part of a thicket (Davis 1974).

RITUAL REQUIREMENTS

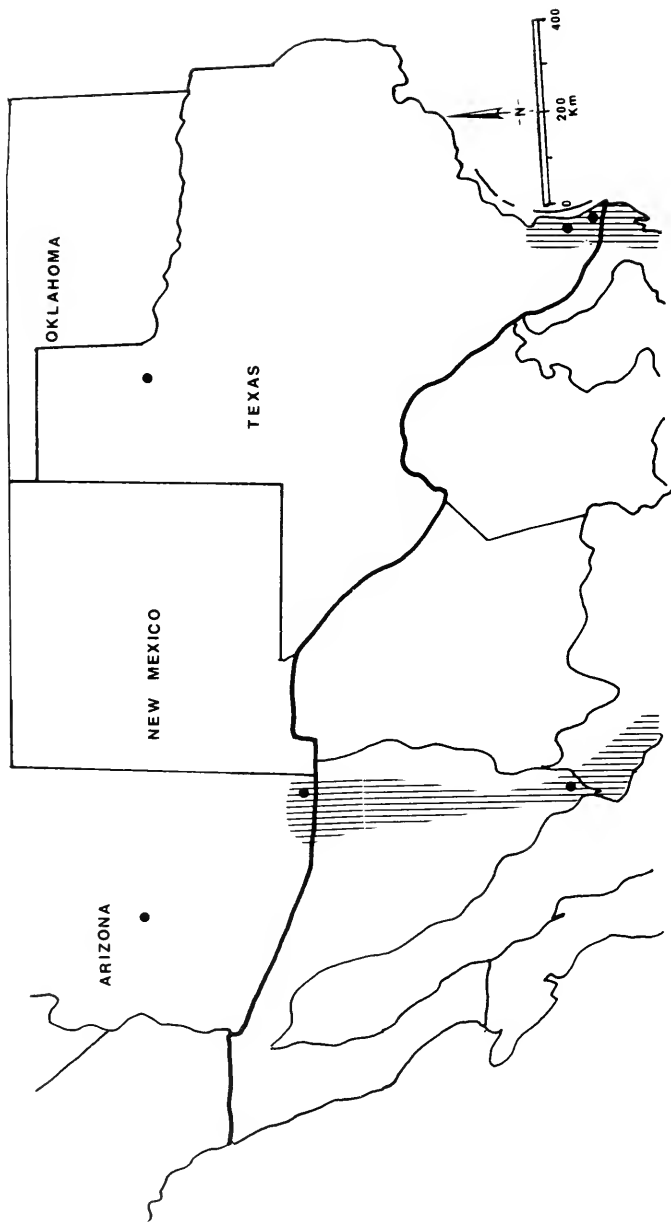
Not known.

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

Home range area is not known. Pairs share the same territory but do not hunt together (Guggisberg 1975). They often rest in trees (Davis 1974); they are excellent tree climbers (Hall and Kelson 1959).

POPULATION NUMBERS AND TRENDS

There are no firm estimates on populations in the United States or Latin America. IUCN is conducting a status survey in Latin America, and the Texas Parks and Wildlife Department is making a field survey in Texas. Preliminary findings of the Texas survey indicate around 35 at Santa Ana National Wildlife Refuge and 24 at Laguna Atascosa National Wildlife Refuge (Brownlee 1978). However, others claim that there are only 12 to 15 ocelots on Laguna Atascosa and none are found



Map depicts the current range of the ocelot in the U.S. and northern Mexico. Dots indicate locations of sightings and/or killings within the last century.

at Santa Ana, due to its small size (688 ha) (R. McBride, personal communication).

Another survey in South Texas in 1976 estimated the ocelot population at 30 to 40 in Willy County, 0 to 2 in Hidalgo County, 12 to 20 in Cameron County, and an unknown number in Kenedy County (R. McBride personal communication).

The species rarely occurs in southern Arizona (Cockrum 1960). Populations are declining in Texas due to predator control activities and particularly to brush-clearing operations in the lower Rio Grande Valley (Culbertson and Schmidly 1974, Davis 1974). Latin American populations are reduced and in some areas are seriously depleted (IUCN 1972, Paradiso 1972).

REPRODUCTION

There is no fixed breeding season in the tropics (Denis 1964). In Texas, breeding takes place in late summer, with young born in September, October, and November (Davis 1974). Gestation period is believed to be about 70 days (Guggisberg 1975). Litter size ranges from two to four, with two being more common (Leopold 1959, Denis 1964, IUCN 1972). In Texas, average litter size appears to be one (R. McBride personal communication). Growth and development of young are not well known.

MANAGEMENT AND CONSERVATION

No recovery team has been appointed at this time.

Ocelots are protected in Texas and some Latin American countries, but U.S. populations are not listed on the official U.S. Endangered Species list.

Brush is no longer cleared on the National Wildlife Refuges in the lower Rio Grande Valley (IUCN 1972), in order to maintain natural habitat. Laguna Atascosa National Wildlife Refuge is thought to contain habitat most similar to that required by ocelots.

AUTHORITIES

W. C. Brownlee
Texas Parks and Wildlife Department
4200 Smith School Road
Austin, TX 78744

W. B. Davis
Department of Wildlife and Fisheries Science
Texas A&M University
College Station, TX 77843

Roy McBride
Department of Biology
Sul Ross State University
Box 725
Alpine, TX 78930

PREPARER'S COMMENTS

The use of questionnaire surveys may lead to overestimates of populations and inaccurate distributional patterns when escaped or released captives are sighted or even when the same individual is sighted repeatedly. Intensive field surveys are needed to accurately define the current status of the ocelot. Its ecology and life history also require further investigation.

LITERATURE CITED/SELECTED REFERENCES

- Bailey, V. 1905 Biological survey of Texas. N. Am. Fauna 25:1-222.
- . 1931. Mammals of New Mexico. N. Am. Fauna 53:283-285.
- Baker, R. H. 1956. Mammals of Coahuila, Mexico. Univ. Kansas Publ. Mus. Natur. Hist. 9:125-335.
- Bangs, O. 1898. The land mammals of peninsular Florida and the coast region of Georgia. Proc. Boston Soc. Natur. Hist. 28:157-235.
- Brownlee, W. C. 1978. Feline status survey. Performance Report, Proj. W-103-R-7. Texas Parks Wildl. Dep. Austin. 4 pp.
- Calahane, V. H. 1947. Mammals of North America. MacMillan Co., New York. 682 pp.
- Chapman, F. M. 1894. Remarks on certain land mammals from Florida, with a list of species known to occur in the state. Bull. Am. Mus. Natur. Hist. 6:333-346.
- Cockrum, W. L. 1960. The recent mammals of Arizona: their taxonomy and distribution. Univ. Arizona Press, Tucson. 276 pp.
- Culbertson, K., and D. J. Schmidly. 1974. Summary of statements on the status of the rare, endangered, and peripheral mammals in Texas. Texas Organization for Endangered Species, Temple. 8 pp.
- Davis, W. B. 1951. Unusual occurrence of the ocelot in Texas. J. Mammal. 32:363-364.

- _____. 1974. The mammals of Texas. Texas Parks Wildl. Dep. Bull. 41:1-294.
- Denis, A. 1964. Cats of the world. Houghton Mifflin Co., Boston. 144 pp.
- Goldman, E. A. 1925. Two new ocelots from Mexico. J. Mammal. 6:122-124.
- _____. 1943. The races of ocelot and margay in Middle America. J. Mammal. 24:372-385.
- Goodwyn, F. 1970. Behavior, life history and present status of the jaguarundi, *Felis yagouaroundi* (Lacepede) in South Texas. M.A. Thesis. Texas A&I University, Kingsville. 63 pp.
- Guggisberg, C. A. W. 1975. Wildcats of the world. Taplinger Publ. Co., New York. 382 pp.
- Hall, E. R., and K. R. Kelson. 1959. Mammals of North America. 2 vols. Ronald Press, New York. 1,083 pp.
- Hock, R. J. 1955. Southeastern exotic felids. Am. Midl. Natur. 53:324-328.
- Harlan, R. 1825. Fauna Americana: being a description of the mammiferous animals inhabiting North America. Anthony Finely, Philadelphia. 320 pp.
- IUCN. 1972. Red data book. Vol. 1, Mammalia. Compiled by H. A. Goodwin and C. W. Holloway. IUCN, Morges, Switzerland.
- Layne, J. N. 1974. The land mammals of Florida. In P. J. Gleason, ed. Environments of south Florida; past and present. Mem. 2 Miami Geol. Surv. 452 pp.
- Leopold, A. S. 1959. Wildlife of Mexico; the game birds and mammals. Univ. California Press, Berkeley. 568 pp.
- Lowery, G. H., Jr. 1974. The mammals of Louisiana and its adjacent waters. Louisiana State Univ. Press, Baton Rouge. 565 pp.
- Lowman, G. E. 1975. A survey of endangered, threatened, rare, status undetermined, peripheral, and unique mammals of the southeastern national forests and grasslands. USDA For. Serv., Atlanta, Ga. 121 pp.
- Maynard, C. J. 1883. The mammals of Florida. Q. J. Boston Zool. Soc. 2:1-50.
- Paradiso, J. L. 1972. Status report on cats (Felidae) of the world, 1971. U.S. Fish Wildl. Serv. Spec. Sci. Rep. Wildl. 157.
- Schmidly, D. J. 1977. The mammals of Trans-Pecos Texas. Texas A&M Press, College Station. 225 pp.
- Sealander, J. A., and P. S. Gipson. 1974. Threatened Arkansas mammals. Unedited draft report to State of Arkansas Planning Department, Little Rock.
- Seton, E. T. 1937. Lives of game animals. Vol. I. Literary Guild, New York.
- Silveira, E. K. 1972. A case of cannibalism among ocelots, *Felis pardalis nitis*, at Brasilia Zoo. Int. Zoo. Yearb. 12:182-183.

ACCOUNT PREPARED/UPDATED BY:

National Fish and Wildlife Laboratory
412 N.E. 16th Avenue, Room 250
Gainesville, FL 32601

Biological Services Program

FWS/OBS-80/01.10
March 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States-

THE ATTWATER'S GREATER PRAIRIE CHICKEN



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

FWS/OBS-80/01.10
March 1980

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—

THE ATTWATER'S GREATER PRAIRIE CHICKEN

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: LUTHER C. GOLDMAN

ATTWATER'S GREATER PRAIRIE CHICKEN

Tympanuchus cupido attwateri Bendire

KINGDOMAnimalia
 CLASSAves
 ORDER.....Galliformes
 FAMILY..... Tetraonidae
 OTHER COMMON

NAMES..... Attwater's prairie chicken
 greater prairie chicken, heath hen

DATE:

Entered into SWIS..... to be determined
 Update 1 August 1978

LEGAL STATUS

Federal: Endangered (32 FR 4001, 11 March 1967)
 States: Endangered: Texas

REASONS FOR CURRENT STATUS

Conversion of natural tall grass prairie to agricultural lands for soybeans, grain, sorghum, rice, and cotton has eliminated extensive amounts of habitat. Commercial development and urban sprawl have contributed to the loss of habitat while overgrazing and oil development have reduced habitat quality (Lehmann and Mauermann 1963, W. Shifflett personal communication).

The Attwater's prairie chicken was formerly killed in great numbers for target practice and sport (Lehmann 1941).

PRIORITY INDEX

Not assigned.

DESCRIPTION

Prairie chickens are large, hen-like birds; males weigh almost 1 kg, and females 0.75 kg. They are brown barred with black above, buffy barred with

black below, and have a short, rounded, dark tail. Males have an orange comb above the eye, and, on each side of the neck, an area of orange skin that inflates during the courtship display. Tufts of feathers (pinnae) extend down each side of the neck, and point forward during courtship.

The Attwater's prairie chicken is distinguished from the lesser prairie chicken (*T. pallidicinctus*), which still occurs in the Texas panhandle, by orange instead of reddish throat pouches. From the northern race (*T. cupido pinnatus*), formerly found in Texas, it differs in having the back of the tarsus unfeathered. From the extinct heath hen (*T. cupido cupido*), it differs in having pure white axillaries and rounded pinnae.

Color plates appear in Lehmann (1941) and Peterson (1947); black-and-white illustrations appear in Lehmann and Mauermann (1963).

RANGE

This species' range formerly extended over the entire Gulf coastal prairie of southwestern Louisiana and Texas, and south to the Rio Grande (Lehmann and Mauermann 1963). At present, it is confined to small, disjunct populations scattered over about 12 Texas counties, mainly Refugio, Austin, and Colorado. It is extirpated in Louisiana.

RANGE MAP

Present range (W. Shifflett personal communication) is shaded on the following page.

STATES/COUNTIES

Texas Aransas, Austin, Brazoria, Chambers,¹ Colorado, Dewitt, Fort Bend, Galveston, Goliad, Harris, Jefferson,¹ Refugio, Victoria, Waller,¹ Wharton.

HABITAT

Coastal grassland prairie approaches ideal conditions when (1) vegetation is diversified and native grasses, sedges, legumes, brush, and dwarfed trees provide a variety of cover; (2) knolls, ridges, and hog wallows are frequent and soils vary from loose sand to tight clay or silt; and (3) permanent sources of water are not more than 0.2 km apart (Lehmann 1941).

Cultivation causes immediate abandonment, but the birds will usually return after the field lies

fallow for a year or two (V. Lehmann personal communication).

FOOD AND FORAGING BEHAVIOR

Food of adults is 85% vegetable and 15% animal; this ratio is approximately reversed in the young. Favorite plants are ruellia (*Ruellia ciliosa*), perennial ragweed (*Ambrosia psilostachya*), blackberry (*Rubus* sp.), doveweed (*Croton* sp.), and sensitive brier (*Neptunia lutea*); favorite animals are grasshoppers and beetles.

Except during breeding season, adults feed twice daily (dawn to 08:00 and 16:00 to dark). Gizzards collected at noon are usually empty. Feeding is slow and deliberate. Their capacity is large; 20 cc in gullet and 30 cc in gizzard. The variety of foods found in a stomach is immense—up to 29 kinds of food and more than 1,300 items (Lehmann 1941).

SHELTER REQUIREMENTS

These birds require light to medium cover for roosting, especially on gentle slopes, and medium heavy to heavy cover for nesting and escape. Light cover is necessary for booming (see Reproduction) and feeding. Hence, considerable habitat diversity is required (Lehmann 1941). Fallow rice fields and weedy, sandy slopes are used for brood habitat in Austin and Colorado counties (W. Shifflett personal communication).

NESTING OR BEDDING

Prairie chickens usually nest on well-drained mounds or ridges near trails and within 1.3 km of a booming ground. The nest is a shallow depression about 18 cm in diameter, more or less roofed over by a medium to heavy grass cover, and lined with bits of dead grass and a few feathers (Lehmann 1941).

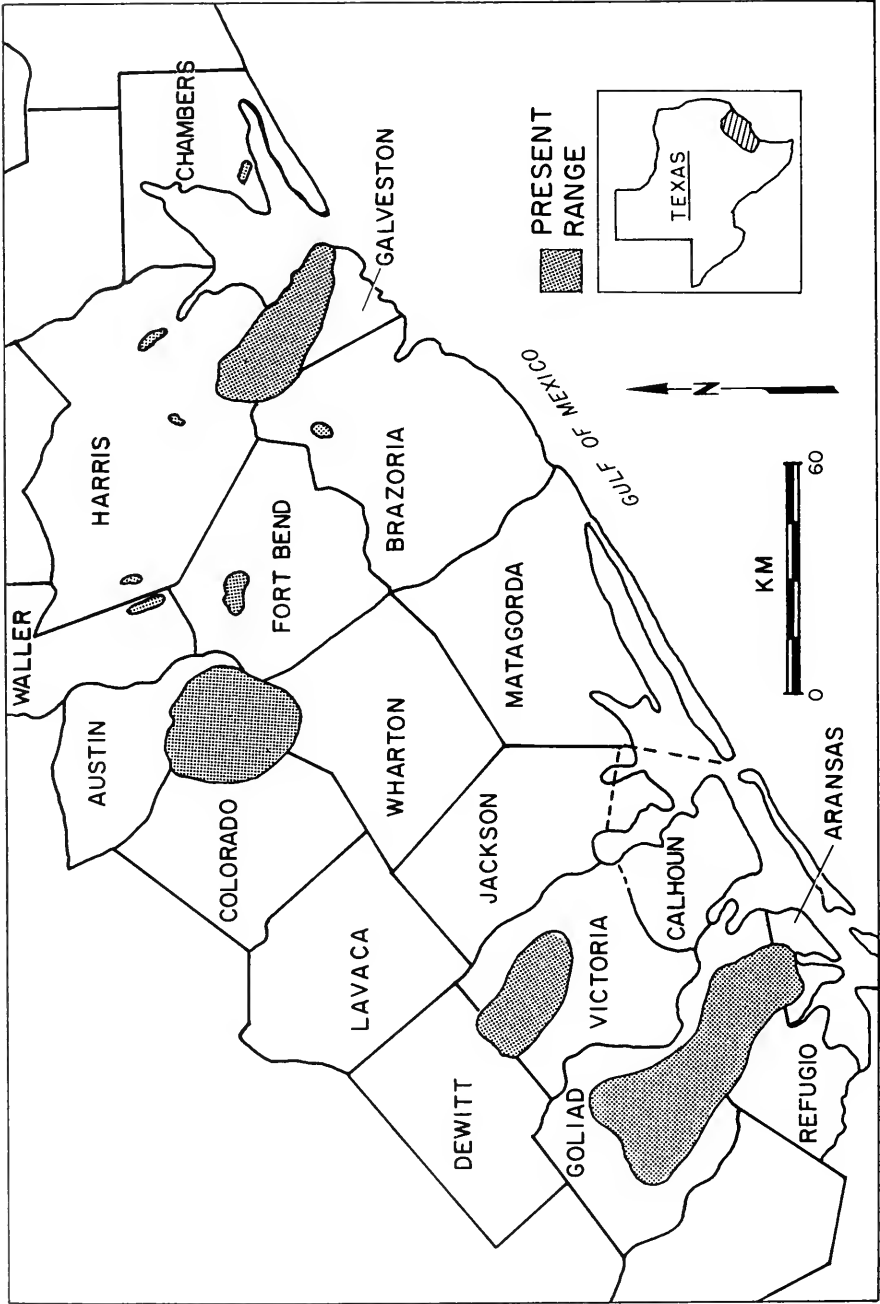
RITUAL REQUIREMENTS

Preferred booming sites are short-grass flats, often not elevated, 0.4 ha or so in area, and surrounded by moderate grass cover suitable for nesting.

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

Permanent sources of surface water no more than 1.6 km apart are a must. Heavy rainfall in late April or May is a hazard to nesting (Lehmann 1941).

¹Indicates counties in which V. Lehmann (personal communication) believes the species may no longer occur.



The shaded area on the map indicates the present range of Attwater's Prairie Chicken.

POPULATION NUMBERS AND TRENDS

The species formerly numbered nearly 1,000,000 birds. In 1937, the population was estimated at 8,700 (Lehmann 1941). In 1962, Lehmann and Mauermann estimated the total population at 1,335. Since then, fluctuation has been only slight, and the 1978 estimate was 1,500 individuals (W. Shifflett personal communication).

REPRODUCTION

Elaborate displays by males on the booming grounds commence in February, peak in March, and end in May. Females visit the booming ground briefly for copulation and then select sites and construct nests. Peak laying occurs in late March and early April, at which time an average of 12 eggs are laid. Hens take two feeding forays daily, incubating the eggs the remainder of the day. The incubation period is 23 days. Hatchlings are precocious and immediately follow the hen away from the nest. Some young leave the hen at 6 to 8 weeks of age, while others remain into the fall (Lehmann 1941).

An annual increase of 100% is considered good, despite the potential for 600% (Lehmann 1941).

MANAGEMENT AND CONSERVATION

Prairie chickens have been protected from hunting since 1937. Lehmann (1941) conducted a thorough study of Attwater's prairie chicken.

A 3,200-ha acquisition in the middle of prime prairie chicken range in Colorado County was designated the Attwater's Prairie Chicken National Wildlife Refuge. Management techniques used to improve the habitat include a closely regulated grazing program, prescribed burning, mowing, shrub eradication, and experimental crop plantings (W. Shifflett personal communication).

The Texas Parks and Wildlife Department and the U.S. Fish and Wildlife Service monitor the Texas population annually (W. Shifflett personal communication).

Lehmann and Mauermann (1963) have made several management recommendations. Suggestions include posting signs on roads to alert motorists that they are in prairie chicken habitat; transplanting of chickens from inhospitable areas east of the Brazos River to better ranges (e.g., Victoria County); and organizing and supervising a predator control program.

A Recovery Team has been appointed.

AUTHORITIES

Bill Brownlee (Recovery Team)
Texas Parks and Wildlife Dept.
4200 Smith School Road
Austin, TX 78744

Royce Jurries
Texas Parks and Wildlife Dept.
1131 Travis Street
Columbus, TX 78934

Val. W. Lehmann
P.O. Box 185
Carrizo Springs, TX 78834

Wayne Shifflett (Recovery Team)
Attwater's Prairie Chicken NWR
P.O. Box 518
Eagle Lake, TX 77434

Nova Silvy (Recovery Team Leader)
Dept. Wildlife and Fisheries Science
Texas A&M University
College Station, TX 77843

James Teer (Recovery Team)
Welder Wildlife Foundation
P.O. Box 1400
Sinton, TX 78387

PREPARER'S COMMENTS

The prairie chicken population is rather stable due in part to the slowing down of conversion of prairie lands to croplands. If several large ranches should alter existing ranching operations, the prairie chicken could be pushed close to extinction. However, the Attwater's prairie chicken NWR should prevent the species from becoming extinct.

LITERATURE CITED/SELECTED REFERENCES

- Brownlee, W. C. 1970-1977. Attwater's prairie chicken population census. Texas Parks Wildl. Dep., Austin. Progress Rep.
- . 1973. Vegetative requirements of Attwater's prairie chickens. Texas Parks Wildl. Dep., Austin. Progress Rep.
- Lehmann, V. W. 1941. Attwater's prairie chicken, its life history and management. N. Am. Fauna 57:65 pp.

Lehmann, V. W. and R. G. Mauermann. 1963
Status of Attwater's prairie chicken. *J. Wildl.
Manage.* 27:713-725.

Peterson, R. T. 1947. A field guide to the birds.
Houghton Mifflin Co., Boston. 230 pp.

ACCOUNT PREPARED/UPDATED BY:

National Fish and Wildlife Laboratory
412 N.E. 16th Avenue, Room 250
Gainesville, FL 32601

Biological Services Program

FWS/OBS-80/01.11

March 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States-

THE CAPE SABLE SPARROW



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

FWS/OBS-80/01.11
March 1980

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES -

THE CAPE SABLE SPARROW

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



Credit: Harold Werner

CAPE SABLE SPARROW

Ammospiza maritima mirabilis Howell

KINGDOMAnimalia
CLASSAves
ORDER Passeriformes
FAMILYFringillidae
OTHER COMMON NAMESCape Sable seaside sparrow

DATE
 Entered into SWIS.to be determined.
 Updates. 17 August 1978, 10 October 1978.

LEGAL STATUS
 Federal: Endangered (32 FR 4001, 11 March 1967)
 States: Endangered: Florida

REASONS FOR CURRENT STATUS
 The Cape Sable sparrow inhabits only un-

stable interior marshes within a limited area of southern Florida. There are only three known disjunct populations, two of them nearly extirpated. Progressive invasion of marshlands by fast-growing exotic trees (*Casuarina*, *Melaleuca*, *Schinus*) poses a major threat to the remaining habitat, which is also under pressure from hurricanes, housing development, and inland encroachment of mangroves. Frequent man-induced wildfires and predation by feral cats and dogs may have caused the declines of some previously extensive colonies (U.S. Department of the Interior 1973; Werner 1975,1976, 1979; MacKenzie 1977).

PRIORITY INDEX
 Not assigned.

DESCRIPTION
 The Cape Sable sparrow is about 13 cm long, and colored olive-gray with olive-brown tail and wings. It is marked with a yellow spot before the

eye and a white streak and black whisker along the jaw. The ventral coloration is light gray to nearly white, with darker streaking on breast and sides. It tends to be greener above and whiter below than other races of seaside sparrows. The sexes are similar.

Immature birds are streaked dorsally with brown to light buff, with less streaking on light underparts. The yellow eye spot and dark whisker are reduced or absent.

Color illustrations appear in Holt and Sutton (1926), Howell (1932), Peterson (1947), and Sprunt (1954); Werner (1975) presents black-and-white photographs.

RANGE

This sparrow is a nonmigratory resident of fresh to slightly brackish marshes in extreme southern and southwestern peninsular Florida. It ranges from 8 to 34 km inland, and is isolated from other races of seaside sparrow by at least 260 km along the Gulf and 280 km along the Atlantic coast of the State. Three disjunct, low-density populations occur in marshes at Cape Sable, the Big Cypress Swamp, and the Taylor Slough area of Everglades National Park, the last being the location of the bulk of the population (Werner 1975, 1976, 1979).

The species was once common landward of the mangrove zone from Carnestown to Shark Valley Slough, including the coastal marl prairie on Cape Sable (Stimson 1956). It is now only rarely seen in this area (Werner 1979).

Emigration of fledglings is the chief dispersal mechanism for an otherwise sedentary populations (Werner 1975, 1976).

RANGE MAP

Known localities for Cape Sable sparrows are based on surveys conducted in 1970-1975 (re-drawn from Werner 1976). Critical Habitat is re-drawn from 42 FR 49685, 11 August 1977.

STATES/COUNTIES

Florida Collier, Dade, Monroe.

HABITAT

The species inhabits seasonally flooded brushless subtropical marshes (prairies) of interior southern Florida. Habitats vary from entirely fresh to slightly brackish, generally remaining dry most of the year. Brushy or rocky marshlands are avoided, as are extremely dense stands of cordgrass (*Spar-*

tina bakeri) (Werner 1975, 1976, 1979).

Werner (1975, 1976) described Cape Sable sparrow habitat in terms of four major graminoid communities: muhly grass (*Muhlenbergia filipes*) prairie; short sawgrass (*Cladium jamaicensis*) prairie; prairies of tall, clumped cordgrass; and prairies of low cordgrass growing with an irregular spatial distribution.

Photographs of habitat appear in Holt and Sutton (1926), Stimson (1968), and Werner (1975).

FOOD AND FORAGING BEHAVIOR

The Cape Sable sparrow is primarily insectivorous, with beetles and spiders comprising the bulk of the diet. Amphipods, mollusks, and vegetable matter are of minor importance (Howell (1932). They feed almost entirely on or near the ground, but are occasionally observed in sawgrass flowers during the breeding season (Werner 1975).

SHELTER REQUIREMENTS

Sparrows generally remain hidden in marsh vegetation during the hottest part of the day. The microclimate may be moderated by moisture from heavy morning dew (Werner 1975, 1979).

NESTING OR BEDDING

A woven grass nest is generally concealed within a tussock of grass 6 to 37 cm above ground. Nest construction may be either cupped or domed (Werner 1975, 1979).

Werner (1975) reported nests primarily in Muhly grass and occasionally in sawgrass. Nesting is also known to take place in cordgrass and glasswort (*Salicornia*) (Nicholson 1928, Stimson 1968).

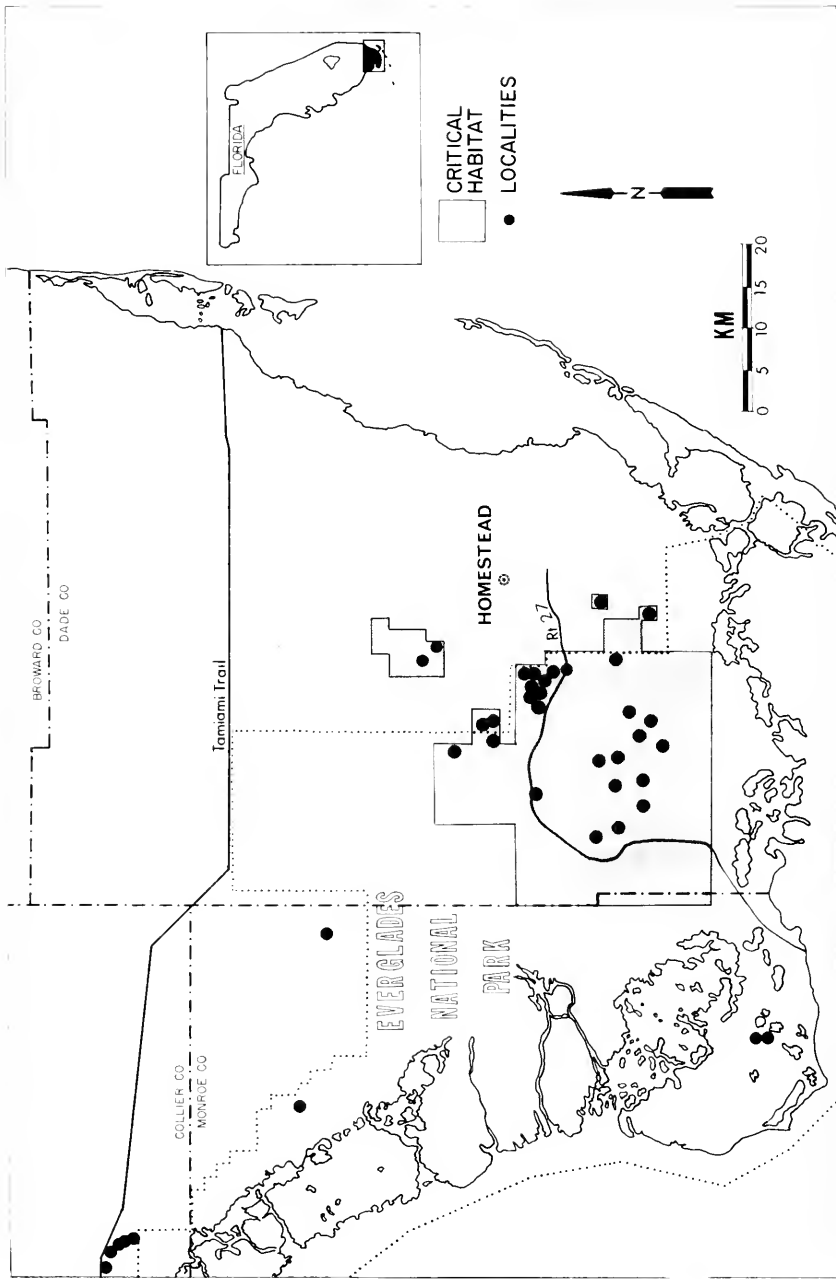
Photographs of nests and nest sites appear in Stimson (1968) and Werner (1975).

RITUAL REQUIREMENTS

Males often chase females during the breeding season. A female occasionally extends and vibrates her wings when approached by a male. The significance of such interactions is not known (Werner 1975).

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

Fire is a dangerous but vital component of Cape Sable sparrow habitat. Periodic burning of interior marshlands is necessary for perpetuation



Known range of Cape Sable sparrow

of optimal conditions. Sparrow populations are closely related to the age of vegetation after fires. Maximum density is achieved within 3 or 4 years after a burn, followed by a sharp decline as the dead component of vegetation increases. Prolonged absence of fire permits the elimination of marsh by hardwood invasion. Colonies may be enhanced or reduced by fire, depending on several critical factors, such as burn pattern, percent of contiguous habitat burned, size and percent of colony evicted, proximity of and isolation from adjacent colonies, and frequency and season of burning (Werner 1975, 1976).

The breeding season appears to be closely related to the hydroperiod of the marsh. Singing and nesting decrease abruptly when the onset of heavy rains causes the marsh to flood (Werner 1979), MacKenzie 1977). Dew may be an important source of moisture during the dry season (Werner 1975, 1976).

Cape Sable sparrows interact very little with other birds in their habitat area. Predation on adult sparrows appears to be low. Mortality may increase as summer floods inundate protective vegetation. Nestlings are subject to attack by ants (Werner 1975, 1976); 19% of nests surveyed by Werner (1975) at Taylor Slough are known to have failed due to predation. Similar failure of an additional 6% is suspected.

The entire nesting cycle is completed within the confines of a male's territory. Werner (1975) reported territories of from 0.3 to 6.8 ha, some of them overlapping. Territories, generally retained through successive breeding seasons, are defended by song and occasional chasing and combat. Average territory size decreased with increasing population density following fire. New residents usually occupy suboptimal sites adjacent to established occupants.

POPULATION NUMBERS AND TRENDS

Werner (1976) estimated the total Cape Sable sparrow population at 1,900 to 2,800 birds. Over 95% live in 8,800 to 12,800 ha of marshland in the Taylor Slough area of South Florida. Muhly grass prairie provides the principal habitat. Werner (1976) described this final stronghold as 'an area of widely spaced individuals, broken by various sized patches of unacceptable habitat, on which islands of greater density appear and disappear, following the tracks of fires. . . .' A formerly large population adjoining Big Cypress Swamp (Stimson 1956) was devastated by extensive fires during the spring breeding season (Stimson 1961,

1968; Werner 1976, MacKenzie 1977). Recent surveys indicate at least a 95% reduction since 1955. Only two singing males were recorded at Ochopee site in 1975, compared with 10 in 1970 (Werner 1975, 1976, 1979).

The species was regularly sighted on the coastal marl prairie of Cape Sable between 1918 and 1935 (Howell 1919, 1932; Holt and Sutton 1926; Nicholson 1928; Semple 1936; Stimson 1956). Believed to have been extirpated by a severe hurricane on 2 September 1935 (Stimson 1956, 1968), they were rediscovered on Cape Sable near Little Fox Lake in 1970 (Werner 1971). Alteration of the habitat by the storm of 1935 apparently is responsible for the population decline. Only a few widely spaced individuals remain (Werner 1975, 1976).

REPRODUCTION

The potential breeding season slightly exceeds 5 months, extending from February to August. Up to three broods are produced in a single season. The pair bond may change between broods or continue over two consecutive years (Werner 1975, 1979).

Normally, three or four eggs are laid per nest, rarely two or five. Eggs are incubated by the female. Incubation requires more than 11 days. Both parents feed the young. Flightless young leave the nest 9 to 11 days after hatching; they are capable of short flights about 2.5 weeks after hatching (Werner 1976, 1979). They become independent at about 45 days (MacKenzie 1977).

Fledglings begin to molt in July; the post-nuptial molt of adults is completed August to September (Werner 1975).

Photographs of nestlings appear in Werner (1975).

MANAGEMENT AND CONSERVATION

Recovery efforts have emphasized determination of ecological requirements as well as restoration and maintenance of habitat. Primary management strategies involve controlling water, fire, and exotics to maintain historic conditions. Acquisition and management of private land in Big Cypress area has been recommended (Werner 1979, MacKenzie 1977).

Specific management recommendations provided by Werner (1975) are: (1) eliminate exotic plants and animals from areas occupied by Cape Sable sparrows; (2) employ controlled periodic burns to retard hardwood invasion of suitable marshes; (3) restrict burning to August and Sep-

tember, to approximate timing of natural lightning strikes that follow the breeding season; (4) start burns with a single ignition spot to prevent entrapment of birds in junction zones; (5) to promote optimum population size, burn 15% to 20% of the habitat each year, using small, evenly distributed fires in the oldest roughs; and (6) the habitat of small colonies should not be burned, but the burning of limited adjacent areas could prove beneficial by expanding the habitat.

Critical Habitat has been designated to include 'areas of land, water, and airspace in the Taylor Slough vicinity of Collier, Dade, and Monroe Counties' (42 FR 49685, 11 August 1977; 42 FR 47840, 22 September 1977). Rulemaking includes areas both within and outside Everglades National Park.

No recovery team has been appointed.

AUTHORITIES

Sonny Bass
Research Biologist
Everglades National Park
P.O. Box 279
Homestead, FL 33030

J. A. Kushlan
Research Biologist
Everglades National Park
P.O. Box 279
Homestead, FL 33030

J. C. Ogden
Research Department
National Audubon Society
115 Indian Mount Trail
Tavernier, FL 33070

W. B. Robertson, Jr.
Research Biologist
Everglades National Park
P.O. Box 279
Homestead, FL 33030

L. A. Stimson
4339 S.W. 9th Terrace
Miami, FL 33134

H. W. Werner
Research Management Specialist
Carlsbad Caverns and Guadalupe Mountains
National Parks
3225 National Park Highway
Carlsbad, NM 88220

PREPARER'S COMMENTS

Previously known as *Ammospiza mirabilis* (Howell 1932).

PREPARER'S COMMENTS

Previously known as *Ammospiza mirabilis* (Howell 1932; Stimson 1954, 1968; American Ornithologist's Union 1957), the Cape Sable sparrow was considered the last avian species identified in continental United States (Stimson 1968; Werner 1975, 1976). It has recently been designated a subspecies of *A. maritima* (Eisenmann 1973). Morphologically and behaviorally similar to other subspecies of seaside sparrows (Griscom 1944, Stimson 1968), it is unique in its geographical isolation and confinement to interior marshes (Werner 1975, 1976, 1979).

LITERATURE CITED/SELECTED REFERENCES

- American Ornithologist's Union. 1957. Check-list of North American Birds, 5th ed. Port City Press, Baltimore.
- Anderson, W. 1942. Rediscovery of the Cape Sable seaside sparrow in Collier County. Fla. Nat. 16:12.
- Beecher, W. J. 1955. Late-Pleistocene isolation of salt-marsh sparrows. Ecology 36:23-28.
- Dietrich, A. L. 1938. Observations of birds seen in South Florida. Fla. Nat. 11:101.
- Eisenmann, E. (Chairman). 1973. Thirty-second supplement to the American Ornithologist's Union check-list of North American birds. Auk 40:411-419.
- Griscom, L. 1944. A second revision of the seaside sparrows. La State Univ. Mus; Zool. Occas. Paper 19:313-328.
- Holt, E. G., and G. M. Sutton. 1926. Notes on birds observed in southern Florida. Ann. Carnegie Mus. 16:409-439.
- Howell, A. H. 1919. Description of a new seaside sparrow from Florida. Auk 36:86-87.
- . 1932. Florida bird life. Coward-McCann, Inc., New York. 579 pp.
- MacKenzie, J. P. S. 1977. Birds in peril. Houghton Mifflin Co., Boston. 191 pp.
- Nicholson, D. J. 1928. Nesting habits of seaside sparrows in Florida. Wilson Bull. 40:225-237.

- . 1938. An historical trip to Cape Sable. Fla. Nat. 11:41-44.
- Ogden, J. C. 1972. Florida region. Am. Birds 26: 852.
- Peterson, R. T. 1947. A field guide to the birds. Houghton Mifflin Co., Boston. 230 pp.
- Robertson, W. B., Jr., and J. A. Kushlan. 1974. The southern Florida avifauna. Pages 414-452 in P. J. Gleason, ed. Environments of South Florida: present and past. Miami Geological Society, Memoir 2.
- Sample, J. B. 1936. The Cape Sable sparrow and hurricanes. Auk 53:341.
- Sprunt, A., Jr. 1954. Florida bird life. Coward-McCann, Inc., New York. 527 pp.
- Stimson, L. A. 1944. Rediscovery of the Cape Sable sparrow confirmed. Fla. Nat. 17:31-32.
- . 1948. Cape Sable sparrow still in Collier County. Fla. Nat. 21:68-69.
- . 1953. Cape Sable seaside sparrow. Fla. Nat. 26:57.
- . 1954. Cape Sable seaside sparrow: *Ammodramops mirabilis* (Howell). Pages 479-481 in A. Sprunt, Jr. Florida bird life. Coward-McCann, Inc., New York. 527 pp.
- . 1956. The Cape Sable seaside sparrow: its former and present distribution. Auk 73: 489-502.
- . 1961. Cape Sable sparrows: fire and range extension. Fla. Nat. 34:139-140.
- . 1968. Cape Sable sparrow. Pages 859-868 in O. L. Austin, Jr. Life histories of North American cardinals, grosbeaks, buntings, towhees, finches, sparrows, and allies. U.S. Natl. Mus. Bull. 237.
- U.S. Department of the Interior. 1973. Threatened wildlife of the United States. Compiled by Office of Endangered Species and International Activities. Bur. Sport Fish. Wildl. Resour. Publ. 114. U.S. Gov. Printing Office, Washington, D.C. 289 pp.
- Werner, H. W. 1971. Cape Sable sparrows rediscovered on Cape Sable. Auk 88:432.
- . 1975. The biology of the Cape Sable sparrow. U.S. Gov. Rep., Everglades Natl. Park. 215 pp.
- . 1976. Distribution, habitat, and origin of the Cape Sable seaside sparrow. M.S. Thesis Univ. of Fla., Tampa. 53 pp.
- . 1979. Cape Sable seaside sparrow. Pages 19-20 in H. W. Kale, ed. Rare and endangered biota of Florida, Vol. 2, Birds. Univ. Presses of Florida, Gainesville.

ACCOUNT PREPARED/UPDATED BY:
 National Fish and Wildlife Laboratory
 412 N.E. 16th Avenue, Room 250
 Gainesville, FL 32601

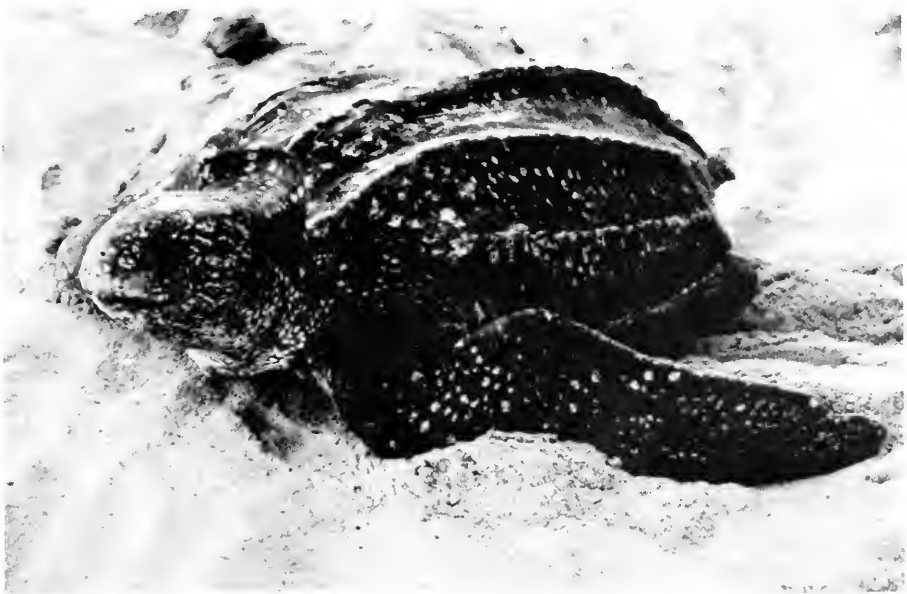
Biological Services Program

FWS/OBS-80/01.12

March 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States-

LEATHERBACK SEA TURTLE



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

FWS/OBS-80/01.12
March 1980

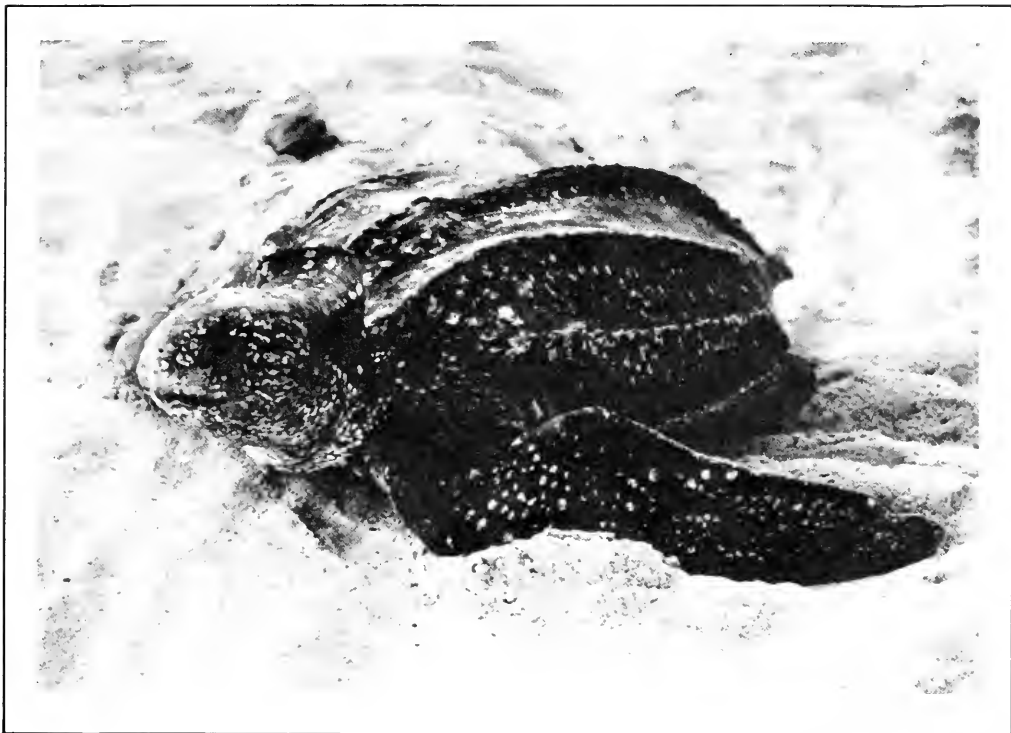
SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—

LEATHERBACK SEA TURTLE

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: P. C. H. PRITCHARD

LEATHERBACK SEA TURTLE

Dermochelys coriacea Linnaeus

KINGDOM Animalia
CLASS Reptilia
ORDER Testudinata
FAMILY Dermochelyidae
OTHER COMMON NAMES leathery turtle

DATES

Entered into SWIS. to be determined
 Updates: . . 22 September 1976, 20 January 1977.

LEGAL STATUS

Federal: Endangered (35 FR 8495;2 June 1970).
States: Endangered: Georgia, Maryland,
 Mississippi, New York, North Carolina,
 South Carolina, Texas.
 Protected: Alabama

REASONS FOR CURRENT STATUS

General population reduction and overuse by humans are the primary factors determining the status of leatherback turtles. Exposure and vulnerability while nesting make overharvesting by man possible.

Sea turtles require relatively undisturbed beaches for nesting. Increasing development and human activity on beaches is incompatible with successful turtle reproduction. Illumination of beaches at night can distract hatchlings away from the sea (McFarlane 1963).

Harvesting eggs has put tremendous pressure on this species. Occasionally adults are slaughtered on nesting beaches. Meat is used as fish bait and as human food (IUCN 1968, Pritchard 1979a, Rebel 1974).

Predation is extensive – particularly on hatchlings. Pritchard (1971) identified several species of crabs, fishes, reptiles, and mammals that prey on hatchlings. Predation on adults is generally

limited to sharks and killer whales (*Orcinus orca*) Caldwell and Caldwell 1969).

Incidental catches by commercial shrimping and fishing boats result in entanglement and subsequent drowning in the trawler nets.

Littering of the seas is believed to have some impact on sea turtle populations. Plastic bags have the appearance of jellyfish, but cause death when eaten by turtles (Rebel 1974).

PRIORITY INDEX

Not assigned.

DESCRIPTION

The largest of all turtles, it is easily distinguished by its leathery skin. The neck and limbs are thick and feebly retractible. Average carapace length is 155 cm. Adults generally weigh from 290 to 590 kg. The carapace is triangular, and is covered with a layer of rubbery skin rather than horny shields. Carapace has seven longitudinal ridges. Head and neck are black or dark brown with a few white or yellow blotches. Each side of the gray upper jaw has a tooth-like cusp. The lower jaw is hooked anteriorly. Paddle-like clawless limbs are black with white margins, and may have white spots.

Hatchlings are dark brown or black with white or yellow carapacial keels and flipper margins. Skin is covered with small scales that become thinner with each molt — starting about 3 weeks after hatching.

Black-and-white photographs are in Carr (1952, 1967), Bustard (1973), Rebel (1974), Riedman and Witham (1974), and LeBuff (1976). Deraniyagala (1939) presents a complete pictorial and descriptive anatomical discussion.

RANGE

The leatherback is widely distributed in the oceans of the world. From tropical Atlantic, Pacific, and Indian Oceans, they are found as far north as British Columbia, Newfoundland, and the British Isles. They are found as far south as Australia, Cape of Good Hope, and Argentina. Other bodies of water, such as the Mediterranean Sea are also inhabited.

In spite of what appears to be a large range, it represents a reduction as compared to the range in earlier times (IUCN 1968).

Major nesting beaches are in Malaya, Surinam, French Guiana, Mexico, Costa Rica, South Africa, Dominican Republic, and U.S. Virgin Islands.

Annual United States nesting is restricted to Florida, although one nesting incident in 1966 in North Carolina was reported by Schwartz (Personal communication). Atlantic Coast nests have been recorded from Flagler Beach to Miami, with the majority of records from Palm Beach and Martin Counties. There appears to be a small population that nests regularly on Hutchinson Island, Martin County. On the Gulf Coast, nesting is common in March and April (A. F. Carr personal communication).

Two reported nesting occurrences in Florida have been on publicly owned beaches: Sebastian State Park, Brevard County, and St. Vincent National Wildlife Refuge, Franklin County. Other recorded nesting beaches are in private ownership. They are protected by the Florida Department of Natural Resources which, according to Witham (Personal communication), protects all nesting sea turtles.

RANGE MAP

Distribution off the continental United States is illustrated by shading adjacent coastlines. Recorded nesting localities are depicted by dots.

STATES/COUNTIES

Alabama: Baldwin, Mobile.

California: Del Norte, Humboldt, Los Angeles, Marin, Mendocino, Monterey, Orange, San Diego, San Francisco, San Luis Abispo, San Mateo, Santa Barbara, Santa Cruz, Sonoma, Ventura.

Delaware: Kent, Sussex.

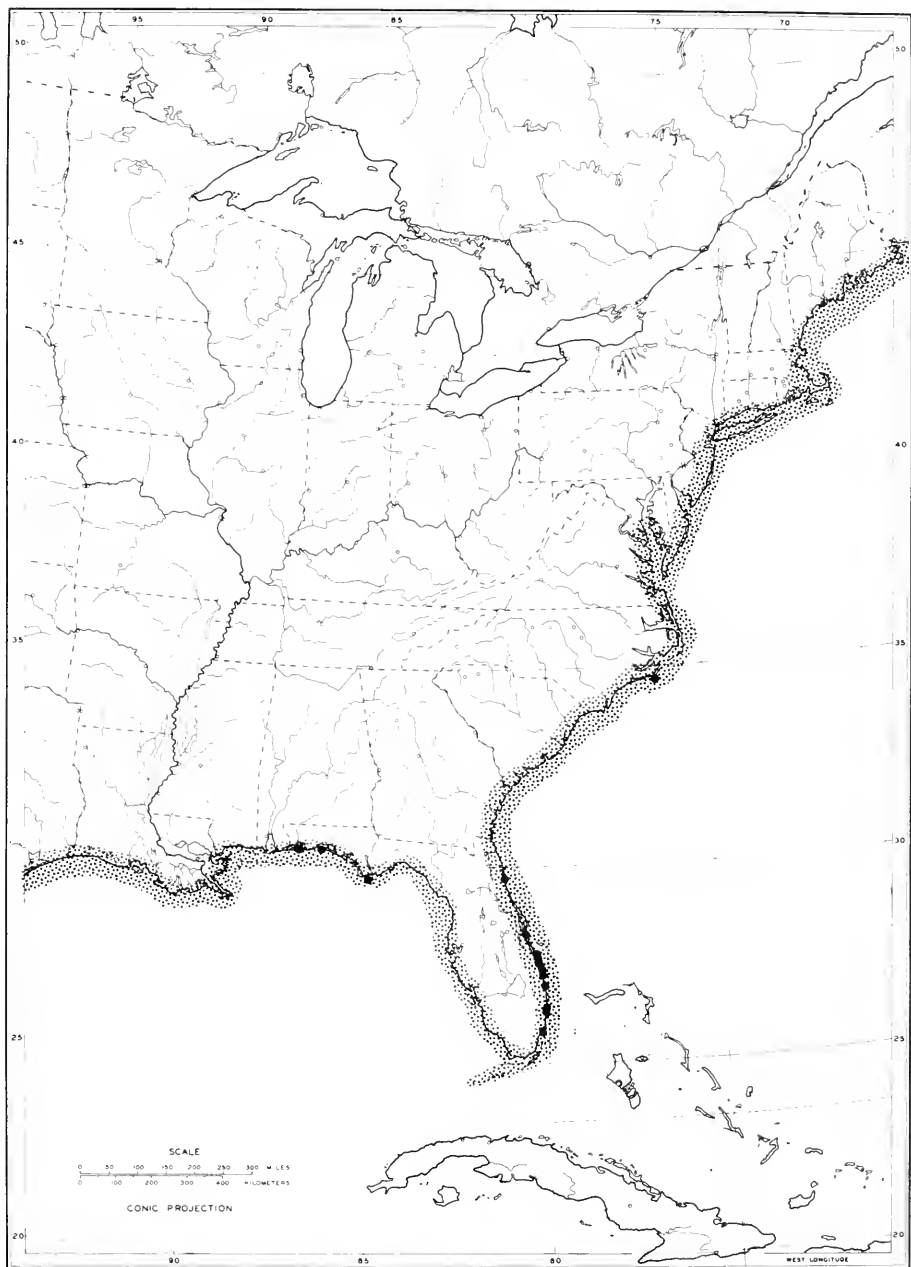
Florida: Bay, Brevard Broward, Charlotte, Citrus, Collier, Dade, Dixie, Duval, Flagler, Franklin, Gulf, Hernando, Hillsborough, Indian River, Jefferson, Lee, Levy, Manatee, Martin, Monroe, Nassau, Okaloosa, Palm Beach, Pasco, Pinellas, St. Johns, St. Lucie, Santa Rosa, Sarasota, Volusia, Wakulla, Walton.

Georgia: Bryan, Camdon, Chatham, Glynn, Liberty, McIntosh.

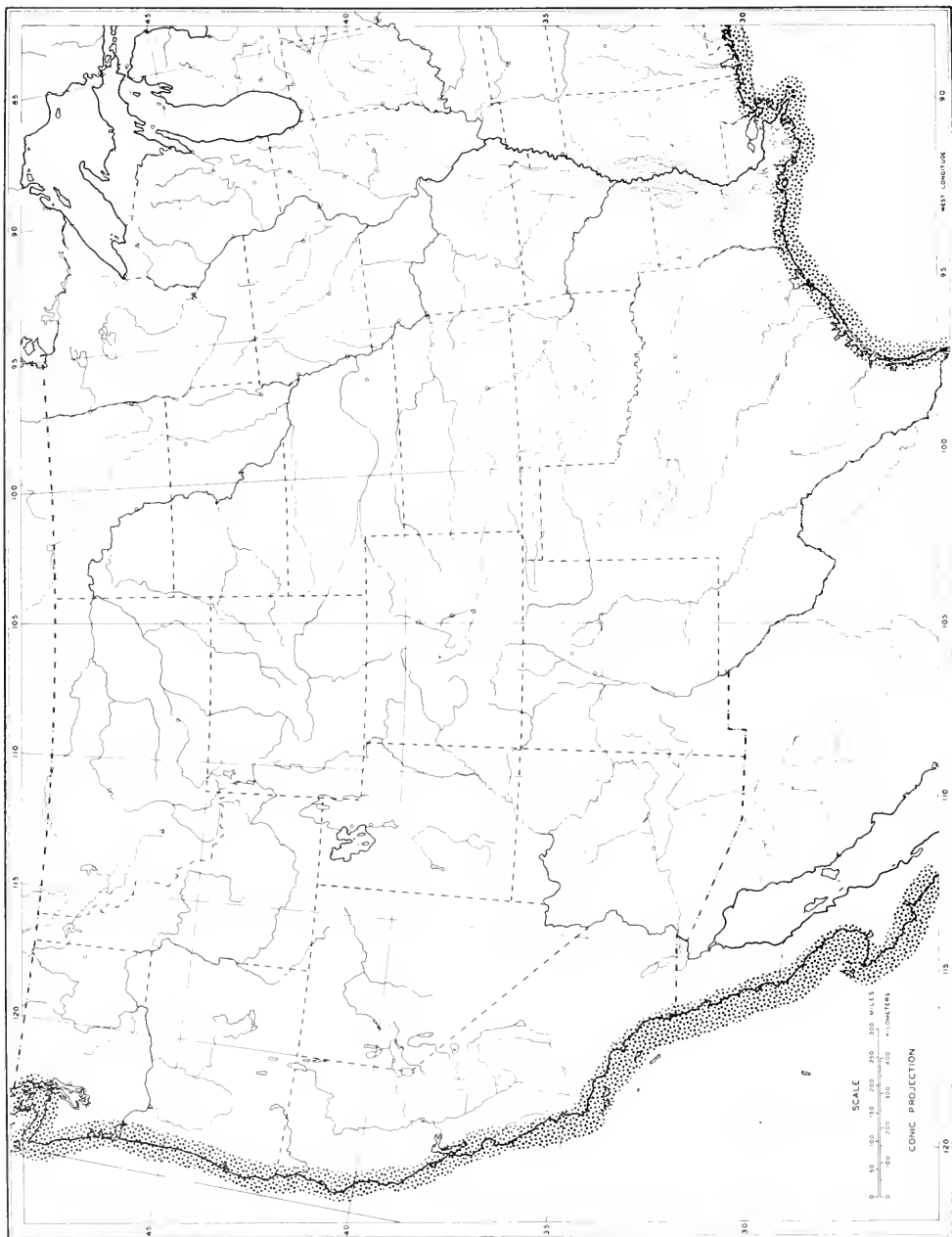
Louisiana: Cameron, Iberia, Jefferson, Lafourche, (Parishes) Plaquemines, St. Bernard, St. Mary, Terrebonne, Vermilion.

Maine: Cumberland, Hancock, Knox, Lincoln, Sagadahoc, Waldo, Washington, York.

Maryland: Calvert, Dorchester, Somerset, St. Marys, Talbot, Worcester.



Eastern distribution of leatherback sea turtle offshore (shading) and nesting beaches (dots)



Western distribution of leatherback sea turtles offshore (shading)

Massachusetts: Barnstable, Dukes, Essex, Middlesex, Nantucket, Norfolk, Plymouth.

Mississippi: Hancock, Harrison, Jackson.

New

Hampshire: Rockingham.

New Jersey: Atlantic, Cape May, Cumberland, Monmouth, Ocean.

New York: Nassau, Suffolk.

North

Carolina: Brunswick, Carteret, Currituck, Dare, Hyde, New Hanover, Onslow, Pender.

Oregon: Clatsop, Coos, Curry, Douglas, Lane, Lincoln, Tillamook.

Rhode

Island: Newport, Washington.

South

Carolina: Beaufort, Charleston, Colleton, Georgetown, Horry.

Texas: Aransas, Brazoria, Calhoun, Cameron, Chambers, Galveston, Jefferson, Kenedy, Kleberg, Matagorda, Nueces, Willacy.

Virginia: Accomack, Gloucester, Lancaster, Mathews, Middlesex, Northampton, Northumberland, Virginia Beach, York.

Washington: Clallam, Grays Harbor, Jefferson, Pacific.

HABITAT

Leatherbacks are the most pelagic of the sea turtles, and are often found near the edge of the continental shelf. In Northern waters, they sometimes enter shallow estuarine bays (Deranigayala 1939, Pope 1939).

FOOD AND FORAGING BEHAVIOR

Although apparently omnivorous, consuming sea urchins, squid, crustaceans, tunicates, fish, blue-green algae, and floating seaweed, its principal food is jellyfish. Deeply notched, sharp edged jaws appear adapted for holding and cutting soft-bodied prey. The mouth has fleshy papillae, and the throat has a valve which probably assist in swallowing and retaining soft-bodied prey (Pritchard 1971).

SHELTER REQUIREMENTS

Not known.

NESTING OR BEDDING

Leatherbacks require a sloping sandy beach backed up by vegetation for nesting. There must be sufficient slope so that the crawl to dry sand is not too far. The depth of the coarse dry sand is important because the female first excavates a pit for her body and then must reach moist sand so that she can make the proper flask-shaped nest (Pritchard 1969a, Witham 1976). Preferred beaches are mainland or island areas near deep water and rough seas (Rebel 1974).

Site specificity such as that displayed by the green turtle (*Chelonia mydas*) is not apparent for the leatherback. Lund (1974) suggests re-nesting is generally greater than 7 miles from the initial nest.

RITUAL REQUIREMENTS

Not known.

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

Not known.

POPULATION NUMBERS AND TRENDS

Estimates are based on counts of nesting females: Trengganu (Malaya), 4,000; French Guiana, 15,000; Costa Rica, 1,000; Trinidad, Surinam, Tongaland, and Ceylon, 200 to 400; and Jalisco (Mexico) to northern Peru, 5,000. Pritchard (1969b) estimates the world female breeding population to be from 29,000 to 40,000.

Lund (1974) estimates that about 25 leatherback nest in Florida each year; The number of females involved is uncertain.

REPRODUCTION

The nesting season varies per locality; Surinam and Guyana, May to July; Costa Rica, April to July; Silebache (includes French Guiana) May to August; Trinidad, March to August; and the Danish West Indies, March to May (Rebel 1974). Florida nesting season is from April to August.

Females nest at night at intervals of 2 to 3 years. As many as six clutches may be laid a season with an average inter-nesting period of 10 days (Pritchard 1969a; Lund 1976) Clutches average 80 to 85 eggs with the last layer of eggs generally abnormal. The white spherical eggs are approximately 50 to 54 mm in diameter (Pope 1939; Lund 1976). Incubation takes from 55 to 74 days and emergence of the hatchlings occurs at night.

Animals mature in 6 to 10 years. Mating takes

place in shallow water offshore of the laying beach. Occasionally males will crawl up the beach in an attempt to mate with nesting females (Le-Buff 1976). Photographs of courtship and mating are in Bustard (1973).

MANAGEMENT AND CONSERVATION

The Malayan Nature Society transplanted eggs into enclosures to increase numbers of hatchlings. This project is now under the control of Malayan Fisheries Department (IUCN 1968).

Marquez M. (1976) recommended formation of seven natural reserves for the coast of Mexico. These are the major Mexican sea turtle nesting sites and include Playa de la Escolbilla, Oaxaca State, a leatherback nesting beach.

Other protective measures should include efforts to curtail the loss of leatherbacks in fishing or shrimping trawls, protection of nesting beaches from turtles, and a limitation of development on nesting beaches (Pritchard 1971).

Legal protection to varying degrees exists in Mexico, Costa Rica, Surinam, French Guiana, Ascension Island, Trust Territory of the Pacific, Tahiti, Fiji Islands, Kingdom of Tonga, Australia, Sarawak, British Indian Ocean, Seychelle's Islands, South Africa and the United States (Pritchard 1969b; U.S. Department of Commerce 1976).

The leatherback is listed in Appendix 1 of 1976 Convention on International Trade in Endangered Species of Wild Fauna and Flora. Commercial trade in this species is subject to strict regulation, and both an export and import permit are necessary for trade by participating countries.

Critical Habitat has been determined to include a major nesting area on Sandy Point Beach at the western edge of St. Croix, U.S. Virgin Islands (43 FR 43688-43689; 26 September 1978), as well as adjacent waters (44 FR 17710-17712; 23 March 1979).

AUTHORITIES

Archie Carr
Department of Zoology
University of Florida
Gainesville, FL 32611
George Hughes
Oceanographic Research Institute
P.O. Box 736
Durban, Natal
South Africa

Frank Lund
P.O. Box 541
Jupiter Island, FL 33458
Nicholas Mrosovsky
Department of Zoology
University of Toronto
Ontario, Canada M5S1A1

Peter Pritchard
Florida Audubon Society
P.O. Drawer 7
Maitland, FL 32751

J. P. Schults
Surinam Forest Service
P.O. Box 436
Paramaribo, Surinam

PREPARER'S COMMENTS

Nesting records for the United States are not complete because the entire coast has not been surveyed.

LITERATURE CITED/SELECTED REFERENCES

- Brongersma, L. D. 1970. Miscellaneous notes on turtles. Ill. Koninkl. Nederl. Akademië Wetenschappen-Amsterdam. Proc. Serv. C. 73(4): 323-335.
- Bustard, R. 1973. Sea turtles, natural history, and conservation. Taplinger Publ., New York. 220 pp.
- Caldwell, D. K. 1959. On the status of the Atlantic leatherback turtle, *Dermochelys coriacea coriacea*, as a visitant to Florida nesting beaches, with natural history notes. Quart. J. Florida Acad. Sci. 21(3):285-291.
- Caldwell, D. K., and M. C. Caldwell. 1969. Addition of the leatherback sea turtle to the known prey of the killer whale, *Orcinus orca*. J. Mammal. 50(3):636.
- Caldwell, D. K., and W. F. Rathjen. 1969. Unrecorded West Indian nesting sites for the leatherback and hawksbill sea turtles, *Dermochelys coriacea* and *Ertmochelys i. imbricata*. Copeia 1969(3):622-623.
- Carr, A. F. 1952. Handbook of turtles. Turtles of the United States, Canada, and Baja California. Comstock Publ. Assoc., Cornell Univ. Press, Ithaca, N.Y. 542 pp.
- . 1967. So excellent a fishe. The Natural

- History Press, Garden City, N.Y. 248 pp.
- Carr, A. F., and A. R. Main. 1973. Report on an inquiry into ecological implications of a turtle farming project. *In* Turtle farming project in northern Australia. Union Offset Co., PTY, Limited, Canberra, Australia. 80 pp.
- Carr, A. F., and L. H. Ogren. 1959. The ecology and migrations of sea turtles, 3. *Dermochelys* in Costa Rica. Ame. Mus. November 1958. 29 pp.
- Deraniyagala, P. E. P. 1939. Tetrapod reptiles of Ceylon. Vol. 1. Columbo Mus. Publ. Ceylon. 412 pp.
- Ernst, C. H. and R. W. Barbour. 1972. Turtles of the United States. Univ. Kentucky Press, Lexington. 347 pp.
- Frair, W., R. G. Ackman, and N. Mrosovsky. 1972. Body temperature of *Dermochelys coriacea*: Warm turtle from cold water. Science 177:791-0793.
- IUCN. 1968. Red data book. Vol. 3. Amphibia and reptilia. Compiled by R. E. Honegger. IUCN, Morges, Switzerland.
- LeBuff, C. R., Jr. 1976. Tourist turtle. Florida Wildl. 30(2):16-17.
- Lund, F. 1974. A survey of marine turtle nesting in the United States. Unpubl. 39 pp.
- . 1979. Atlantic leatherback. Pages 54-55 *in* R. W. McDiarmid ed. Rare and endangered biota of Florida, Vol. 3, Amphibians and reptiles. Univ. Presses of Florida, Gainesville.
- Marquez M., R. 1976. Reservas naturales para la conservacion de las tortugas marinas en Mexico. INP/SI 83:1-22.
- McFarlane, R. W. 1963. Disorientation of loggerhead hatchlings by artificial road lighting. Copeia 1963(1):153.
- Montoya, A. E. 1969. Programas de investigacion y conservacion de las tortugas marinas en Mexico. Pages 34-53 *in* Marine turtles. IUCN New Publ. Ser. Suppl. Paper 20.
- Neill, W. H., E. R. Stevens, E. G. Carey, K. D. Lawson, N. Mrosovsky, and W. Frair. 1974. Thermal inertia versus thermoregulation in 'warm' turtles and tunas. Science 184:1008-1010.
- Pope, C. H. 1939. Turtles of the United States and Canada. Alfred A. Knopf, Inc., New York. 343 pp.
- Pritchard, P. C. H. 1969a. Sea turtles of the Guianas, Bull. Fla. St. Mus. 13(2):120-132.
- . 1969b. Summary of world sea turtle survival situation. IUCN Bull. 2(11):90-91.
- . 1971. The leatherback or leathery turtle *Dermochelys coriacea*. IUCN Monogr. 1. Morges, Switzerland. 39 pp.
- Rebel, T. P. 1974. Sea turtles and the turtle industry of the West Indies, Florida, and the Gulf of Mexico. Rev. Ed. Univ. of Miami Press, Coral Gables. 250 pp.
- Riedman, S. R., and R. Witham. 1974. Turtles extinction or survival? Abelard-Schuman, New York. 156 pp.
- Survival Service Commission. 1969. Marine turtles. Proc. working meeting of marine turtle specialists organized by IUCN at Morges, Switzerland.
- Tweedie, M. W. F. 1953. The breeding of the leathery turtle. Proc. Zool. Soc. London 123 (2):273-275.
- U.S. Department of Commerce. 1976. Proposed listing of the green sea turtle (*Chelonia mydas*), loggerhead (*Caretta caretta*), and pacific ridley sea turtle (*Lepidochelys olivacea*) as threatened species under the Endangered Species Act of 1973. Draft EIS. Natl. Oceanic Atm. Admin., Natl. Marine Fish. Serv. Washington, D.C.
- Witham, R. 1976. *Dermochelys coriacea*. *In* H. O. Hillestad, D. B. Means, and W. W. Baker, eds. Endangered and threatened vertebrates of the southeastern United States. Tall Timbers Res. Stn. Misc. Publ. 4.
- Worth, R. F., and J. B. Smith. 1976. Marine turtle nesting on Hutchinson Island, Florida in 1973. Florida Dep. Nat. Resour. Marine Res. Lab. Florida Mar. Res. Publ. 18.
- Yerger, R. W. 1965. The leatherback turtle on the Gulf coast of Florida. Copeia 1963 (3):365-366.
- Zim, H. S., and H. M. Smith. 1953. Reptiles and amphibians. A Guide to familiar America species. Simon and Schuster, New York. 147 pp.

ACCOUNT PREPARED/UPDATED BY:
 National Fish and Wildlife Laboratory
 412 N.E. 16th Avenue, Room 250
 Gainesville, FL 32601

Biological Services Program

FWS/OBS-80/01.13

March 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States-

GREEN SEA TURTLE



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

FWS/OBS-80/01.13
March 1980

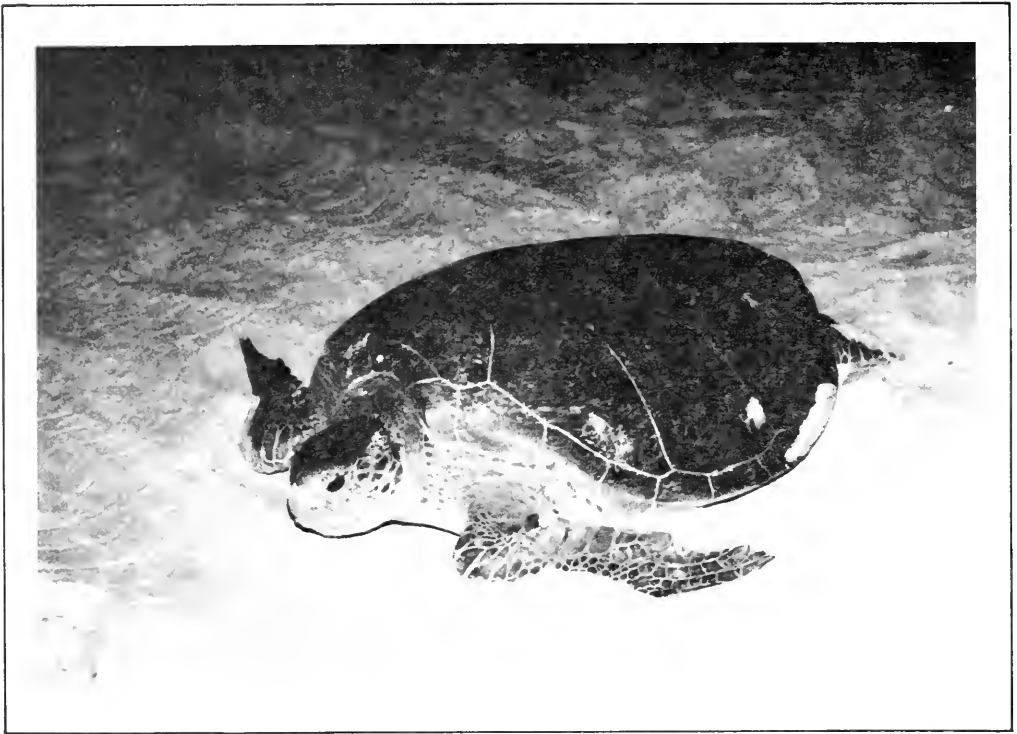
SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—

GREEN SEA TURTLE

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



Credit: D. James

GREEN SEA TURTLE
Chelonia mydas Linnaeus

KINGDOM Animalia
CLASS Reptilia
ORDER Testudinata
FAMILY Cheloniidae
OTHER COMMON

NAMES Edible turtle, tortuga verde.

DATE

Entered into SWIS. to be determined.
 Updates. . . 22 September 1976, 8 February 1977.

LEGAL STATUS

Federal Endangered: waters of Florida and Pacific Coast of Mexico (43 FR 32800-32811, 28 July 1978).

Threatened: elsewhere throughout its range (43 FR 32800-32811, 28 July 1978).

States: Endangered: Florida, Maryland, Mississippi, New Jersey, Texas.
 Protected: Alabama, Georgia, North Carolina, South Carolina.

REASONS FOR CURRENT STATUS

The green turtle's vulnerability while nesting has led to its overexploitation for food by local populations seeking a readily available source of protein food. Recent technological advances such as freezing and canning have increased its use for food, and an increase in demand for turtle products (leather, cosmetics, and pharmaceuticals) has placed considerable stress on the species. Nesting populations in Bermuda, Florida, the Greater Antilles, and Jamaica have been extirpated or nearly so (U.S. Department of Commerce 1976).

In many areas, excessive predation on eggs and hatchlings has substantially reduced recruitment, causing populations to decrease.

Relatively undisturbed beaches are necessary for nesting. Increasing development and use of beaches is incompatible with sea turtle reproduction. Illumination of beaches at night, for example, can distract hatchlings away from the sea (McFarlane 1963).

Sea turtles are caught incidentally to commercial fishing and shrimping activities. Some turtles are eaten by fishermen, some are sold in local markets, and some are mutilated or drowned as a result of entanglement in trawls (U.S. Department of Commerce 1976).

PRIORITY INDEX

Not assigned.

DESCRIPTION

The green turtle is a large sea turtle with a broad, heart-shaped shell and small head. Flippers are paddle shaped, each with a single claw. Adults are 91 to 122 cm long and weigh 100 to 200 kg.

The color varies widely. In general, hatchlings have black carapaces, white plastrons, and white margins on the shell and limbs. Adults have a smooth, keelless carapace, colored light to dark brown, with brown mottling. The plastron is whitish to light yellow; the upper surface of the head is light brown with yellow markings; sides of the head are brown with broad yellow margins; the neck is dusky above and yellow near the shell below. The tail and flippers are colored like the carapace and plastron.

The carapace can be identified by four costal plates, none of which borders the nuchal shield, and by the absence of jagged marginals. Large scutes on the carapace do not overlap. There is only one pair of prefrontals between the eyes.

This species is illustrated in Carr (1967), Parsons (1962), Ernst and Barbour (1972), Rebel (1974), and Riedman and Witham (1974).

RANGE

The green turtle is distributed world-wide in waters above 20°C in the coldest month. Juveniles are sometimes found over a wider temperature range and thus a greater area. Green turtles live in waters off the North American coast from Massachusetts to Mexico and from British Columbia to Baja California (U.S. Department of Commerce 1976). They are uncommon off California.

Major nesting grounds in the Western Hemisphere include the Michoacan Coast, Mexico; Tortuguero, Costa Rica; Shell Beach, Guyana; Bigi

Santi, Surinam; and Aves Island. See Hirth (1971) for nesting sites in the Eastern Hemisphere.

Known annual nesting in the continental U.S. is limited to small nesting populations of the east coast of Florida, from Brevard County to Broward County. Jupiter and Hutchinson Islands have the greatest number of nests. For detailed information on nesting at Hutchinson Island, see Gallager et al. (1972) and Worth and Smith (1976).

Their former distribution included nesting beaches on the Dry Tortugas, Cayman Islands, several other previously undisturbed islands, and more extensively in Florida (IUCN 1968).

A small population of Pacific green turtles (*Chelonia mydas agassizii*) bask and nest on some of the islands in the Hawaiian Islands National Wildlife Refuge. These islands are Federally owned and protected, although until recently, according to Balazs (1976), turtles had been harvested.

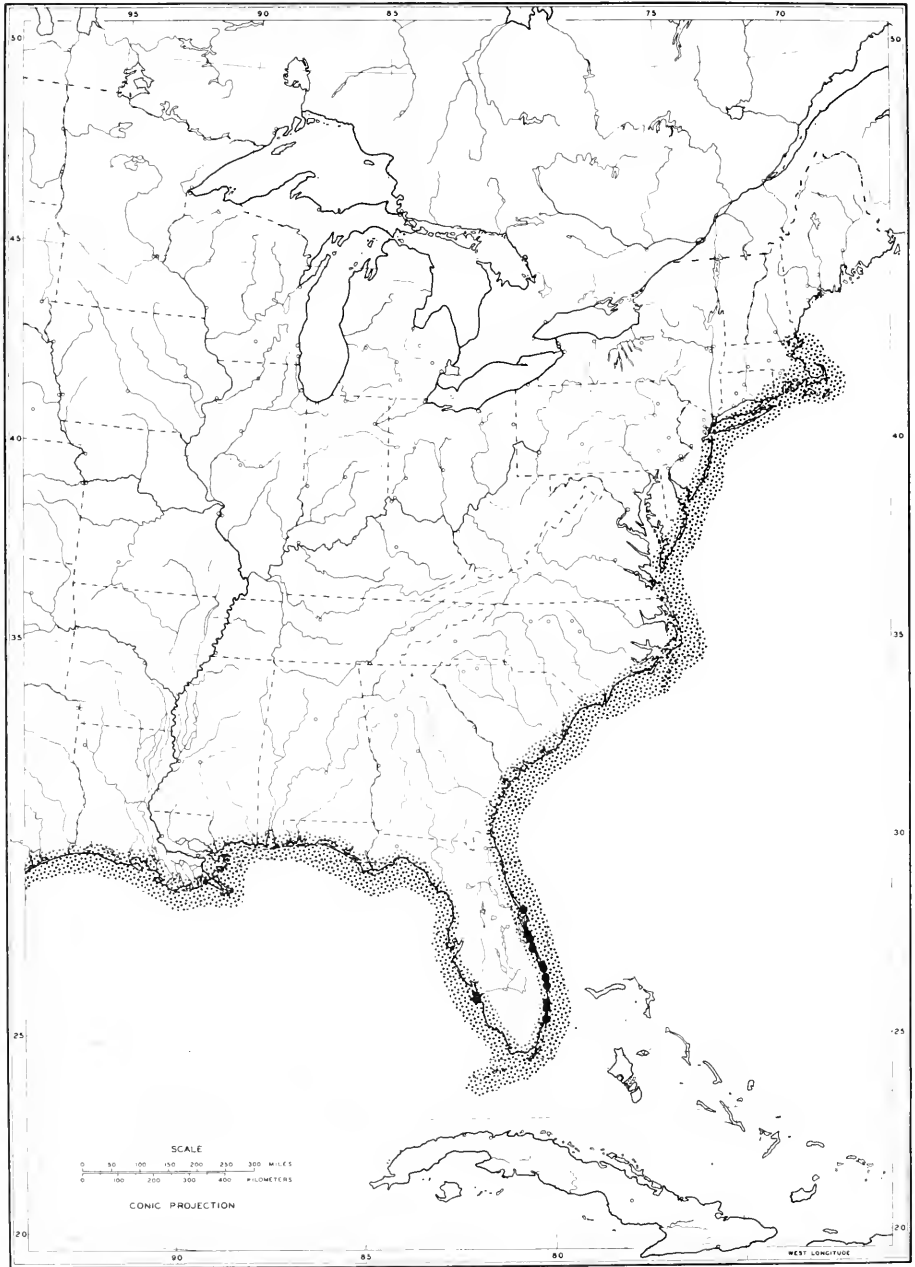
In Florida, green turtles have nested on publicly owned lands in Merritt Island and Hobe Sound National Wildlife Refuges, and St. Lucie and Sebastian State Parks. Other nesting beaches are privately owned and the Florida Department of Natural Resources, according to R. Witham (personal communication), protects all nesting on these beaches.

RANGE MAP

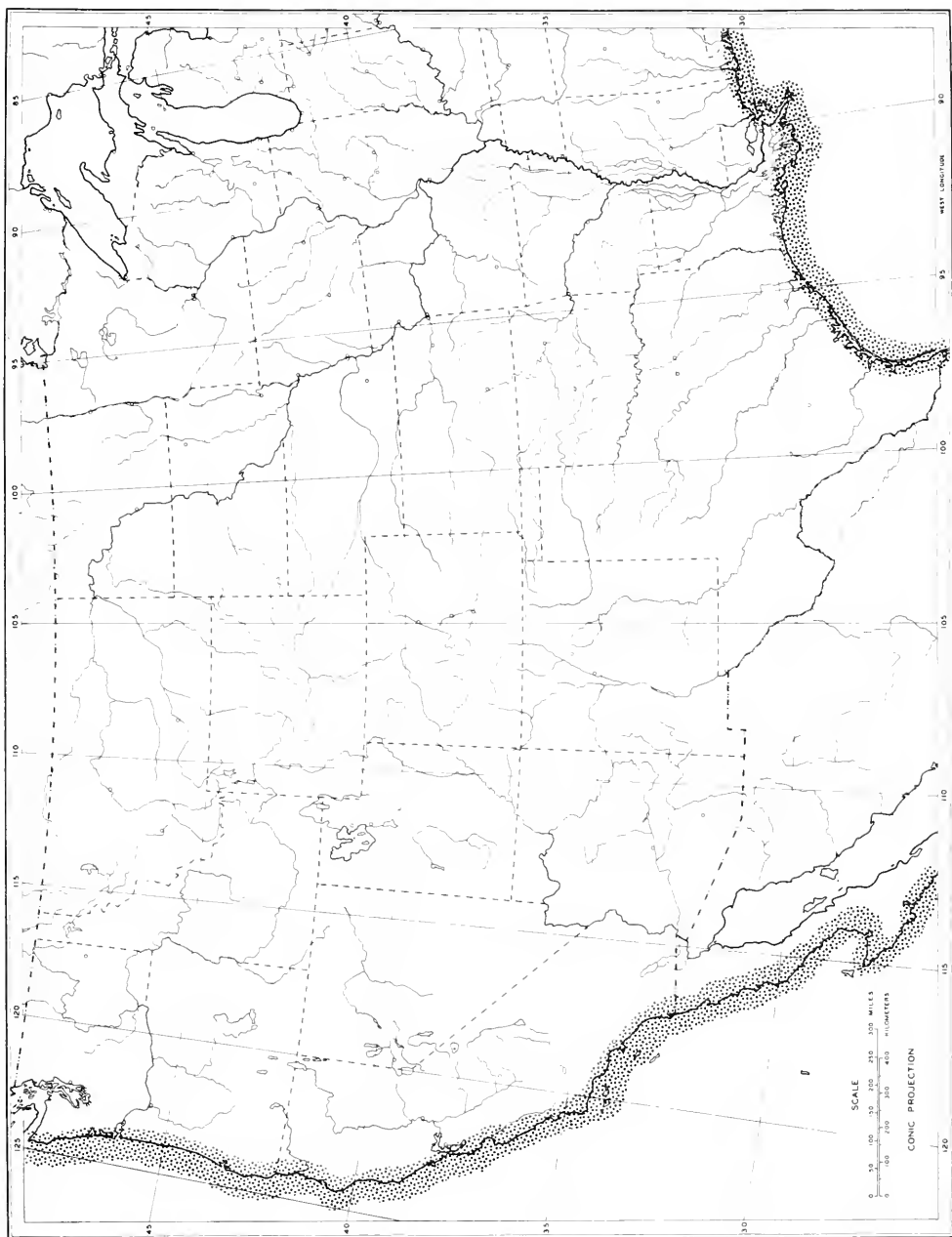
Distribution offshore continental U.S. is illustrated on the following maps by shading of the adjacent coastline; nesting beaches are depicted by dots.

STATES/COUNTIES

Alabama	Baldwin, Mobile.	Mobile.
California	Del Norte, Humboldt, Los Angeles, Marin, Mendocino, Monterey, Orange, San Diego, San Francisco, San Luis Obispo, San Mateo, Santa Barbara, Santa Cruz, Sonoma, Ventura.	
Delaware	Sussex.	
Florida	Bay, Brevard, Broward, Charlotte, Citrus, Collier, Dade, Dixie, Duval, Flagler, Franklin, Gulf, Hernando, Hillsborough, Indian River, Jefferson, Lee, Levy, Manatee, Martin, Monroe, Nassau, Okaloosa, Palm Beach, Pasco, Pinellas, St. Johns, St. Lucie, Santa Rosa, Sarasota, Volusia, Wakulla, Walton.	
Georgia	Bryan, Camden, Chatham, Glynn, Liberty, McIntosh.	



Eastern distribution of green sea turtles offshore (shading) and nesting beaches (dots)



Western distribution of green sea turtles offshore (shading)

Louisiana (parishes)	Cameron, Iberia, Jefferson, Lafourche, Plaquemines, St. Bernard, St. Mary, Terrebonne, Vermilion.
Maryland	Worcester.
Massachusetts	Barnstable, Dukes, Essex, Middlesex, Nantucket, Norfolk, Plymouth.
Mississippi	Hancock, Harrison, Jackson.
New Jersey	Atlantic, Cape May, Monmouth, Ocean.
New York	Nassau, Suffolk.
North Carolina	Brunswick, Carteret, Currituck, Dare, Hyde, New Hanover, Onslow, Pender.
Oregon	Clatsop, Coos, Curry, Douglas, Lane, Lincoln, Tillamook.
Rhode Island	Newport, Washington.
South Carolina	Beaufort, Charleston, Colleton, Georgetown, Horry.
Texas	Aransas, Brazoria, Calhoun, Cameron, Chambers, Galveston, Jefferson, Kenedy, Kleberg, Matagorda, Nueces, Willacy.
Virginia	Accomack, Northampton.
Washington	Clallam, Grays Harbor, Jefferson, Pacific.

HABITAT

The green turtle inhabits comparatively shallow waters inside reefs and in bays and inlets. Favored habitat appears to be lagoons and shoals with an abundance of marine grass and algae. This habitat type occurs in much of the Gulf of Mexico and Caribbean shore waters and around many oceanic islands. Green turtles are long-distance migrants and are occasionally seen in the open sea en route from feeding grounds to nesting beaches or vice versa (Carr 1952, 1967).

FOOD AND FORAGING BEHAVIOR

Adults are largely herbivorous, feeding on marine algae and shallow water pastures of marine grasses (including *Thalassia*, *Zostera*, *Cymodocea*, and *Halophila*) (Carr 1952, Randall 1965). Small mollusks, sponges, crustaceans, and jellyfish are often consumed (Carr 1952, Hirth 1971).

SHELTER REQUIREMENTS

Pacific green turtles bask on reefs or uninhabited islands.

Some green turtles have been known to rest with their shells wedged under rocks or reefs on the bottom of the sea (Carr 1952).

Witham (1976b) states that hatchlings find refuge and food in sargassum (*Sargassum* sp.). Frick (1975) observed hatchlings resting on sargassum clumps.

NESTING OR BEDDING

Successful nesting requires a sloping beach platform with open ocean exposure and minimal disturbance. A variety of textures of sand can be used, but it must be friable and well drained (A. F. Carr personal communication). The presence or absence of vegetation does not appear to be critical; vegetation can be helpful in nesting because roots may prevent the sand from crumbling; on the other hand, it can be detrimental if the roots pierce the eggshells (Caldwell 1959). On beaches without rooted plants, rain or the wetting of the sand by the turtle aids in preventing the sand from crumbling (Bustard 1973, Carr and Main 1973).

Illustrated descriptions of nesting appear in Hendrickson (1958), Carr and Ogren (1960), and Hirth (1977).

RITUAL REQUIREMENTS

Not known.

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

Not known.

POPULATION NUMBERS AND TRENDS

Estimates of the breeding female population for the Western Hemisphere nesting areas are:

Sarawak Turtle Islands	10,000
Surinam	2,500
Tortuguero	6,000
Aldabra	fewer than 1,000
Australia	75,000, but includes flatbacks (<i>Chelonia depressa</i>) and loggerheads (<i>Caretta caretta</i>)
Florida	.50 (Hirth 1971, Lund 1974).

Ehrenfeld (1974) estimates the world population of green turtles at between 100,000 and 400,000.

Numbers fluctuate with losses of nesting beaches to storms or development. Thus, it is difficult to predict trends. According to A. F. Carr (personal communication), persons investigating green turtles around the world are concerned with the apparent decline in total numbers.

REPRODUCTION

Breeding season varies with locality:

Michoacan Coast, Mexico May to September
Tortuguero, Costa Rica June to November
Shell Beach, Guyana March to August
Bigi Santi, Surinam February to August
Aves Island March to December
Florida April to July
(Hirth 1971, Rebel 1974).

Nocturnal nesting occurs at 2-, 3-, or 4-year intervals (Carr and Ogren 1960, Hirth 1971). As many as seven clutches are laid in one season, with renesting occurring at 9- to 13-day intervals. Carr and Ogren (1960) plotted returns of turtles at Tortuguero in 1956 through 1959 and observed that renesting was usually within 1.5 km of the previous site.

Clutch size varies from 75 to 200 eggs with incubation taking from 48 to 70 days, depending on beach and water conditions (Carr and Hirth 1962). Hatchlings generally emerge at night within a period of 48 hours (IUCN 1968, Rebel 1974).

Animals are believed to reach maturity in 4 to 6 years in tropical waters and 5 to 13 years in temperate waters. Hirth (1971) estimates survival rates to maturity to be 1% to 3% of the hatchlings. A. F. Carr (personal communication to L. H. Ogren 1975) estimates survivorship in Costa Rica to be about 0.1% of the hatchlings.

Copulation occurs near the nesting beach (Bustard 1973). Whether the female stores sperm for successive laying seasons has not been determined. Photographs of courtship and mating appear in Booth and Peters (1972).

MANAGEMENT AND CONSERVATION

Carr (1969) has made several suggestions for protection of the green turtle: Export of turtle products should be discontinued and catches for local use should be strictly supervised. No turtle boats should be permitted to operate off the northern 20 km of Tortuguero Beach. The sale or storage of calipee in Costa Rica should also be prohibited.

The Survival Service Commission (1969) suggests that setting aside Ascension, Astove, Aves,

Aldabra, Jabal Aziz, Sabah Turtle Islands, and the French Frigate Shoal as turtle islands could help stabilize turtle populations in those areas.

Marquez M. (1976) recommends formation of several natural reserves for the coast of Mexico, which include the major Mexican sea turtle nesting sites. Two reserves, Playa de Rancho Nuevo, Tamaulipas State, and Isla Contoy, Quintana Roo State, are green turtle nesting areas.

Cayman Turtle Farm, Ltd., has made extensive efforts at captive breeding. At present, the farm is dependent on natural stocks of eggs, and according to Hirth (1971), the project cannot be considered a complete success until it is independent of those sources. Some biologists suggest that such a project may never be ecologically or economically efficient. Others are concerned that turtle production could increase demand and thus increase the pressure on natural stocks (Ehrenfeld 1974).

Hatcheries operate in Australia, Malaysia, Mexico, United States, and other countries. These and similar efforts to curtail natural predation could have a beneficial impact on numbers. Stocking has been attempted in many areas, but there have been no indications of definite success.

Green turtles are legally protected to varying degrees in the following places: Mexico, Costa Rica, Panama, Surinam, French Guiana, Ascension Island, Trust Territory of the Pacific, Tahiti, Fiji Islands, Kingdom of Tonga, Australia, Sarawak, British Indian Ocean and Seychelles Islands, Israel, South Africa, Europa Islands, and the U.S. (Pritchard 1969, U.S. Department of Commerce 1976, 43 FR 32800-32811).

Most populations are listed under Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora; commercial trade is subject to strict regulation, and both an export and import permit are necessary for trade by participating countries. Australian populations are listed under Appendix II, which requires export permits for trade in those populations.

AUTHORITIES

George H. Balazs
University of Hawaii at Manoa
Hawaii Institute of Marine Biology
P.O. Box 1346, Coconut Island
Kaneohe, HI 96744

Archie Carr
Department of Zoology
University of Florida
Gainesville, FL 32611

Harold Hirth
Department of Biology
University of Utah
Salt Lake City, UT 84112

George Hughes
Oceanographic Research Institute
P.O. Box 736
Durban, Natal
South Africa

Frank Lund
P.O. Box 541
Jupiter Island, FL 33458

Peter Pritchard
Florida Audubon Society
P.O. Drawer 7
Maitland, FL 32751

J. P. Schulz
Surinam Forest Service
P.O. Box 436
Paramaribo, Surinam

Ross Witham
Florida Department of Natural
Resources
Marine Research Lab
P.O. Box 941
Jensen Beach, FL 33457

PREPARER'S COMMENTS

Nesting records for the U.S. are not complete, as the entire coast has not been surveyed. Recruitment in Florida is probably very low due to predation, particularly by raccoons (*Procyon lotor*).

LITERATURE CITED/SELECTED REFERENCES

- Allen, E. R., and W. T. Neill. 1953. Know your reptiles: the green turtle. *Florida Wildl.* 7(4): 19, 32.
- Banks, E. 1937. The breeding of the edible turtle (*Chelonia mydas*). *Sarawak Mus. J.* 4(15): 523-532.
- Balazs, G. H. 1976. Green turtle migrations in the Hawaiian Archipelago. *Biol. Conserv.* 9:125-140;

- Booth, J., and J. A. Peters. 1972. Behavioural studies on the green turtle (*Chelonia mydas*) in the sea. *Anim. Behav.* 20(4):808-812.
- Bustard, H. R. 1970. The adaptive significance of coloration in hatchling green sea turtles. *Herpetologica* 26:224-227.
- . 1973. Sea turtles, natural history and conservation. Taplinger Publ., New York 220 pp.
- Caldwell, D. K. 1959. The loggerhead turtles of Cape Romain, South Carolina. *Bull. Florida St. Mus.* 4(10):340.
- . 1963. The sea turtle fishery of Baja California, Mexico. *Calif. Fish and Game* 49(3):140-151.
- Caldwell, D. K., and A. F. Carr. 1957. Status of the sea turtle fishery in Florida. *Trans. N. Am. Wildl. Comm.* 22:457-463.
- Carr, A. F. 1952. Handbook of turtles: The turtles of the United States, Canada, and Baja California. Comstock Publ. Assoc., Cornell Univ. Press, Ithaca, New York. 542 pp.
- . 1964. Transoceanic migrations of the green sea turtle. *Bioscience* 14(8):49-52.
- . 1967. So excellent a fishe. *The Natural History Press*, Garden City, N. Y. 248 pp.
- . 1969. Sea turtle resources of the Caribbean and Gulf of Mexico. *IUCN Bull.* 2(10): 74-83.
- . 1970. Green sea turtles in peril. *Natl. Parks Conserv. Mag.* 44(271):19-24.
- . 1972. Great reptiles, great enigmas. *Audubon Mag.* 74(2)24-35.
- . 1975. The Ascension Island green turtle colony. *Copeia* 1975(3):547-555.
- Carr, A. F., and H. Hirth. 1962. The ecology and migrations of sea turtles: 5 comparative features of isolated green turtle colonies. *Am. Mus. Novit.* 2091:1-42.
- Carr, R. F., and R. M. Ingle. 1959. The green turtle (*Chelonia mydas*) in Florida. *Bull. Mar. Sci. Gulf-Carib.* 9(3):315-320.
- Carr, A. F., and A. R. Main. 1973. Report on an inquiry into ecological implications of a turtle farming project. *In* Turtle farming project in northern Australia. Union Offset Co., Pty., Limited, Canberra, Australia. 80 pp.
- Carr, A. F., and L. Ogren. 1960. The ecology and migrations of sea turtle, 4. The green turtle in

- the Caribbean Sea. Bull. Am. Mus. Nat. History 121(1):1-48.
- Cox, G. A., and R. G. Mauermann. 1976. Incidental catch and disposition of sea turtles by the Brownsville-Port Isabel Gulf shrimp fleet. Unpubl.
- Deraniyagala, P. E. P. 1939. Tetrapod reptiles of Ceylon. Vol. 1. Columbo Mus. Publ. Ceylon. 412 pp.
- Ehrenfeld, D. 1974. Conserving the edible sea turtle: Can mariculture help? Am. Sci. 62(1):23-31.
- Ehrhart, L. M. 1976. Final report to the National Aeronautics and Space Administration Kennedy Space Center. A study of a diverse coastal ecosystem of Florida. Office of Graduate Studies and Research, Florida Technological Univ. Orlando. Unpubl.
- Ernst, C. H., and R. W. Barbour. 1972. Turtles of the United States. Univ. Kentucky Press, Lexington. 347 pp.
- Frick, J. 1971. Observations on sea turtles at Aldabra Atoll. Phil. Trans. Roy. Soc. London Ser. Bull. 260:273-410.
- Gallagher, R. M., M. H. Hollinger, R. M. Ingle, and C. R. Futch. 1972. Marine turtle nesting on Hutchinson Island, Florida in 1971. Florida Dep. Nat. Resour. Spec. Sci. Rep. 37. 11 pp.
- Harrison, T. 1956. The edible turtle (*Chelonia mydas*) in Borneo. 4. Growing turtles and growing problems. Sarawak Mus. J. 7(7):233-239.
- Hendrickson, J. R. 1958. The green sea turtle, *Chelonia mydas*, (Linn.) in Malaya and Sarawak. Proc. Zool. Soc., London. 130(4):455-535.
- Hendrickson, J. R., and E. Balasingam. 1966. Nesting beach preferences of Malayan sea turtles. Bull. Natl. Mus., Singapore. 33(10):69-76.
- Hirth, H. F. 1971. Synopsis of biological data on the green turtle, *Chelonia mydas*. F.A.O. Fish. Syn. 85. Firm/585. SAST-Green Turtle-5.31 (07)005.02.
- Ingle, R. M., and W. F. G. Smith. 1949. Sea turtles and the turtle industry of the West Indies, Florida, and the Gulf of Mexico. Univ. Miami. Press, Miami.
- IUCN. 1968. Red data book. Vol. 3. Amphibia and reptilia. Compiled by R. E. Honnegger. IUCN, Morges, Switzerland.
- Lund, F. 1974. A survey of marine turtle nesting in the United States. Unpubl. 39 pp.
- . 1979. Atlantic green turtle. Pages 23-24 in R. W. McDiarmid ed. Rare and endangered biota of Florida, Vol. 3. Amphibians and reptiles. Univ. Presses of Florida, Gainesville.
- Marquez M., R. 1976. Reservas naturales para la conservacion de las tortugas marinas en Mexico. INP/St183:1-22.
- McFarlane, R. W. 1963. Disorientation of loggerhead hatchlings by artificial road lighting. Copeia 1963(1):153.
- Montoya, A. E. 1969. Programas de investigacion y conservacion de las tortugas marinas en Mexico. Pages 34-53 in Marine turtles. IUCN New Publ. Ser. Suppl. Paper 20.
- Parsons, J. J. 1962. The green turtle and man. Univ. of Florida Press, Gainesville. 126 pp.
- Pope, C. H. 1939. Turtles of the United States and Canada. Alfred A. Knopf, Inc. New York. 343 pp.
- Pritchard, P. C. H. 1969. Summary of world sea turtle survival. IUCN Bull. 2(11):90-91.
- Randall, J. 1965. Grazing effect on sea grasses by herbivorous reef fishes in the West Indies. Ecology 46:225.
- Rebel, T. P. 1974. Sea turtles and the turtle industry of the West Indies, Florida, and the Gulf of Mexico. Univ. of Miami Press, Miami. 250 pp.
- Riedman, S. R., and R. Witham. 1974. Turtles extinction or survival? Abelard-Schuman, New York. 156 pp.
- Schwartz, F. J. 1976. Behavioral and tolerance responses to natural cold winter water temperatures by three species of sea turtles in North Carolina. Page 5 in Florida and interregional conference on sea turtles. Florida Dep. Nat. Resour. Marine Res. Lab. Unpubl.
- Survival Service Commission. 1969. Marine turtles. Proc. Work. Meet. Marine Turtle Special. organized by IUCN at Morges, Switzerland.
- True, F. W. 1884. The fisheries and fishery industries of the United States, Sec. 1, Pt. 2. The useful aquatic reptiles and batrachians. U.S. Comm. Fish.
- U.S. Department of Commerce. 1976. Proposed listing of the green sea turtle (*Chelonia mydas*), loggerhead (*Caretta caretta*), and Pacific

- ridley sea turtle (*Lepidochelys olivacea*) as threatened species under the Endangered Species Act of 1973. Draft EIS. Natl. Oceanic Atm. Admin., Natl. Mar. Fish. Serv. Washington, D.C.
- U.S. Department of the Interior. 1973. Threatened wildlife of the United States. Compiled by Office of Endangered Species and International Activities, Bur. Sport Fish. Wildl. Resour. Publ. 114. U.S. Gov. Printing Office, Washington, D.C. 289 pp.
- Walker, W. F. 1971. Swimming in sea turtles of the family Cheloniidae. *Copeia* 1971(2):229-233.
- . 1976a. *Chelonia mydas* account. In H. O. Hillestad, D. B. Means, and W. W. Baker, eds. Endangered and threatened vertebrates of the southeastern United States. Tall Timbers Res. Sta. Misc. Publ. 4.
- . 1976b. Evidence for ocean-current mediated dispersal in young turtles, *Chelonia mydas* (Linnaeus). M.S. Thesis. Univ. of Oklahoma, Norman. 48 pp.
- Worth, D. F., and J. B. Smith. 1976. Marine turtle nesting on Hutchinson Island, Florida, in 1973. Florida Dep. Nat. Resour. Mar. Res. Lab. Publ. 18.

ACCOUNT PREPARED/UPDATED BY:

National Fish and Wildlife Laboratory
412 N.E. 16th Avenue, Room 250
Gainesville, FL 32601

Biological Services Program

FWS/OBS-80/01.14

March 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States-

THE TEXAS BLIND SALAMANDER



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

FWS/OBS-80/01.14
March 1980

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—

THE TEXAS BLIND SALAMANDER

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: J. JOHNSON

TEXAS BLIND SALAMANDER
Typhlomolge ratbbuni Stejneger

KINGDOM Animalia
 CLASS Amphibia
 ORDER Caudata
 FAMILY Plethodontidae
 OTHER COMMON NAMES None

DATE

Entered into SWIS. to be determined.
 Updates. . . . 21 November 1977, 31 March 1978,
 22 August 1978.

LEGAL STATUS

Federal Endangered (32 FR 4000, 11 March
 1978.
 States Endangered: Texas

REASONS FOR CURRENT STATUS

The Texas blind salamander is endangered be-

cause of its extremely restricted distribution in a fragile subterranean ecosystem. At accessible locations (especially Ezell's Cave), sightings declined sharply in the 1960's, due probably to overcollecting by scientific, commercial, and hobbyist collectors. When the cave was sealed to prevent human entrance, the bat colony that supplied a presumably important energy resource in the form of guano was eliminated.

Recent research (Longley 1978) has shown that the major part of the population is located in inaccessible parts of the Edwards Aquifer and is probably stable at present. However, there is a potential for contamination of the aquifer, as well as evidence that extensive groundwater withdrawal is causing the head in that aquifer to decrease. This could ultimately lead to intrusion of poor quality water from adjacent aquifers (Longley 1978).

PRIORITY INDEX

Not assigned.

DESCRIPTION

The Texas blind salamander is all white or pinkish with blood-red external gills and tooth-pick-like legs. Head and snout are strongly flattened with two small black dots representing vestigial eyes beneath the skin. It reaches a total length of 13 cm. Color photographs appear in Mohr and Poulson (1966), Zahl (1972), and Conant (1975).

RANGE

The species occurs only in subterranean waters of the Edwards Aquifer near San Marcos, Hays County, Texas. It can be seen only in caves, sinkholes, and fissures, including Ezell's Cave, Primer's Well, and Rattlesnake Cave. Two additional sites, Johnson's Well and Wonder (Beaver) Cave, have been recorded, but no Texas blind salamanders have been seen in either location for many years (Russell 1976). Longley (1978) has placed nylon nets over Pipe Spring at San Marcos Springs and the type locality artesian well, Aquatic Station, Southwest Texas State University in San Marcos, and collected Texas blind salamanders as they were washed out of the aquifer.

Their total distribution is limited to about 104 km² mostly beneath the city of San Marcos (Russell 1876). However, based on known distribution (see range map), the figure could be less than this, perhaps as little as 10 km² (F. E. Potter personal communication).

RANGE MAP

Current localities (observed within the past 5 years) are indicated by dots. Former localities (not observed within the past 50 years) are shown by triangles (F. E. Potter personal communication).

STATES/COUNTIES

Texas Hays.

HABITAT

The blind salamander inhabits water-filled caverns of the San Marcos Pool of the Edwards Aquifer. It is known only from incidental specimens washed out of the aquifer or found near the water surface in caves. Water quality is considered very good with average temperatures in the vicinity of 21°C (Longley 1978).

FOOD AND FORAGING BEHAVIOR

These salamanders feed on any living invertebrates they can handle, including a tiny snail species, copepods, amphipods, and a shrimp. Captive specimens have been maintained for up to 2 years on epigeal forms of daphnia and other small crustaceans, suggesting use of any such forms as may happen to wash into the aquifer from the surface.

SHELTER REQUIREMENTS

Not known.

NESTING OR BEDDING

Not known.

RITUAL REQUIREMENTS

Not known.

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

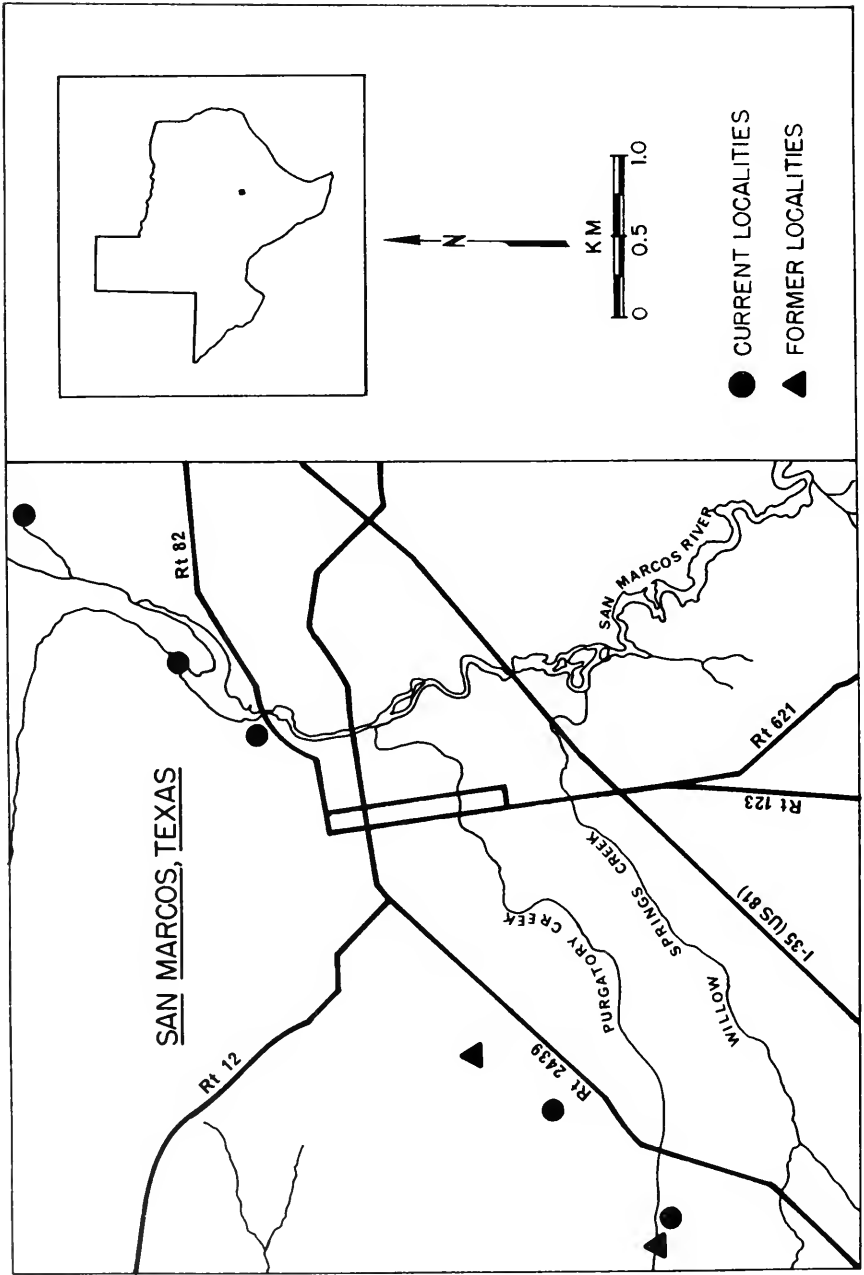
The blind salamander is completely adapted to the cave environment.

POPULATION NUMBERS AND TRENDS

Information is lacking on population size, but it is believed to be stable because of the large number of specimens and high percentage of juveniles washed out of the aquifer by springs and artesian wells. In the 2-year period 1975-1977, Longley (1978) netted 133 specimens, 32 of which washed from the type locality artesian well and 101 of which washed from Pipe Spring at San Marcos Springs, a previously unreported locality for the species.

REPRODUCTION

Information on reproduction is scanty. One gravid female contained 39 eggs. Tiny specimens less than 2 cm long have been found throughout the year (Longley 1978). Dunn (1926) reported eggs laid March 15, 1886, and spermatheca packed with spermatozoa in early fall of 1916. Gravid females have been observed each month of the year (F. E. Potter personal communication). Brandon (1971) discusses testicular lobes ranging from zero to four in the seven specimens he examined. There appears to be a correlation between size (age class), number of lobes, and number of times sperm has been produced.



Distribution of Texas blind salamander

MANAGEMENT AND CONSERVATION

Following the original fear that the species was being depleted, the Nature Conservancy purchased Ezell's Cave in 1967. The bat colony that had roosted there and contributed much of the basic energy for the cave and local aquifer community had been almost eliminated when the cave entrance was sealed some years before. Although efforts to reestablish the bat colony have thus far been unsuccessful, a few cave-dwellers, including *Typhlomolge rathbuni*, are still infrequently observed (F. E. Potter personal communication).

The continued protection afforded by official listing should minimize the potential impact of collectors on the few cave habitats accessible to them. The major part of the blind salamander's habitat is inaccessible, but adverse impact is projected as the aquifer level declines with increased ground water usage (Longley 1978). Concurrent with this decline in water quantity is the increased potential for urban pollution as more and more urbanization takes place along the aquifer recharge zone. General management plans, designed by action agencies to maximize recharge and minimize introduced contaminants, mostly to benefit human consumption, should also benefit the diverse assemblage of species occupying the aquifer, including *Typhlomolge rathbuni*. A study is currently underway at Ezell's Cave to determine existing environmental conditions (water quality) and present trends in faunal abundance and diversity. The results should serve as a basis on which to monitor conditions in the cave.

AUTHORITIES

- Glenn Longley
Biology Department
Southwest Texas State University
San Marcos, TX 78666
- Floyd E. Potter, Jr.
Texas Parks and Wildlife Department
4200 Smith School Road
Austin, TX 78744
- Samuel S. Sweet
Department of Biological Sciences
University of California, Santa Barbara
Santa Barbara, CA 93106

PREPARER'S COMMENTS

Mitchell and Reddell (1965) placed the Texas blind salamander in the genus *Eurycea*; however, Brandon (1971) retained *Typhlomolge*. New data

on skull morphology support the continued recognition of the genus *Typhlomolge* (Potter and Sweet 1979).

LITERATURE CITED/SELECTED REFERENCES

- Brandon, R. A. 1971. North American troglobitic salamanders: Some aspects of modification in cave habitats with special reference to *Gyrinophilus palleucus*. Bull. Natl. Speleol. Soc. 33:1-21.
- Conant, R. 1975. A field guide to reptiles and amphibians of eastern and central North America, 2nd ed. Houghton Mifflin Co., Boston. 429 pp.
- Dunn, E. R. 1926. The salamanders of the family Plethodontidae. Smith College Publications, Northampton, Mass. 441 pp.
- Longley, G. 1975. Environmental assessment, Upper San Marcos River watershed. Environmental Sciences of San Marcos. Soil Conserv. Serv. Contract AG-48-SCS 01256. 367 pp.
- . 1978. Status of the Texas blind salamander. Endangered Species Report 2. U.S. Fish Wildl. Serv., Albuquerque. 45 pp.
- Mitchell, R. W., and J. R. Reddell. 1965. *Eurycea tridentifera*, a new species of troglobitic salamander from Texas and a reclassification of *Typhlomolge rathbuni*. Texas J. Sci. 17:12-27.
- Mohr, C. E., and T. L. Poulson. 1966. The life of the cave. McGraw-Hill Book Co., New York. 232 pp.
- Potter, F. E., Jr. 1963. Gross morphological variation in the genus *Typhlomolge* with description of a new species. Unpubl. M.S. Thesis. Univ. of Texas, Austin. 66 pp.
- Potter, F. E., Jr. and S. S. Sweet. 1979. Generic boundaries in Texas cave salamanders and a redescription of *Typhlomolge robusta* (Amphibia: Plethodontidae). Copeia. In press.
- Russell, W. H. 1976. Distribution of troglobitic salamanders in the San Marcos area, Hays County, Texas. Unpubl. Rep. 7601, Texas Assoc. Biol. Invest. Trogl. *Eurycea*, Austin. 35 pp.
- Zahl, P. A. 1972. The shadowy world of salamanders. Natl. Geog. Mag. 142(1):104-117.

ACCOUNT PREPARED/UPDATED BY:

National Fish and Wildlife Laboratory
412 N.E. 16th Avenue, Room 250
Gainesville, FL 32601

Biological Services Program

FWS/OBS-80/01.15
March 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States-

YUMA CLAPPER RAIL



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

FWS/OBS-80/01.15
March 1980

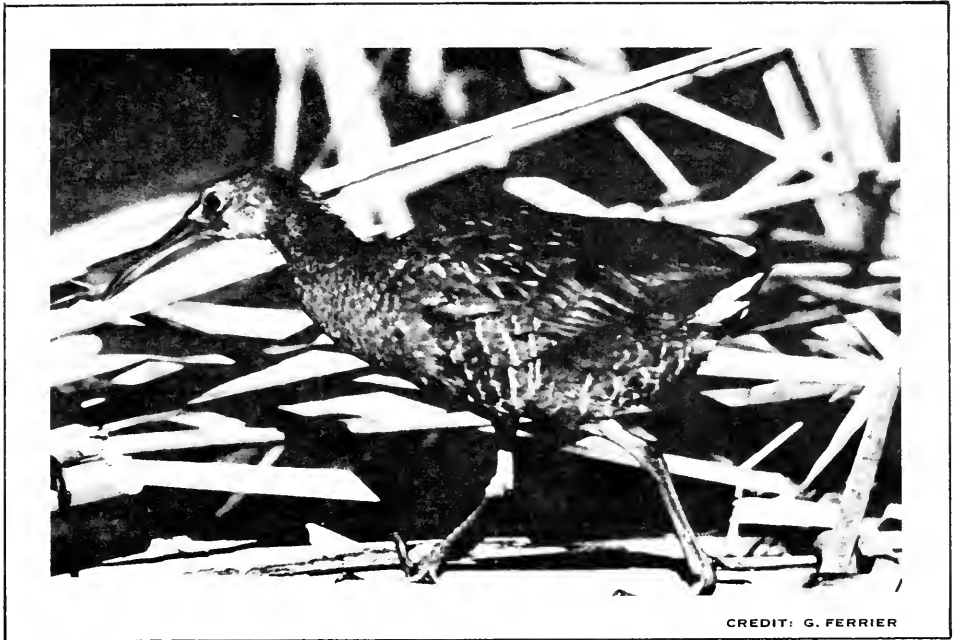
SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES

YUMA CLAPPER RAIL

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: G. FERRIER

YUMA CLAPPER RAIL

Rallus longirostris yumanensis Dickey (1923)

KINGDOM Animalia
CLASS Aves
ORDER Gruiformes
FAMILY Rallidae
OTHER COMMON NAMES None

DATE
 Entered into SWIS to be determined
 Update to be determined

LEGAL STATUS

Federal: Endangered (32 FR 4001, 11 Mar 1967). Migratory Bird Treaty Act of 3 July 1918 (40 Stat. 755; 16 U.S.C. 703-711) as amended 3 December 1969. Public Law 91-135.
State: California: Rare
 Arizona: Protected

REASONS FOR CURRENT STATUS

Grinnell (1914) did not report any clapper rails and noted that marshes were few and small in size during his 3-month vertebrate survey along the Lower Colorado River from 15 February to 15 May 1910, suggesting a considerable increase in both habitat and rails as a result of damming of river since then (Ohmart and Smith 1973). Since clappers normally do not return to the Colorado River habitat until about April 22-25, it would have been easy for Grinnell to miss the influx of birds.

Reclamation projects along the Colorado River have both created and destroyed marsh habitat. Dam construction may have generally increased habitat by creating marshes. Therefore, birds may now be at the northernmost point of their historic range.

Channelization has eliminated large areas of habitat near Yuma since 1963 (Tomlinson and Todd 1973).

PRIORITY INDEX

8

DESCRIPTION

R. l. yumanensis is a chicken-size bird, gray-brown above with cinnamon brown breast, flanks barred gray and white, and a white patch under the upturned tail. Bill, legs, and toes are long. Similar to *R. l. levipes* but paler underparts, duller and more olivaceous upper parts. More slender tarsus and bill (Dickey 1923). Very similar to *levipes* of southern coastal California, differing only in more slender proportions and paler coloration (Van Rossem 1929). Similar to *rhizophorae* (of Sonora) in paleness but, in general, more brownish (less grayish) and has more pointed wings because of difference in length of primaries. Compared with *levipes*, it is paler on breast and throat, has grayer flanks, duller wing coverts and more extensive brown in the crown (Banks and Tomlinson 1974). Ripley (1977), although noting the above differences, is dubious about the validity of *yumanensis* as a subspecies.

Measurements — Male: Wing 143.1-160.1 mm (av. 149.8 mm); tail 60.3-69.0 (av. 64.2); exposed culmen 55.4-61.8 (av. 59.2); tarsus 47.9-55.0 (av. 50.3); middle toe without claw 50.3-54.6 (av. 52.7); weight 222-307 g (av. 256g). Female: wing 135.6-148.5 mm (av. 141.8mm); tail 57.8-62.6 (av. 59.9); exposed culmen 51.9-58.2 (55.5); tarsus 43.0-49.5 (45.4); middle toe without claw 46.5-51.1 (49.0); weight 192-268g (219g). Banks and Tomlinson 1974).

Eggs are oval, glossy, pale pinkish buff and cartridge buff, with sparse spots of varying brown shades; 41.8 by 28.8mm (Bent 1926).

RANGE

This rail breeds, at present, in marshes along the Colorado River in California and Arizona, from Needles to the Topock marsh south to the Colorado River delta in Sonora; west to marshes along the southeastern Salton Sea, California; east, locally, to the Gila River near Tacna, Arizona, and possibly the Salt River near Phoenix (Tomlinson and Todd 1973, Ohmart and Smith

1973). It is thought to winter, at least in part, in coastal and interior marshes and coastal mangrove swamps in Mexico, including Estero Mescales, 8km north of Teacapan, and Castillo, 11 km east of Mazatlan, Sinaloa; also at Laguna San Felipe, Puebla (Banks and Tomlinson 1974).

The former more restricted range is documented by Dickey (1923), Bent (1926, Van Rossem (1929), Moffitt (1932), Abbott (1940), and Grinnell and Miller (1944).

Lack of authentic winter records in the northern breeding areas is noted by Phillips et al. (1964), Todd (1971), and Tomlinson and Todd (1973). Winter records of clapper rails (presumably *yumanensis* but possibly wanderers of other subspecies) at Salton Sea appearing on two 1976 Christmas bird counts published in *American Birds* 31 (4):880, 1977 and confirmed by R. Guy McCaskie (pers. comm.); and also at Topock Marsh in January 1974 (Smith 1974), suggest that some individuals do not migrate.

Breeding populations along the Colorado River, the Colorado River delta and at Salton Sea have been identified from specimens as *yumanensis* (Banks and Tomlinson 1974). No specimens representative of the small, isolated populations along the Gila and Salt Rivers in Arizona, nor any winter specimens from the Colorado River or Salton Sea have been critically examined.

RANGE MAP:

The following map depicts breeding range (from Tomlinson and Todd 1973) and winter records (from Banks and Tomlinson, 1974).

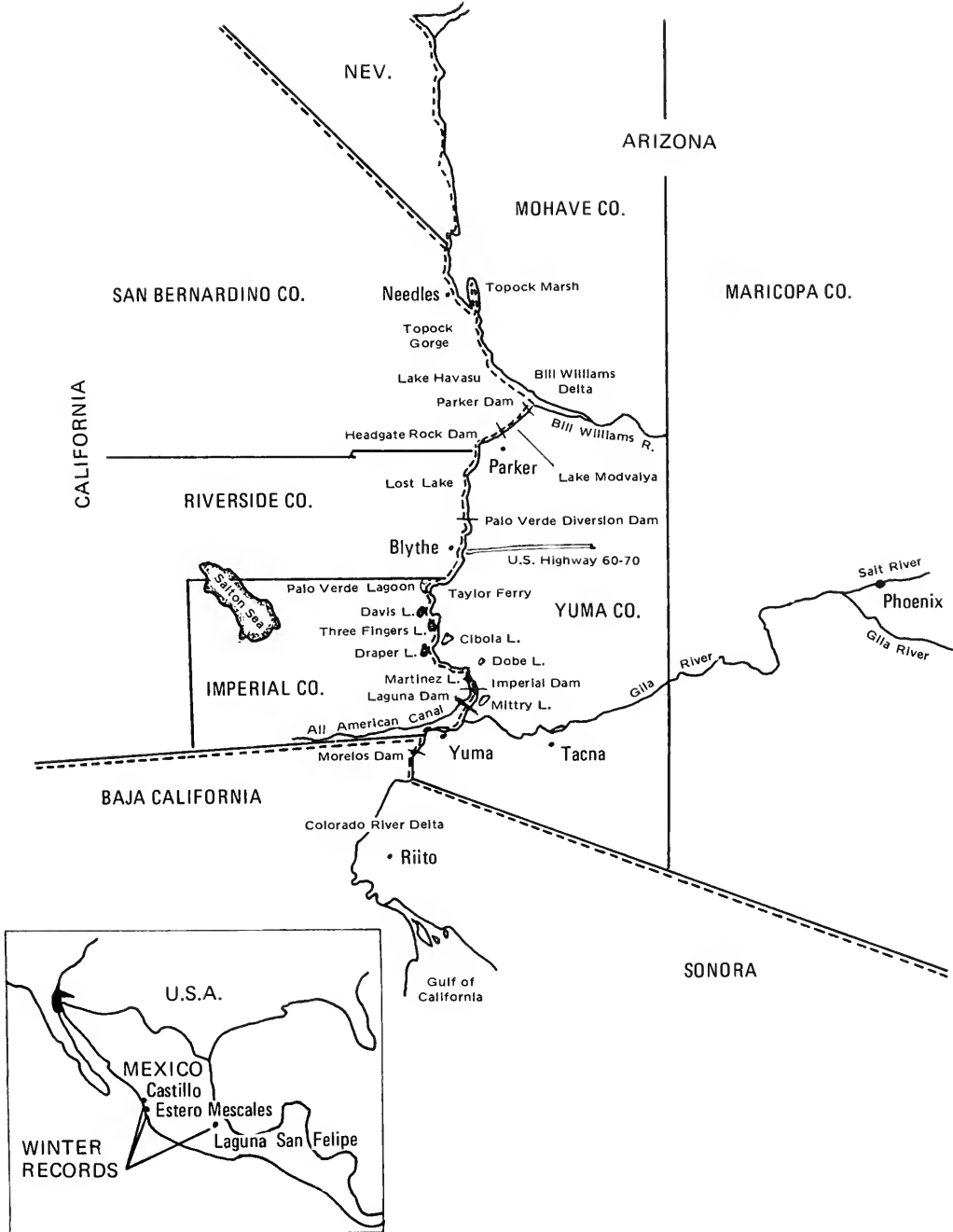
STATES/COUNTIES:

California: Imperial, Riverside, San Bernardino.

Arizona: Maricopa, Mohave, Yuma.

HABITAT

The Yuma clapper rail requires freshwater or



Known range of the Yuma clapper rail.

brackish stream sides and marshes, associated with heavy riparian and swamp vegetation (Grinnel and Miller 1944), such as alkaline cattail marshes (Phillips et al. 1964). In general, habitat consists of shallow-water marshes containing dense stands of cattail (*Typha latifolia*) and big bulrush or tule (*Scirpus acutus*), in both brackish and freshwater situations. Shallow water with mud flats available for feeding are selected over areas where water is deep and steep banks prevalent. Stands of cattail and tules dissected by narrow channels of water 1.6 to 7 m wide had densest populations, according to Tomlinson and Todd (1973). Preferred breeding habitat is light cattail or tule stands with downed vegetation, with adjacent dry land a must (Ohmart and Smith 1973). Water of breeding habitat on the Colorado River Delta in Mexico is salty and growths of cattails and tules appear to be limited to small fresh or brackish sloughs. The vegetation is characterized by an overstory of saltcedar (*Tamarix* sp.) and an understory of iodine bush (*Allenrolfia occidentalis*), all quite different from the habitat above the delta (Tomlinson and Todd 1973).

The rail seems to require wet mudflat or sandbar sites, covered rather densely with mostly mature vegetation exceeding 0.5 m. Optimum conditions are created by open ponds or channels as opposed to unbroken stands of vegetation. Saltcedar (*Tamarix pentandra*) stands are rarely utilized (Todd 1971).

The following habitat characteristics appeared in locations where clapper rail densities were higher than average:

1. Water, flowing through many small channels from 0.5 to 3 m wide, either covered with vegetation or appearing as small bodies of open water 0.02 to 0.2 hectares in size.
2. Extensive areas of water of depth less than 0.3 m little or no daily fluctuation in water level.
3. High ground in strips or, less importantly, as small islands.
4. Emergent vegetation, cattail or bulrush, with little or no *Phragmites* sp., which are too high and have few down stems (Gould 1975).

At Topock Marsh, the highest densities were found in light cattail stands — lowest, in heavy stands. Dense cattail had 0.9 rails per 10 ha; light

light cattail 1.9 per 10 ha; dense bulrush 1.7 per 10 ha; light bulrush 1.8 per 10 ha. The majority of rails were in the ecotone between emergent vegetation and higher ground, either at the shoreline or on hummocks in the marsh (Smith 1974).

Winter habitat probably includes mangrove swamps on the Pacific coast of Sinaloa and freshwater marshes of Puebla (Banks and Tomlinson 1974).

FOOD AND FORAGING BEHAVIOR

The major food is invertebrates, with little vegetable matter. Crayfish (*Procambarus* and *Oropectes*) were the dominant food in 9 of 10 stomachs from Topock Marsh south to Imperial Reservoir. Of two stomachs from the confluence of the Gila and Colorado Rivers, one contained primarily (98%) freshwater clams (*Corbicula* sp.), and the other, 97% isopods. Colorado River delta specimens contained a greater variety of food, but the major components were water beetles and fish. Of 16 stomachs, 9 had crayfish, 11 had insect fragments, 4 had water beetles, 4 had fish, and 3 contained clams. Other insects in small amounts were weevils, damselfly nymphs, dragonfly nymphs, grasshoppers, and insect eggs. Spiders, leeches, prawns, and a small mammal bone were also found. Plant material consisted of twigs (10% in one stomach), 2 legume seeds (1 stomach) and 18 unidentified black seeds (3 stomachs). Like other subspecies of clapper rail, *yumanensis* seems to be a selective opportunist whose variety of food is limited by its availability in the particular habitat (Ohmart and Tomlinson 1977). In Topock Marsh, crayfish are an important part of the diet. Crayfish are found in all areas where rails occurred, with the greatest number of crayfish in water 8 to 15 cm deep with abundant stems and leaves lying in the water. Floating and recumbent vegetation is important in foraging areas, as they provide habitat for crayfish and a platform to walk on (Smith 1974).

SHELTER REQUIREMENTS

None other than mentioned in other sections.

NESTING OR BEDDING

In three nests, material consisted of black

sticks with dry leaves on them; two nests were made of fine stems with dry blossoms attached. Nests were located on hummocks and in the crotches of small shrubs just above water in dense cattail and tamarisk associations (Abbott 1940).

RITUAL REQUIREMENTS

The rail appears to defend its territory (Tomlinson *in* Ohmart and Smith 1973). The 'clatter call' is given in unison by male and female and with adjacent birds (Tomlinson *in* Ohmart and Smith 1973). Territory size averages 1.44 ha (Smith 1974).

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

None other than specified in other sections.

POPULATIONS NUMBERS AND TRENDS

A multiagency Yuma clapper rail census recorded 889 along the Colorado River in 1973 and 787 in 1974. In the Imperial Valley, 134 were recorded in 1974 (no count in 1973). Total count for the Colorado River and Imperial Valley combined in 1974 was 921 rails (Gould 1975). Estimated local populations in 1973 were: Topock Marsh 109-136, Topock Gorge-52-65, Bill Williams River delta-21-35, Colorado River delta-145 (Cornelius 1972, Ohmart and Smith 1973). Total population was estimated at over 1,000 (Tomlinson *in* Ohmart and Smith 1973).

Factors regulating populations include predation by raccoon and coyote (Abbot 1940), bobcat, feral house cat, dog, and Cooper's hawk (Todd *in* Ohmart and Smith 1973); and habitat destruction (Tomlinson and Todd 1973, Cornelius 1972).

REPRODUCTION

A nest with 7 slightly incubated eggs was found near the Salton Sea on 12 May 1940. Observations along the lower Colorado River in summer (8 May to 16 September) include an adult with 3 young 2 weeks old on 17 July (Phillips et al. 1964); and a nest with one egg, another with two eggs, and two empty found on 5 May. A nest with six fresh eggs, one with seven fresh eggs, and one with seven slightly incubated eggs were found on 12 May. Abbot (1940) reports a clutch of six

slightly incubated eggs on 26 May, and five clutches ranging from six to seven eggs (average 6.5).

The incubation period is unknown, but is probably similar to other clapper rails, 21 to 23 days (Ohmart and Smith 1973).

Hatching success is suggested by three quarter- to half-grown downy chicks found on 23 June (Tomlinson *in* Ohmart and Smith 1973) and three 2-week-old young (Phillips et al. 1964).

A breeding period in May and June was indicated by responses to taped calls (Tomlinson and Todd 1973).

MANAGEMENT AND CONSERVATION

An annual or periodic index to abundance of rails will be important in view of constant change in the rivers through reclamation projects. Taped call notes could be used to obtain such an index, but would be costly to maintain. Since cattails and tules are so important as habitat, estimates of rail population size can be determined by inspection of aerial photographs taken periodically. Prior research could determine average density of rails for specific habitat types and sizes. Spot checks on the ground would help to determine accuracy (Tomlinson and Todd 1973).

State, national, and international uses of Colorado River water are all involved in management of Yuma clapper rails. Occasionally, such management, even that for fish and wildlife, if it involves dredging out cattail growth, is detrimental to rail survival. The main requirement in management for Yuma clapper rails is that extensive growths of cattails and tules must be preserved throughout its range.

AUTHORITIES

Richard L. Todd
Arizona Department of Game and Fish
2222 West Greenway Road
Phoenix, Arizona 85023

Roy E. Tomlinson
U.S. Fish and Wildlife Service
P.O. Box 1306
Albuquerque, New Mexico 87103

Philip M. Smith
1613 W. Peoria Ave. No. 2
Phoenix, Arizona 85029

Robert D. Ohmart
Department of Zoology
Arizona State University
Tempe, Arizona 85281

Gale W. Monson
8831 N. Riviera Drive
Tucson, Arizona 85704

Gordon I. Gould, Jr.
1080 E. Nevada
Blythe, California 92225

PREPARER'S COMMENTS

Research attention focused on the Yuma clapper rail because of its endangered status has cleared up two important matters. Despite doubts expressed by Ripley (1977), Banks and Tomlinson (1974) have shown, on the basis of critical study of adequate specimens, that it is a taxonomically valid subspecies, examples of which can be recognized as migrants when away from their breeding areas.

Also, it has been found that the populations of this rail will respond to changing distribution of its preferred type of habitat, which has now been described in detail, by extending its range (Tomlinson and Todd 1973, Ohmart and Smith 1973, Smith 1974, Gould 1974). This information should make possible the continued existence of this subspecies by means of specific habitat management for it, in addition to the several other competing land uses in the limited sites available along the lower Colorado River and adjoining areas.—John W. Aldrich.

LITERATURE CITED/SELECTED REFERENCES

Abbott, C. G. 1940. Notes from the Salton Sea, California. *Condor* 42:264.

Banks, R. C., and R. E. Tomlinson. 1974. Taxonomic status of certain Clapper Rails of southwestern United States and northwestern Mexico. *Wilson Bull.* 86:325-335.

Bent, A. C. 1926. Life histories of North American marsh birds. *U.S. Nat. Mus. Bull.* 135:275.

California Department of Fish and Game. 1978. At the crossroads: a report on California's

endangered and rare fish and wildlife. *Biannual Rep.* 103 pp.

Cornelius, S. S. 1972. Yuma Clapper Rail census, Havasu National Wildlife Refuge. Unpubl.

Dickey, D. R. 1923. Description of a new Clapper Rail from the Colorado River valley. *Auk* 40:90-94.

Gould, G. I., Jr. 1975. Yuma Clapper Rail study—censuses and habitat distribution 1973-74. California Dep. Fish Game Admin. Rep. 75-2, April 1975.

Grinnell, J. 1914. An account of the mammals and birds of the lower Colorado Valley. *Univ. Calif. Publ. Zool.* 12:51-294.

Grinnell, J., and A. H. Miller. 1944. The distribution of the birds of California. *Pac. Coast Avifauna* 27:128.

Moffitt, J. 1932. Clapper Rails occur on marshes of Salton Sea, California. *Condor* 34:137.

Oberholser, H. C. 1937. A revision of the Clapper Rails (*Rallus longirostris Boddaert*). *Proc. U.S. Nat. Mus.* 84:313-354.

Ohmart, R. D., and R. E. Tomlinson. 1974. Food of western Clapper Rails. *Wilson Bull.* 89:332-336.

Ohmart, R. D., and R. W. Smith. 1973. North American Clapper Rails (*Rallus longirostris*), literature survey with special consideration being given to the past and current status of *yumanensis*. *Bur. Reclam. Rep.*

Phillips, A., J. Marshall, and G. Monson. 1964. The birds of Arizona. *Univ. Arizona Press, Tucson.* 31pp.

Ridgway, R., and H. Friedmann. 1941. The birds of North and Middle America, Part 9. *U.S. Nat. Mus. Bull.* 50.

Ripley, S. D. 1977. Rails of the world. *David R. Godine, Boston.*

Smith, P. M. 1974. Yuma Clapper Rail study,

Mohave County, Arizona, 1973. California Dep. Fish Game, Spec. Wildl. Investig. Prog. Rep. Job 11-5.9. June 1974.

Todd, R. C. 1971. Report on the study of the Yuma Clapper Rail along the Colorado River. Prepared for Colorado River Wildlife Council Meeting,, April 5-6, 1971, Las Vegas, Nevada.

Tomlinson, R. D., and R. L. Todd. 1973. Distribution of two western Clapper Rail races as determined by responses to taped calls. *Condor* 75:177-183.

Van Rossem, A. J. 1929. The status of some Pacific Coast Clapper Rails. *Condor* 31:213-215.

Biological Services Program

FWS/OBS-80/01.16
March 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States- **SANTA BARBARA SONG SPARROW**



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—
SANTA BARBARA SONG SPARROW

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



PHOTO OF CLOSELY RELATED SUBSPECIES

CREDIT: HERBERT CLARKE

SANTA BARBARA SONG SPARROW

Melospiza melodia graminea Townsend (1890)

KINGDOMAnimalia
 CLASS Aves
 ORDER Passeriformes
 FAMILY Fringillidae
 OTHER COMMON

NAMES. Bell Finch, Coast Song Sparrow, California Song Sparrow.

DATE

Entered into SWIS.To be determined
 Updates.....To be determined

LEGAL STATUS

Federal: Endangered. (42 FR 36427), 14 July 1977.
 States: Protected: California.

REASONS FOR CURRENT STATUS

There is general agreement among ornithologists who have searched for song sparrows on Santa Barbara Island during the breeding season that the subspecies *M. m. graminea* is extinct (G. L. Hunt, Jr. pers. comm. to J. W. Aldrich, 18 Aug. 1972, and Warren King, 26 March 1974; Smail and Henderson 1974). The main reason for its decline and extinction was elimination of dense vegetation over the entire island by feral domestic rabbits whose population exploded from 1953-1959; and, finally, extensive fire in 1959 that destroyed the remaining vegetation and litter down to the mineral soil. Feral cats, which were numerous in earlier times, along with barn owls (*Tyto alba*) and American kestrels (*Falco sparverius*) may have contributed to the decline, particularly after the 1959 fire destroyed the concealing vegetation (Smail and Henderson 1974).

PRIORITY INDEX

None assigned.

DESCRIPTION

M. m. graminea is small, brownish gray above, white streaked with black below, with a black spot on chest. It is distinguished from related races of song sparrow by shorter wings and tail, and, except for *micronyx* of San Miguel Island, by more grayish (less brownish) coloration. It differs from *M. m. clementae* of the Other Channel Islands in smaller bill, tarsus, and feet; from *M. m. cooperi*, of the adjoining mainland; in smaller bill; from *coronatorum* of Los Coronados Islands in larger tarsi and feet. Nineteen adults measured: length, 5.50 - 6.12 in (140 - 155 mm) av. 5.80 in (147 mm); wing, 2.25 - 2.50 in (57.2 - 63.5 mm) av. 2.35 in (59.7 mm); bill, 0.40 - 0.46 in (10.2 - 11.7 mm) av. 0.43 in (10.9 mm) (Townsend 1896, Grinnell 1897, 1928, Van Rossen 1924).

RANGE

Formerly a permanent resident on Santa Barbara Island off southwestern California, it was confined to that island (Willett 1933; Grinnell and Miller 1944, American Ornithologist Union 1957).

RANGE MAP

See range map on following page.

STATES/COUNTIES

California: Los Angeles.

HABITAT

Santa Barbara Island, with an area of only 2.6 km², is 61 km from the mainland and 37 km from the nearest other island (Santa Catalina). No permanent fresh water is present on the island. A low ridge extends along the western edge with high points 171 and 193 m above sea level. The central portion is a graded slope, almost level in some areas, then falling steeply to the ocean on the eastern edge, which is cut by a number of canyons. It has an equable climate, and practically never frosts; rainfall is only 12 in (30.5 cm), but wet fogs are frequent. Vegetation was formerly long, coarse grass growing thick and tangled everywhere, making walking difficult (Townsend 1890). Sparse brush covered slopes and ravines (Grinnell

1897). The song sparrows were found where the brush afforded protection (Wright and Snyder 1913). Song sparrows used bushes for nesting, and fog supplied the moisture essential to birds of this type (Grinnell and Miller 1944). In more recent times, thickets of giant tree-sunflower (*Coreopsis gigantea*) were abundant (Philbrick 1972; Sumner 1958). Gross changes in vegetation have taken place in the 20th century as a result of agriculture, the effect of overgrazing by rabbits, and more recently, a severe fire (1959) that burned over almost the entire island and eliminated most of the remaining vegetation (Smail and Henderson 1974).

FOOD AND FORAGING BEHAVIOR

No information is available, but the diet presumably consisted of insects and small seeds, the same as mainland populations.

SHELTER REQUIREMENTS

Dense growths of grass (Townsend 1890), sparse brush cover on slopes and ravines used for nesting (Grinnell 1897), and thickets of giant tree-sunflower (Smail and Henderson 1974) were all important cover vegetation for song sparrows.

NESTING AND BEDDING

Five nests were all practically the same size and composition. A typical one was supported by obliquely growing twigs of a bush and lined with yellow grasses, in marked contrast to the larger brown grass and weed stems of which the nest structure was built (Grinnell 1897).

RITUAL REQUIREMENTS

Song, notes and actions are the same as those of mainland races of song sparrow, a strongly territorial species.

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

None is known other than dense vegetative cover for nesting and concealment.

POPULATION NUMBERS AND TRENDS

Once extremely abundant - in fact, the most abundant bird - on the small island of Santa Barbara (Townsend 1890). They were numerous



Total range of the Santa Barbara song sparrow.

everywhere, especially on the brush-covered fields on the southern part of the mesa (Grinnell 1897). They were abundant residents on Santa Barbara on first of May 1908, and at times were "fairly swarming" in short scrub (Howell 1917), abundant residents on the island in 1911 (Willett 1933); permanent residents, abundant, but no year given (Grinnell and Miller 1944). By 1967, the subspecies was extinct according to Kenneth Baker, National Park Service (pers. comm. to Clinton Lostetter, FWS 1972). Monitoring of all land birds by means of periodic searches of all parts of Santa Barbara Island from 15 May to 23 July 1972 failed to produce sight or sound of a song sparrow (George L. Hunt, Jr. pers. comm. 1972). No trace of song sparrows was found on the island by diligent search by Smail and Henderson from 13 to 17 May 1974, despite open condition of land that made it easy to observe any bird present. A song sparrow sighting on the island by Robert DeLong on 19 August 1967 may be the last record of the subspecies (Smail and Henderson 1974). Records of single song sparrows in 1972 and 1973 by George Hunt, Jr. were thought by him to be migrants of other races from the mainland, since they were associated with waves of migrant landbirds (Smail and Henderson 1974).

REPRODUCTION

Nest containing 2 eggs, advanced in incubation, were found 16 June 1911. At that date most of the young were already full grown (Willett 1912 and 1933). In mid-May 1897, full-grown juveniles were numerous, more so than adults, which were all apparently engaged in nest building or raising second broods. From 3 to 5 eggs were laid per set. Five sets averaging 3.8 eggs each were secured on May 14 and 15. Eggs averaged 0.61 x 0.78 in (15.5 x 19.8 mm), with extremes of 0.70 to 0.82 in (17.8 - 20.8 mm) in length and 0.57 to 0.64 in (14.5 - 16.3 mm) in diameter (Grinnell 1897).

MANAGEMENT AND CONSERVATION

It is now too late to manage for this species, but the example may be useful in planning habitat restoration and management to prevent extinction of other wildlife species on Santa Barbara Island. The Santa Barbara song sparrow is protected by the Migratory Bird Treaty Act and by the National Monument status of the island,

under the National Park Service.

AUTHORITIES

George Hunt, Jr.
U. of Calif.
Irvine, Calif.

Kenneth Baker
Nat. Park Service

John Smail
Point Reyes Bird Observatory

R. P. Henderson
Point Reyes Bird Observatory

PREPARER'S COMMENTS

The evidence seems conclusive that the subspecies of song sparrow that bred on Santa Barbara Island (*M. m. graminea*) is now extinct and that song sparrows observed on the island from time to time are probably migrants from other breeding areas.

LITERATURE CITED

- American Ornithologists Union. 1957. Check-list of North American Birds, 5th Edition. Baltimore, Md., Amer. Ornith. Union.
- Grinnell, J. 1897. Report on the birds recorded during a visit to the islands of Santa Barbara, San Nicholas and San Clemente in spring of 1897. Pasadena Academy of Sciences Pub. 1:1-21(6).
- Grinnell, J. 1928. The Song Sparrow of San Miguel Island, California. Proc. Biol. Soc. Wash. 41:37-38.
- Grinnell, J., and A. H. Miller. 1944. The distribution of the birds of California. Pac. Coast Avifauna 27:608 pp. (554).
- Howell, A. B. 1917. Birds of the islands off the coast of southern California. Pac. Coast Avifauna 12:1-127(80).
- Van Rossem, A. J. 1924. A survey of the Song Sparrows of Santa Barbara Islands. Condor 26:217-220.
- Philbrick, P. N. 1972. The plants of Santa Barbara Island, California. Madrono 21:329-393.

- Smail, J., and R. P. Henderson. 1974. Part II. Santa Barbara Island. *In* "The status of the Song Sparrow and Bewick's Wren on San Clemente Island and Santa Barbara Island, California" by R. M. Stewart, John Smail, William Clow and R. P. Henderson. Report to Endangered Species Office U. S. Fish and Wildlife Service by Point Reyes Bird Observatory, Bolinas, Calif. 94924. Oct 1974.
- Sumner, L. 1958. The rabbits of Santa Barbara Island, a progress report. *In* Smail and Henderson 1974. (listed above).
- Townsend, C. H. 1890. Scientific results of exploration by the U. S. Fish Commission Albatross. No. XIV - Birds from the coasts of western North America and adjacent islands, collected in 1888-89 with descriptions of new species. *Proc. U. S. Nat. Mus.* 13:131-142 (139).
- Willett, G. 1912. Birds of the Pacific slope of southern California. *Pac. Coast Avifauna* 7:1-122(84).
- Willett, G. 1933. A revised list of the birds of southwestern California. *Pac. Coast Avifauna* 21:1-204 (185).
- Wright, H., and G. K. Snyder. 1913. Birds observed in the summer of 1912 among the Santa Barbara Islands. *Condor* 15:86-92(91).

Biological Services Program

FWS/OBS-80/01.17
March 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States- **ESKIMO CURLEW**



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

FWS/OBS-80/01.17
March 1980

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—

ESKIMO CURLEW

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: OES, WASHINGTON, D.C.

ESKIMO CURLEW
(*Numenius borealis* Forster)

KINGDOM Animalia
 CLASS Aves
 ORDER Charadriiformes
 FAMILY Charadriidae

OTHER COMMON

NAMES Doughbird, fute, prairie
 pigeon, pipi-pi-uk or tura-tura
 courlis du nord or Corbigeau
 des Esquimaux, chittering
 curlew, zarapito, Chorlo
 campino and Chorlo grande.

DATE

Entered into SWIS. To be determined
 Updates. To be determined

LEGAL STATUS

Federal: Endangered: (32 FR 4001, 11 March
 1967; 35 FR 12122, 29 July 1970).
 States: Endangered: South Carolina, Texas,
 Alaska.

REASONS FOR CURRENT STATUS

The evidence is overwhelming that unrestricted hunting for the market, particularly during northward spring migrations through the midwestern prairies of the United States, and to a lesser degree in the fall migration in southeastern Labrador and (after severe storms) on the coast of Massachusetts, drastically and rapidly reduced this curlew's population between 1870 and 1890 (Mackay 1892, Forbush 1912, p. 427, Swenk 1915, Bent 1929, p. 126, Greenway 1958, Vincent 1966, Fish and Wildlife Service 1973). Other factors that may have contributed to its rapid decline are severe storms during long overocean migrations (Townsend and Allen 1907, Forbush 1912); habitat altered by cultivation and grazing on wintering grounds and the spring migration route (Cooke 1910, Dement'ev and Gladkov 1951); and a succession of unsuccessful breeding seasons caused by unfavorable weather (Banks 1977). A characteristic of the Eskimo curlew that may have contributed to its rapid decline was its tame nature and extreme gregariousness, making it easy to shoot (Swenk 1916, Bent 1929, p. 127, Coues 1861).

MacKay 1892). Its continued failure to recover after hunting in the United States was banned by the Migratory Bird Treaty Act in 1916 must be attributable to some unique characteristic that makes it more vulnerable to environmental conditions than other shorebirds with similar migration, breeding, and wintering ranges. That characteristic may be a greater concentration of all members of the population at all times, making it more vulnerable to short but critical periods of unfavorable weather and habitat conditions (Banks 1977). The conversion of native grasslands to cultivated fields in both the main wintering area in southern South America and the principle migration route through the tall grass prairie of the United States, which coincided with the population decline (Cooke 1910, Dement'ev and Gladkov 1969) and has continued to the present is one likely reason for its failure to recover.

It may be that only the natural grasslands of the southern South American pampas and the tall grass prairies of the United States could produce enough easily available food, in the form of grasshopper egg pods, to supply the energy for both the curlew's exceptionally long migration flights and the initiation of breeding in the spring. The Arctic tundra presumably provides enough crowberries and blueberries to support the fall migration, but the South American and North American grasslands, whose more productive areas are now largely cultivated, may not provide enough suitable insect life in winter and early spring to enable the curlews to travel their long traditional migration routes.

PRIORITY INDEX

55

DESCRIPTION

Esquimo curlews are medium-sized shorebirds (about 30 cm long), smaller than whimbrels with shorter (about 5 cm), more slender, slightly down-curved bills; uniformly dark (rather than barred) primaries; greenish (rather than gray) legs; more blackish above with unstriped dark crowns. They may be distinguished from very similar little curlews (*Numenius minutus*) which breed in north-east Asia and migrate through western Asia to Australia, by their generally darker and more buffy coloration with v-shaped black marks, instead of streaks, below and darker cinnamon buff

coloration under wings (Forrand 1977). The two forms are considered races of the same species by Dement'ev and Gladkov (1951) but as two distinct species by the American Ornithologists' Union (1957).

RANGE

N. borealis formerly nested in the Arctic tundra of northwestern Mackenzie between the Mackenzie and Coppermine Rivers (MacFarlane 1891, Swainson and Richardson 1881). There have been several probable sightings by Canadian Wildlife Service personnel east of the Mackenzie River delta in a general area where nesting is known to have occurred formerly. They probably nested in Alaskan tundra west to the Bering Sea (Nelson 1887, Murdock 1885); they wintered in grasslands of southern South America from southern Brazil and Uruguay, with a few probably north of Buenos Aires, Argentina (Cooke 1910), south to middle-eastern Argentina, chiefly north of the Chubut River; casually to Chile and Tierra del Fuego (Greenway 1958, Barrows 1884, Bent 1929, Cooke 1910, Swenk 1926, Sclater and Hudson 1889, Wetmore 1926).

Fall migration (adults preceeding young), beginning in July, was southeasterly from the breeding grounds to a feeding and staging area on the coast of southern Labrador (Audubon 1835, Townsend 1907, Coues 1861, Austin 1932, Todd 1963); thence via Newfoundland and Nova Scotia (Tufts 1961, Peters and Burleigh 1951) over the Atlantic Ocean directly to eastern South America, and ending on the wintering grounds in early September (Sclater and Hudson 1889, Barrows 1884). Severe storms occasionally forced the birds to land on the north Atlantic coast of the United States (Bent 1929, Forbush 1912, Sage and Bishop 1913, Palmer 1949, Griscom and Snyder 1955), Bermuda, and the eastern islands of the West Indies (Bond 1956).

There was a much smaller flight down the west side of Hudson Bay with a few individuals reaching points on the Great Lakes and even Cincinnati, Ohio, and Cooke Co. Texas (Cooke 1910, Hagar and Anderson 1977). By what route those birds reached the wintering grounds (if they did) is unknown.

Spring migration began in late February (Barrows 1884), heading northwest from the wintering area, probably across the Andes in Chile, the

Pacific Ocean, northern Middle America (Guatemala - Salvin 1861), and the Gulf of Mexico, to the coasts of Texas and Louisiana, arriving there in early March (Greenway 1958); thence gradually northward, primarily through the prairies of middle United States, to eastern South Dakota; thence rather quickly to the breeding grounds, arriving before the end of May (Bent 1929). There was some accidental in-migration in Greenland, Iceland, Britain, the Falkland Islands, and north-eastern Siberia (American Ornithologists' Union 1957).

RANGE MAP

A map of breeding and wintering areas and migration routes is shown on the following page.

STATES/COUNTIES

Alaska:	Cape Lisbourne, Kotzebue Sound, Nulato, Point Barrow, St. Michael, St. Paul Id.
Arkansas:	Washington.
Colorado:	Denver.
Connecticut:	Middlesex, New Haven, Toland.
Illinois:	Cooke.
Indiana:	Knox, White.
Iowa:	Des Moines, Jackson, Johnson, Polk, Poweshiek.
Kansas:	Douglas, Ellis, Lyon, Russell, Sedgwick, Woodson.
Louisiana:	Acadia, Jefferson Davis, Orleans, Plaquemines.
Maine:	Cumberland, Hancock, Knox, Lincoln, Penobscot.
Massachusetts:	Barnstable, Dukes, Essex, Nantucket, Suffolk.
Michigan:	Kalamazoo, St. Clair.
Missouri:	Jasper, St. Louis, Vernon.
Nebraska:	Adams, Buffalo, Douglas, Fillmore, Hall, Hamilton, Lincoln, Madison, York.
New York:	Monroe, Nassau, Niagara, Suffolk, Queens.
Ohio:	Hamilton.
Oklahoma:	Osage.

Pennsylvania:	Eric.
South Dakota:	Brown, Clay, Douglas, Hanlin, Pennington, Yankton.
Texas:	Aransas, Bexar, Cameron, Calhoun, Cooke, Galveston, Kendall, Lampassas, Nueces, Pecos, San Patricio, Victoria, Washington, Wise, Young.
Wisconsin:	Dodge.

HABITAT

The Eskimo curlew nested on treeless Arctic tundra, fed in open natural grassland and tundra, burned prairies, meadows, pastures, plowed lands, and intertidal zones during migration and on wintering grounds. Most of the time was spent in the North American tundra and tall-grass prairie, and the South American pampas (MacFarlane 1881; Coues 1861, 1874; Cooke 1910; Swenk 1916; Bent 1929; Greenway 1958).

FOOD AND FORAGING BEHAVIOR

The chief food in late summer on Arctic tundra, including the migration staging area in Labrador, was crowberry (*Empetrum nigrum* and blueberry *Vaccinium* sp.). (Audubon 1835; Coues 1861, 1874; Townsend 1907; Greenway 1958.) A small species of snail abounding on rocks in intertidal areas in southern Labrador was also eaten extensively (Coues 1861). Ants were mentioned as food on tundra breeding areas (Swainson and Richardson 1881, Bent 1929, Coues 1861). Grasshoppers (*Melanoplus* sp.) and their egg capsules or pods, obtained by probing in unplowed prairie land, were important food on the spring migration (Swenk 1916). On plowed land, they fed on white grubs and cutworms (Swenk 1916). Adult grasshoppers would not be available on the prairies as early in spring as curlews were moving through successive temperature zones on way north (U.S. Entomological Commission 1877), so only egg pods and emerging young grasshoppers were present at that time.

SHELTER REQUIREMENTS

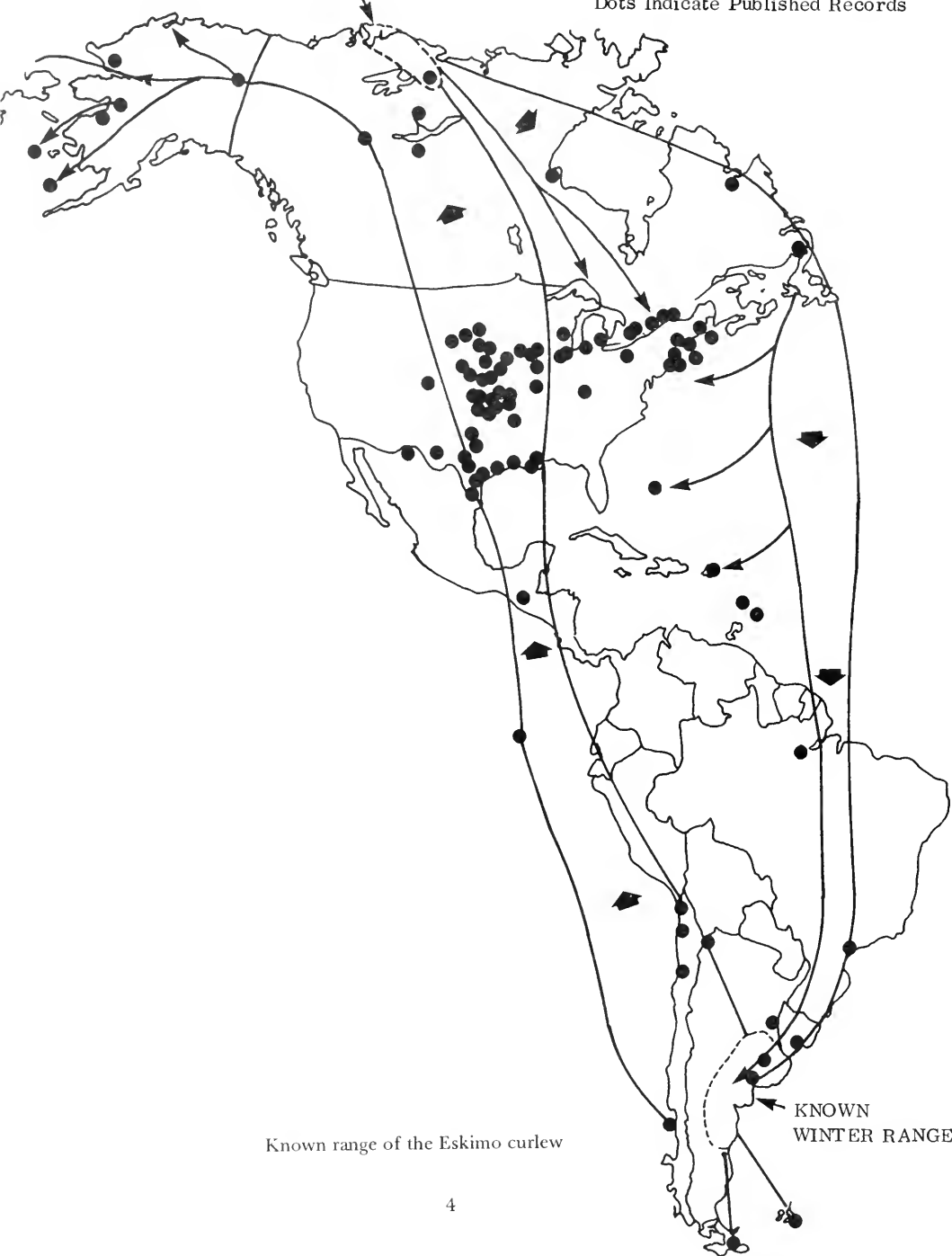
None known.

NESTING OR BEDDING

Nests are shallow depressions in the surface of

KNOWN BREEDING RANGE

Dots Indicate Published Records



Known range of the Eskimo curlew

open tundra, lined sparsely with decayed leaves and dried grasses (MacFarlane 1891).

There is no information on any special roosting behavior or requirements. Roosting is evidently in the open in the same habitat as nesting and winter and migration feeding.

RITUAL REQUIREMENTS

None known. Presumably, there is an aerial territory flight song like other shorebirds have.

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

Open Arctic tundra for nesting and summer feeding. Extensive natural upland grassland for winter and migration feeding.

POPULATION NUMBERS AND TRENDS

No exact population counts or even reliable estimates have ever been made. Comments of early observers were that the curlews were formerly present in tremendous numbers on the Labrador and prairie migration stopovers. They arrived in Texas in "immense flocks" in spring from 1856-1875 (Bent 1929).

In Kansas, they were abundant as late as 1878, but were much reduced in 1879 and decreased rapidly after that (Bent 1929). From 1866 to 1888, they reached Omaha, Neb., in late April, remaining in force for a week to 10 days. Enormous flocks consisting of thousands of individuals formed dense masses extending a quarter to a half mile (0.4-0.8 km) in length and a hundred or more yards (91 m) in width which, when alighting, would cover 40 to 50 acres (16 to 24 hectares) of ground. At that time, they were slaughtered literally by the cart-load. Their numbers in the prairies began diminishing rapidly in the early 1880's (Swenk 1916). On the Labrador migration staging area in 1833, Audubon (1835) described great flocks that reminded him of passenger pigeon abundance. A "cloud" of curlews in fall migration was seen on the Magdalen Islands in 1890—perhaps the last big flocks seen in the east (Forbush 1912). During the last 50 years, very few have been seen during migration at any one time. The most recent records are Galveston Island, Texas, 22 March 1959 (1), 3 April 1960 (1), 31 March 1961 (1), 24 March 1962 (1), and 31 March 1962 (2) (Emanuel 1962); Barbados, West Indies, fall migra-

tion 1963 (1 specimen); North Point, West side of James Bay, Ontario, 15 August 1976 (2).

REPRODUCTION

Nests are very difficult to find. Incubating birds flush long before observers approach. Eggs, usually 4 to a clutch, resemble the grass in color, being dark brownish green to blue blotched with brown, more heavily on the larger end (MacFarlane 1891). Eggs were present in nests at Fort Anderson, Mackenzie from May 27 through June 13 (MacFarlane 1891). Eggs were found at Point Lake, Mackenzie, on 13 June 1822 (Swainson and Richardson 1881). Time of hatching and length of time young are dependent on adults is unknown, but by the end of July the breeding season is over for the most part and the adults head south, soon to be followed by the young.

MANAGEMENT AND CONSERVATION

With the present state of our knowledge of the distribution of the remaining Eskimo curlew population, particularly during the breeding and wintering seasons, nothing can be done to manage it except to rigidly protect the occasional individuals that are discovered; to keep a lookout for them in areas where they formerly concentrated, such as the southern tip of the Labrador Peninsula, the coast of New England and Long Island, the tall-grass prairie belt from the coast of Texas and Louisiana north to South Dakota, and the Argentina grasslands from Buenos Aires south to the Chubut River. Also, special effort should be made to locate the present breeding grounds of the small remaining population, with special attention given to the former breeding area along the Arctic coast between the Anderson and Coppermine Rivers and south to Great Bear Lake, Mackenzie. It might be beneficial to increase the area of unplowed grassland along the migration routes and/or in wintering grounds.

AUTHORITIES

No living person has had enough personal experience with Eskimo curlews to be considered an authority on the species.

PREPARER'S COMMENTS

The preparer has been most impressed by the

failure of the Eskimo curlew population to recover from its rapid decline in the 1880's after hunting was stopped, in contrast with the golden plover, a shorebird with a similar migration pattern with which it associated in migration and on its wintering grounds. The decrease in availability of grasshopper egg pods, which were much more numerous before most of the natural grassland of the tall grass prairie belt was plowed up to plant crops (U.S. Entomological Commission 1877) may have been the main reason for failure to recover. Grasshoppers avoid cultivated land for egg laying and the great destructive flights of grasshoppers in the American prairies declined at about the same time as the Eskimo curlew; both coincided with the extensive breaking of the prairie sod in the American Midlands.

LITERATURE CITED/SELECTED REFERENCES

- American Ornithologists's Union. 1957. Checklist of North American Birds, 5th ed. Port City Press, Baltimore, Md.
- Audubon, J. J. 1835. Ornithological Biography, Vol. 3:69.
- Austin, O. L., Jr. 1932. The birds of Newfoundland Labrador. Memoirs Nuttall Ornith. Club. Cambridge, Mass.
- Baerg, W. J. 1931. Birds of Arkansas. Agric. Exp. Sta. U. of Arkansas, Fayetteville.
- Banks, R. C. 1977. The decline and fall of the Eskimo Curlew, or why did the curlew go extaille? Amer. Birds 31:127-134.
- Barrows, W. B. 1884. Birds of lower Uruguay. Auk 1:313-319.
- Beardslee, C. S. and H. D. Mitchell. 1965. Birds of the Niagara Frontier Region. Bull. Buffalo Soc. Nat. Sci. 22.
- Bent, A. C. 1929. Life histories of North American shorebirds. Part II. U.S. Nat. Mus. Bull. 146.
- Bond, J. 1956. Checklist of birds of the West Indies. Acad. Nat. Sci. Philadelphia.
- Bull, J. 1964. Birds of the New York Area. New York, Harper and Row Publishers.
- Butler, A. W. 1898. The Birds of Indiana. Indiana Dept. Geol. & Nat. Resources 22nd Ann. Report. Indianapolis.
- Coues, E. 1861. Notes on the ornithology of Labrador. Proc. Acad. Nat. Sci. Philadelphia 13:215-257.
- . 1874. Birds of the Northwest; a handbook of the ornithology of the region drained by the Missouri River and its tributaries. U.S. Geol. Surv. Terr. Wisc. Publ. No. 3, 791 pp.
- Cooke, W. W. 1910. Distribution and migration of North American shorebirds. Bur. Biol. Surv. Bull. 35:1-100.
- Dement'ev, L. P., and N. A. Gladkov, ed. 1969. Birds of the Soviet Union Vol. III. Translated from Russian by Israel Program for Scientific Translators, Jerusalem pp. 356-360.
- DuMont, P. A. 1934. A revised list of the birds of Iowa. U. of Iowa Studies 15(5):1-171.
- Emanuel, V. L. 1961. Another probable record of an Eskimo Curlew on Galveston, Island, Texas. Auk 78:259-260.
- . 1962. Texans rediscover the near extinct Eskimo Curlew. Audubon Magazine 64:162-165.
- Farrand, J., Jr. 1977. What to look for: Eskimo and Little Curlews compared. Amer. Birds 31: 137-138a.
- Fish and Wildlife Service. 1973. Threatened Wildlife of the United States. Resource Publ. 114, 289 pp.
- Forbush, E. H. 1912. A history of the game birds, wildfowl and shorebirds of Massachusetts and adjacent states. Mass. State Board of Agric. Boston 622 pp. (p. 416)
- . 1925. Birds of Massachusetts and other New England states. Part I. Mass. Dept. Agric. Boston.
- Greenway, J. C., Jr. 1958. Extinct and vanishing birds of the world. Spec. Publ. No. 13 Amer. Comm. Internat. Wildlife Protection. New York 518 pp.
- Griscom, L. and D. E. Snyder. 1955. The Birds of Massachusetts, and annotated and revised list. Salem, Peabody Museum.
- Griscom, L. and E. V. Folger. 1948. The Birds of Nantucket. Harvard Univ. Press, Cambridge.
- Hagar, J. A. and K. S. Anderson. 1977. Sight record of Eskimo Curlew. Amer. Birds 31:135-136.

- Housse, P. R. 1945. Las Aves de Chile. Ediciones de la Universidad de Chile.
- Jones, Lynds. 1903. Birds of Ohio. Ohio State Acad. Sci. Spec. Papers No. 6.
- Johnson, A. W. 1965. The birds of Chile. Buenos Aires, Platt Establecimientos Graficos S.A.
- Johnston, R. F. 1960. Directory to the bird-life of Kansas. U. of Kansas, Mus. Nat. Hist. Misc. Pub. 23:172.
- MacFarlane, R. 1891. Notes on and list of birds collected in Arctic America, 1861-1866. (*Numenius* p. 429) Proc. U.S. Nat. Mus. 14: 413-446.
- MacKay, G. H. 1892. Habits of the Eskimo Curlew (*Numenius borealis*) in New England. Auk 9:16-21.
- Merriam, C. H. 1877. A review of the birds of Connecticut. New Haven, Tuttle, Morehouse and Taylor Printers.
- Murdock, J. 1885. Bird Migration at Point Barrow, Arctic Alaska. Auk 2:63.
- Murphy, R. C. 1933. Probable record of Eskimo Curlew (*Numenius borealis*) at Montauk Point, N.Y. Auk 50:101-102.
- Nelson, E. W. 1887. Report on Natural history collections made in Alaska between years 1877 and 1881. Arctic series of publications issued in connection with the Signal Service, U.S. Army. Wash. D.C. G.P.O.
- Oberholser, H. C. 1938. The bird life of Louisiana. Louisiana Dept. of Conservation. Bull. 28.
- . 1974. The bird life of Texas. Vol. I. U. of Texas Press, Austin.
- Palmer, R. S. 1949. Maine birds. Bull. Mus. Comp. Zool., Harvard, 102:656 pp.
- Peters, H. S. and T. D. Burleigh. 1951. The Birds of Newfoundland. Dept. Nat. Resources, Newfoundland, St. Johns.
- Ridgway, R. 1919. The birds of North and Middle America. Part VIII. Bull. 50. U.S. Nat. Mus. p. 413.
- Roberts, T. S. 1932. The birds of Minnesota. Vol. I. Minneapolis, Univ. of Minnesota Press.
- Sage, J. H. and L. B. Bishop. 1913. The birds of Connecticut. Conn. Geol. and Nat. Hist. Surv. Bull. 20.
- Salvin, O. 1861. A list of species to be added to the ornithology of Central America. Ibis 39: 351-356.
- Sclater, P. L. and W. H. Hudson. 1889. Argentine Ornithology. Vol. 2. R. H. Porter London. p. 192.
- Swainson, W. and J. Richardson. 1881. Birds (part second) Fauna Boreali-Americana. London, John Murray.
- Swenk, M. H. 1916. The Eskimo Curlew and its disappearance. Smithsonian Rep. for 1915, pp. 325-340.
- . 1926. The Eskimo Curlew in Nebraska. Wilson Bull. 38:117-118.
- Todd, W. E. C. 1940. Birds of Western Pennsylvania. Univ. Pittsburg Press.
- . 1963. Birds of the Labrador Peninsula and adjacent areas. Toronto, Univ. Toronto press.
- Townsend, C. W. and G. M. Allen. 1907. Birds of Labrador. Proc. Boston Soc. Nat. Hist. 33: 277-428.
- Tufts, Robie W. 1961. The birds of Nova Scotia. Nova Scotia Museum, Halifax.
- U.S. Entomological Commission. 1877. First Annual Report of the U.S. Entomological Commission for the year 1877 relating to the Rocky Mountain Locust.
- Vincent, J. (Compiler). 1966. Red data book. Vol. 2. Aves. Internatl. Union for Conservation of Nature and Natural Resources. Morges, Switzerland.
- Wetmore, A. 1926. Observations on the birds of Argentina, Paraguay, Uruguay and Chile. U.S. Nat. Mus. Bull. 133:448 pp.
- . 1939. Recent observations on the Eskimo curlew in Argentina. Auk 56:475.
- Widmann, O. 1907. Birds of Missouri. St. Louis.
- Williams, G. G. 1959. Probable Eskimo Curlew on Galveston Island, Texas. Auk 76:539-541.
- Wood, N. A. 1951. The birds of Michigan. Univ. of Mich Press, Ann Arbor.

Biological Services Program

FWS/OBS-80/01.18
March 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States- **SOUTHERN SEA OTTER**



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES

SOUTHERN SEA OTTER

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: W. C. LOY, USFWS

SOUTHERN SEA OTTER
Enhydra lutris nereis [Merriam]

REASONS FOR CURRENT STATUS

KINGDOMAnimalia
 CLASSMammalia
 ORDERCarnivora
 FAMILYMustelidae
 OTHER COMMON
 NAMESCalifornia sea otter

DATE
 Entered into SWISTo be determined
 Updates1 November 1978

LEGAL STATUS
 Federal Threatened (42 FR 2965, 14 Jan 1977)
 States Fully protected: California

The southern sea otter is the southernmost form of a marine mammal that originally extended along the rim of the Pacific Ocean from the northern islands of Japan to Baja California. Originally estimated to number from 16,000 to 10,000 off the California coast, the species was heavily hunted for its valuable fur by Russian, Indian, Spanish, British, and American traders. By 1911, the California population was reduced to an estimated 50 animals. Following protection afforded by the International Fur Seal Treaty of 1911 and by the State of California in 1913, the population began to recover. A survey conducted by the California Department of Fish and Game in 1976 estimated the population at about 1,860 individuals located along a 257-km span of coastline (Woodhouse et al. 1977). The population now (1978) occurs along about 320 km of coastline. Considering that there are oil depots at both ends of the current range (Moss Landing and Morro Bay) and increased tanker traffic offshore,

and that sea otters may die if their fur is contaminated by oil, the current population size and distribution is marginal to insure survival.

PRIORITY INDEX

Not assigned.

DESCRIPTION

Although the smallest of marine mammals, the sea otter is the largest member of the weasel family. Adult otters in California weigh from 20 to 39 kg and are from 1 to 1.6 m long. The dense, dark-brown fur may become grizzled with age, especially in older males, and the forelimbs are modified for feeding, while the flipper-like hind limbs are used in swimming (Merriam 1904, Kenyon 1969). The skull is flattened dorsally, with large nasal openings; two rear upper cheek teeth are wider than long; there are three upper premolars and two lower incisors on each side of the jaw (Hall and Kelson 1959).

RANGE

Originally found from Morro Hermoso, Baja California, north along the Pacific Coast to California, Oregon, and Washington, the sea otter is currently restricted to coastal waters of central California. Established populations now occur from Año Nuevo Island in the north to Avila Beach to the south (Wild and Ames 1974). Occasional individuals are seen in California as far north as Humboldt County and as far south as Los Angeles County.

RANGE MAP

The extent of coastline supporting established populations of the southern sea otter is shown by shading on the accompanying map (Wild and Ames 1974, R. J. Jameson, pers. observ.).

STATES/COUNTIES

California Santa Cruz, Monterey, San Luis Obispo

HABITAT

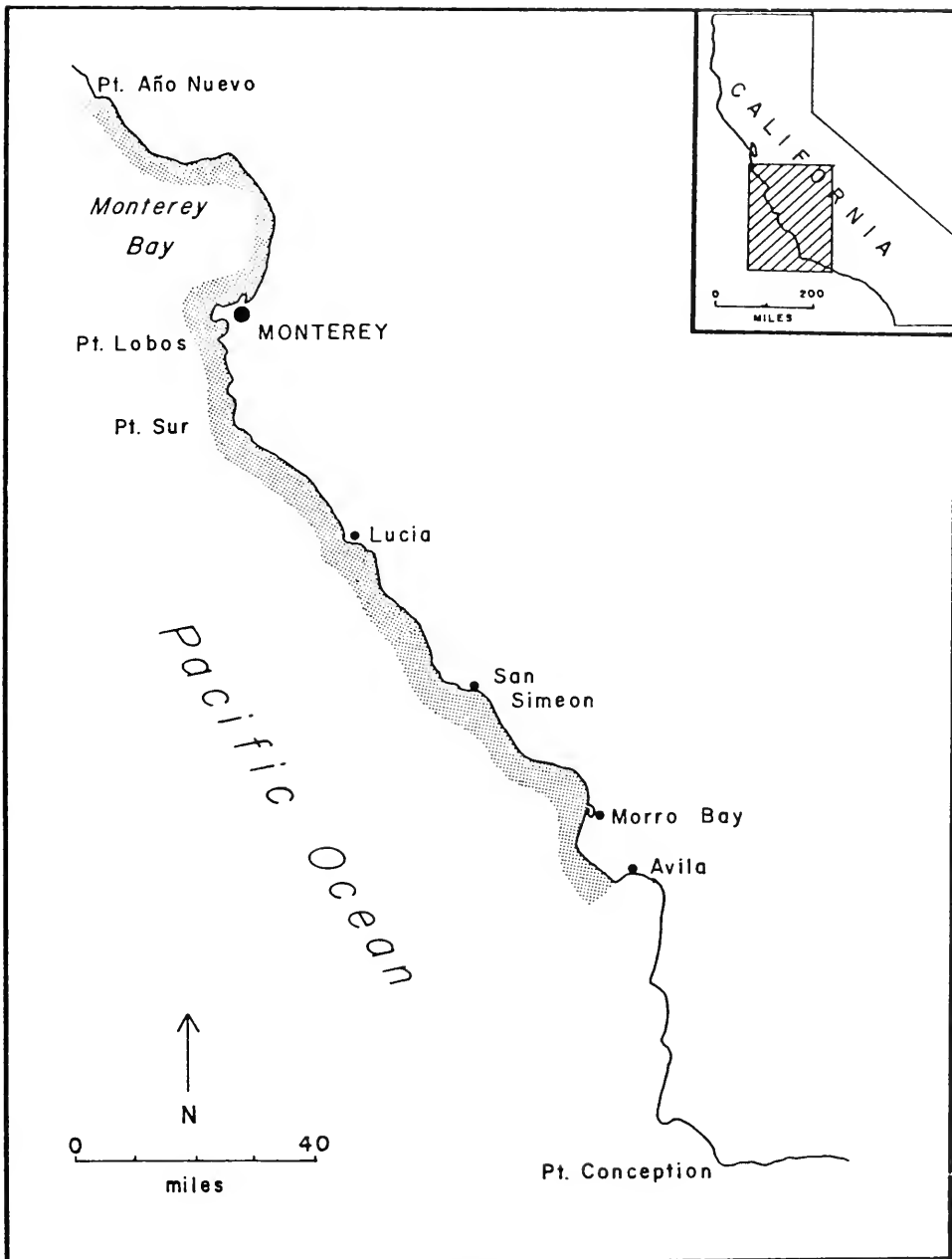
Otter habitat is the neritic zone within 3 miles of shore; the animals are usually found within one-half mile of shore and occasionally on shore.

Associated with a wide variety of sublittoral communities, the presence of an adequate food supply is an important factor in determining the presence of sea otters (Woodhouse et al. 1977). Although found over sandy substrates, sea otter population centers seem to be associated with hard substrates and stands of kelp (*Macrocystis pyrifera* and *Nereocystis lutekana*). Water depth ranges from 0 to 36 m; in California, sea otters are usually found in depths of less than 25 m. Shelter from storm waves seems to be a requirement, either in the form of kelp beds or sheltered coves (Kenyon 1969).

FOOD AND FORAGING BEHAVIOR

Food supply represents a critical environmental factor for sea otters. A sea otter consumes about 20% to 25% of its body weight in food each day (Kenyon 1969), and a meal passes through the digestive tract in about 2.8 hr (Stullken and Kirkpatrick 1955). This large volume of food is apparently needed to maintain body temperature in cold waters (Morrison et al. 1974). To meet these requirements, Loughlin (1977) found that radio-tagged otters spent 34% of their total time (or 73% of their active time) in foraging. Sea otters are active both day and night, and 45% of their foraging is nocturnal (Loughlin 1977, Shimek and Monk 1977). Feeding is usually in water 1 to 25 m deep. Occasionally, individuals will leave the water at low tide to forage for mussels (*Mytilus californianus*), but they return to the water to eat them (R. J. Jameson, unpubl.). Foraging dives range from 10 to 120 sec, but are usually less than 60 sec long. Depth of water and availability and type of prey seem to be important factors in determining the length of these foraging dives. Food is usually gathered from the bottom, but California sea otters spend considerable time foraging in the kelp canopy where snails (*Tegula* spp) and kelp crabs (*Pugettia producta*) are abundant. A stone 'tool' may be used to break hard-shelled molluscs, such as abalone, from the bottom (Houk and Geibel 1974) and at the surface, this tool may be used as an anvil to break mollusc shells (Hall and Schaller 1964). Woodhouse et al. (1977) conclude that the type of food eaten corresponds to availability more than to preference, although foraging energetics certainly favors the collecting of food items with high caloric rewards.

Foods commonly taken by sea otters in Cali-



The range of the southern sea otter

ifornia include the following: abalone (*Haliotis* sp.), Turban snails (*Tegula* sp.), sea urchins (*Strongylocentrotus* sp.), rock crabs (*Cancer* sp.), kelp crabs (*Pugettia* sp.), mussels (*Mytilus* sp.), Pismo clams (*Tivela stultorum*), and octopus (*Octopus* sp.). (Hall and Schaller 1964, Ebert 1968, Wild and Ames 1974, Miller et al. 1975, Woodhouse et al. 1977).

In recently reoccupied habitat, the diet may consist almost exclusively of readily available large food items such as abalone, sea urchins, and Pismo clams, but with continued occupancy and consequent depletion of large, easily obtained food items, the otters' diets become more diverse (Wild and Ames 1974).

SHELTER REQUIREMENTS:

Sea otters in California do not 'haul out' as frequently as they do in Alaska; however, in recent years several regular hauling areas have been discovered. These areas are used primarily during the winter and spring months when kelp beds are reduced in size, and air and water temperatures are lower (R. J. Jameson, unpubl.). Most of the year, otters seek shelter in the extensive beds of giant kelp that occur throughout most of the present range.

NESTING OR BEDDING:

Sea otters may roll themselves in kelp fronds while resting or sleeping, presumably to avoid transport by wind and currents. Mothers will similarly leave pups in kelp while diving for food (Fisher 1939). Typical haul-out areas are relatively low-lying intertidal rocks covered with a lush growth of a variety of marine algae.

RITUAL REQUIREMENTS:

Sea otters are most frequently members of aggregations known as 'rafts' (Loughlin 1977, Schneider 1978). Territoriality may be expressed by some males who defend areas near female rafts, but the evidence for territoriality is circumstantial and needs to be better documented. Otters are known to remain in the same limited

area for extended periods (Loughlin 1977). During the breeding season, a male-female pair may remain together for only one copulation, or may form a bond that can last several days (Kenyon 1969, Vandever 1970). It is not known if a special set of habitat characteristics are required for courtship and breeding, but available information suggests there are none.

OTHER ENVIRONMENTAL REQUIREMENTS

Lacking a layer of blubber, sea otters depend on air trapped in their dense fur for insulation against heat loss to their environment (Kenyon 1969). With captives, Kenyon discovered that soiled fur rapidly loses its insulating ability, rendering the animal a sure victim to hypothermia. Recent experiments in Alaska have shown that sea otters exposed to crude oil floating on the water can die (Siniff et al. 1977). This finding is of critical importance, since it relates to the potential damage to otters from offshore oil pollution. Although no wild sea otter deaths have yet been reported from oil pollution in California, a major spill could be very damaging (California Department of Fish and Game 1976).

POPULATION NUMBERS AND TRENDS

The rate of increase of the California sea otter population has been 5.4% per year since 1940 (Woodhouse et al. 1977). The present population is far below the 16,000 estimated as the potential for California waters (California Department of Fish and Game 1976), or the estimate of 47,800 given by Miller (1974) for all waters from the Oregon-California border to Morro Hermoso, Baja California. While the currently occupied range may be nearing carrying capacity, population growth has occurred in recent years by expansion of the range both up and down the coast (Wild and Ames 1974). Observations indicate that high densities of otters occur at the limits of the range. These groups, consisting primarily of males, move into unoccupied territory as the food supply behind them is depleted (California Department

of Fish and Game 1976). If expansion and population growth are allowed to continue at current rates, doubling of population size could be expected every 15 years.

Resident sea otters are relatively sedentary; the average linear dimension of the home range is about 2.5 km (Loughlin 1977). Females have larger home ranges (averaging 80 ha) than males (38.5 ha) (Loughlin 1977); however, recent tagging studies indicate that some otters, particularly males, use large segments of coastline up to 160 km (R. J. Jameson Unpubl.). These individuals spend the winter with large rafts of males near the ends of the range, returning to the central part during the peak breeding season (summer). They have few natural enemies. White sharks apparently prey on sea otters (Morejohn et al. 1975). Most mortality seems to occur in young of the year and older individuals (Kenyon 1969, Morejohn et al. 1975). Sea otters have moderate to heavy loads of internal parasites (Morejohn et al. 1975), and these may cause higher mortality during times of stress. Due to the high daily caloric requirement, severe winter storms preventing feeding may be responsible for additional mortality (Wild and Ames 1974),

REPRODUCTION

Some female sea otters begin reproductive activity at 3 years of age, and all over 6 years are reproducing. Males do not mature until 5 or 6 years of age (Schneider 1978). Breeding season peaks from July to September (R. J. Jameson Unpubl.), and pupping is most frequent from November through March (Vandever 1970). Implantation is delayed 4 to 4½ months, and development then proceeds for 4 to 4½ months, making the gestation period 8 to 9 months overall (Sinha et al. 1966, Schneider 1978). Twinning is rare among sea otters, and it is unlikely that a female could support two pups. Two years has been accepted as the interval between births (Kenyon 1969), but recent studies in Alaska and California indicate that some females pup in consecutive years.

MANAGEMENT AND CONSERVATION

The California sea otter population currently represents a slowly recovering population of marine mammals occupying only part of its original

range. With few natural enemies, continued growth in numbers and range may be expected. Because of its relatively low reproductive potential, continued protection from human predation and habitat degradation will be necessary if this recovery is to continue. The most recent sea-otter survey, conducted by the California Department of Fish and Game in 1979 resulted in an estimate of less than 1,500, a decrease of about 300 from the 1976 census. Since the weather conditions during the 1979 survey were unfavorable, it is considered quite low.

Kelp forests growing along rocky coasts appear to constitute optimum otter habitat in California. Estes and Palmisano (1974) indicated that sea otter predation on herbivores may be important in the maintenance of large stands of kelp. If increased growth of macrophytes is correlated with this predation by sea otters, their presence in an area may increase primary productivity. The trophic consequences of the reestablishment of the sea otter population remain to be seen. Meanwhile, protecting the kelp bed habitat from physical and chemical degradation will continue to be important for the entire littoral ecosystem.

The southern sea otter now occupies only a small fraction of its original range. The continuity of the sea otters' current territory makes the species quite vulnerable to catastrophic events and augments the importance of establishing satellite populations in other parts of its former range to insure its survival. Previous translocation programs have demonstrated the feasibility of establishing new populations of the sea otter (Kenyon 1969, Jameson et al. 1978). Establishment of satellite populations will greatly decrease the probability of the entire population's being destroyed by an epizootic or an oil spill.

In the past 10 years, questions have arisen concerning the compatibility of the sea otter with sport and commercial shellfishing interests. The abundance of large abalones, sea urchins, and Pismo clams diminishes following reoccupancy of an area by sea otters (Miller 1974, Woodhouse et al. 1977). However, other studies indicated that after the initial period of reinvasion, the diet of the sea otter becomes more diverse, and the community food web may enjoy a broader base resulting from reduction of the numbers of large herbivores (Palmisano and Estes 1977, Rosenthal and Barilotti 1973), and a consequent increase of

macrophytic algae. Under such a regime of predation, large herbivores are usually restricted to refugia protected from carnivores (Lowry and Pearse 1973, Cooper et al. 1977). This was apparently the undisturbed condition of California sublittoral communities (Rashkin 1972). The superabundance of large herbivores upon which the commercial shellfish industry is based is apparently an artifact of the historic reduction in sea otter numbers. Herbivore-carnivore numbers can be expected to return to equilibrium following the sea otter's reoccupancy of its former range.

AUTHORITIES

Ronald J. Jameson
National Fish and Wildlife Laboratory
Piedras Blancas Field Station
P.O. Box 67
San Simeon, California 93452

Karl W. Kenyon
U.S. Fish and Wildlife Service (retired)
11990 Lakeside Place N.W.
Seattle, Washington 98125

A. M. Johnson
National Fish and Wildlife Laboratory
Anchorage Field Station
4454 Business Park Boulevard
Anchorage, Alaska 99503

James E. Estes
National Fish and Wildlife Laboratory
CCMS; Applied Science Building
University of California
Santa Cruz, California 95064

J. E. Vandever
93 Via Ventura
Monterey, California 93940

Tom Loughlin
National Marine Fisheries Service
Marine Mammals and Endangered Species Div.
F-33 NMFS
Washington, D.C. 20235

D. Miller and J. Ames
California Department of Fish and Game
2201 Garden Road
Monterey, California 93940

PREPARER'S COMMENTS

Recently there has been some controversy over the systematic status of the southern populations of sea otter (Roest 1973, 1976; Davis and Lidicker 1975). Pointing to an apparent latitudinal cline in some skull measurements, Roest (1973) contended that the southern sea otter is not subspecifically distinct, but represents one end of a size continuum. Davis and Lidicker (1975) argue that available evidence is best interpreted to suggest that a genetically distinct group of sea otters exists off the California coast.

Subspecies are often recognized primarily on morphological criteria, which usually are the result of genetic divergence due to selection within different sets of environmental parameters. To date, most attention has been paid to relatively few cranial measurements in sea otters. The northern and southern populations of the sea otter appear to display some differences in diet and anatomy as well as in cranial morphology (Woodhouse et al. 1977, Miller 1974), which may or may not be genetically based. It is certainly possible that selection has resulted in some genetic divergence between these populations. However, we suggest the application of modern systematic techniques aimed at assessing this genetic distance between populations (such as karyology, protein electrophoresis, immunology, and perhaps DNA annealing) to adequately resolve this controversy. Meanwhile, it would be inappropriate to sacrifice the protection afforded the recovering southern populations to the matter at hand, because sections 3 and 4 of the Act allows [sic] the listing of populations of species in portions of their range, as well as entire species and subspecies. Since the southern sea otter does form a significant population, it can be treated independently under the Act, regardless of its taxonomic status. The Service decided, however, to utilize the subspecific designation *Enhydra lutris nereis* in this rule-making, although this decision had no connection with the decision to list as threatened."

LITERATURE CITED/SELECTED
REFERENCES

- Barabash-Nikiforov, I. I., V. V. Reshetkin, and N. K. Shidlovskaya. 1947. The sea otter (kalan). Transl. from Russian by A. Birron and Z. S. Cole. 1962. Nat. Sci. Found. and U.S. Dept. Int., Washington, D.C. (Israel Program for Sci. Transl.).
- Bolin, R. L. 1938. Reappearance of the southern sea otter along the California coast. J. Mamm. 19:301-303.
- Booolotian, R. A. 1961. The distribution of the California sea otter. Calif. Fish and Game 47:287-292.
- California Dept. of Fish and Game. 1976. A proposal for sea otter protection and research, and request for the return of management to the state of California., 2 vol., unpubl.
- Cooper, J. M. and A. Hines. 1977. Subtidal abalone populations in an area inhabited by sea otters. Veliger 20:163-167.
- Davis, J. and W. Z. Lidicker, Jr. 1975. The taxonomic status of the southern sea otter. Proc. Calif. Acad. Sci. 40:429-437.
- Ebert, E.E. 1968. A food habits study of the henn sea otter, *Enhydra lutris nereis*. Calif. Fish and Game 54:33-42.
- Estes, J.A. 1977. Population estimates and feeding behavior of sea otters. pp 511-525 in M.L. Merritt and R. G. Fuller, eds., The Environment of Amchitka Island, Alaska. U.S. ERDA TID-26712.
- Estes, J.A. and J. F. Palmisano. 1974. Sea otters: their role in structuring nearshore communities. Science, 185:1058-1060.
- Fisher, E. M. 1939. Habits of the southern sea otter. J. Mammal 20:21-36.
- Hall, E. R. and K. R. Kelson. 1959. The mammals of North America. Ronald Press, New York.
- Hall, K. R. L. and G. B. Schaller. 1964. Tool-using behavior of the California sea otter. J. Mammal 45:287-298.
- Houk, J. L. and J. J. Geibel. 1974. Observation of underwater tool use by the sea otter, *Enhydra lutris* Linnaeus. Calif. Fish and Game 60:207-208.
- Jameson, R. J., A. M. Johnson and K. W. Kenyon. 1978. The status of translocated sea otter populations in the eastern Pacific Ocean. Proc. 2nd Conf. Biol. Marine Mamm. p.8.
- Kenyon, K.W. 1969. The sea otter in the eastern Pacific ocean. No. Amer. Fauna. 68 pp.
- Lensink, C. J. 1962. The history and status of sea otters in Alaska. Unpubl. Ph.D. dissertation, Purdue Univ. pp.
- Loughlin, T. R. 1977. Activity patterns, habitat partitioning, and grooming behavior of the sea otter, *Enhydra lutris*, in California. Unpubl. Ph.D. dissertation, Univ. of Calif., Los Angeles. pp.
- Lowry, L. F. and J. S. Pearse. 1973. Abalones and sea urchins in an area inhabited by sea otters. Mar. Biol. 23:213-219.
- Merriam, C. H. 1904. A new sea otter from southern California. Proc. Biol. Soc. Washington 17:159-160.
- Miller, D.J. 1974. The sea otter *Enhydra lutris*. Calif. Dept. Fish and Game, Marine Resources Leaflet 7. pp.
- Miller, D. J., J. E. Hardwick and W. A. Dahlstrom. 1975. Pismo Clams and sea otters. Calif. Dept. Fish and Game, Marine Resources Tech. Rep. 31. pp.
- Morejohn, G. V., J. A. Ames, and D. B. Lewis. 1975. Post mortem studies of sea otters, *Enhydra lutris* L., in California. Calif. Dept. Fish and Game, Marine Resource Tech. Rep. 30. pp.
- Morrison, P., M. Rosenmann, and J. A. Estes.

1974. Metabolism and thermoregulation in the sea otter. *Physiol. Zool.*, 47:218-229.
- Palmisano, J. F. and J. A. Estes. 1977. Ecological interactions involving the sea otter. pp. 527-567, in M. L. Merritt and R. G. Fullers, eds., *The Environment of Amchitka Island, Alaska*. U.S. ERDA TID - 26712.
- Rashkin, P. 1972. Monterey Peninsula shell mounds - some general remarks. *Monterey Co. Archaeol. Soc. Quart.* 1:5.
- Roest, A. I. 1973. Subspecies of the sea otter, *Enhydra lutris*. *Los Angeles Co. Mus. Contrib. Sci.* 252:1-17.
- . 1976. Systematics and the status of sea otters, *Enhydra lutris*. *Bull. So. Calif. Acad. Sci.* 75:267-270.
- Rosenthal, R. J. and D. C. Barilotti. 1973. Feeding behavior of transplanted sea otters and community interactions off Chichagof Island, southeast Alaska. pp. 74-88, in W. J. North, ed., *Calif Inst Tech., Kelp Habitat Improv. Proj., Ann. Rep.* 1 July 1972-30 June 1973.
- Sandegren, F. E., E. W. Chu, and J. E. Vandever. 1973. Maternal behavior in the California sea otter. *J. Mammal* 54:668-679.
- Scheffer, V. B., and F. Wilke. 1950. Validity of the subspecies *Enhydra lutris nereis*, the southern sea otter. *J. Washington Acad. Sci.* 40:269-272.
- Schneider, K. B. 1978. Sex and age segregation of sea otters. *Alaska Dept of Fish and game, Final Rep., Job 8.9R* 45 pp.
- Shaw, S. B. 1971. Chlorinated hydrocarbon pesticides in California sea otters and harbor seals. *Calif. Fish and Game* 57:290-294.
- Shimek, S. J. and A. Monk. 1977. Daily activity of sea otter off the Monterey peninsula, California. *J. Wildl. Mgmt.* 41(2):277-283.
- Sinha, A. A., C. H. Conaway, and K. W. Kenyon. 1966. Reproduction in the female sea otter. *J. Wildl. Mgmt.* 30(1):121-130.
- Siniff, D. B., A. M. Johnson, and T. W. Williams. 1977. Observations on responses of sea otters (*Enhydra lutris*) to oil contamination. *Proc. 2nd Conf. Biol. Mar. Mammal.* p. 32.
- Stephenson, M. D. 1977. Sea otter predation on pismo clams in Monterey Bay. *Calif. Fish and Game* 63:117-120.
- Stullken, D. E., and C. M. Kirkpatrick. 1955. Physiological investigation of captivity mortality in the sea otter (*Enhydra lutris*). *Trans. 20th N. Amer. Wildl. Conf.* pp. 476-494.
- Vandever, J. E. 1970. Reproduction in the sea otter. pp. 221-227, in *Proc. 7th Ann. Conf. on Biol. Sonar and diving Mammals*, Stanford Res. Inst., Menlo Park, Calif.
- Wild, P. W. and J. A. Ames. 1974. A report on the sea otter, *Enhydra lutris* L., in California. *Calif. Dept Fish and Game, Marine Resources Tech. Rep.* 20. pp.
- Woodhouse, C. D., R. K. Cowen, and L. R. Wilcoxon. 1977. A summary of knowledge of the sea otter, *Enhydra lutris*, L., in California and an appraisal of the completeness of biological understanding of the species. *U.S. Mar. Mammal Comm. Rep. No. MMC-76/02* (PB 270 374).

ACCOUNT PREPARED BY

National Fish and Wildlife Laboratory
Piedras Blancas Field Station
P.O. Box 67
San Simeon, California 93452

National Fish and Wildlife Laboratory
1300 Blue Spruce Drive
Fort Collins, Colorado 80524

Biological Services Program

FWS/OBS-80/01.19

March 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States- **MORRO BAY KANGAROO RAT**



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

FWS/OBS-80/01.19
March 1980

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—
MORRO BAY KANGAROO RAT

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: GLENN R. STEWART

MORRO BAY KANGAROO RAT

Dipodomys heermanni morroensis (Merriam)

KINGDOM Animalia
 CLASS Mammalia
 ORDER Rodentia
 FAMILY Heteromyidae
 OTHER COMMON NAMES Heermann's kangaroo rat

DATE
 Entered into SWIS to be determined
 Updates 16 October 1978

LEGAL STATUS

Federal Endangered (35 FR 16047, 13 Oct 1970).
 States Endangered: California

REASONS FOR CURRENT STATUS

Historically, this isolated subspecies has occupied a range of less than 10 km² (Grinnell 1922). Recent appraisals have documented a continually shrinking range and, concomitantly, decreased population size. Three factors have contributed to this decline (Congdon and Roest 1975):

1. Direct loss of habitat due to growth of residential areas.
2. Successional changes of sparsely vegetated areas into more thickly vegetated chaparral communities.
3. Increased predation by domestic cats hunting in fields adjacent to human dwellings.

PRIORITY INDEX

Not assigned

DESCRIPTION

The darkest colored of all kangaroo rats, this population was originally described as a distinct species, partly on the basis of its dark pelage and markings (Merriam 1907, Grinnell 1922). The hip stripe, characteristic of the genus, is often incompletely formed, thus failing to completely separate the thigh patch from the rest of the back (Grinnell 1922, Stewart and Roest 1960). The white side tail stripes are narrow; less than one-half the width of the dark dorsal and ventral stripes. The tail is often completely black just behind the white basal collar (Grinnell 1922). Auditory bullae are less highly inflated than neighboring subspecies of *D. heermanni* (Grinnell 1922, Boulware 1943).

RANGE

This rat is found in six disjunct patches of habitat just south and southeast of Morro Bay, California. The total area currently occupied is estimated at 1.3 km² (Roest 1977). All current populations occupy remnants of the historical range, and can be enclosed by a circle 6.5 km in diameter.

RANGE MAP

Distribution is shown on the accompanying map (after Roest 1977). Occupied areas are indicated by shading.

STATES/COUNTIES

California: San Luis Obispo.

HABITAT

Habitat consists of early seral stages of the chaparral community, where vegetation is low and sparse and shrubs are widely scattered (Congdon and Roest 1975), on medium-textured sandy loam (Stewart and Roest 1960). Plants typical of the habitat include *Lotus scoparius*, *Erigeron parvifolium*, *Salvia mellifera*, and scattered annual

grasses (Stewart and Roest 1960).

FOOD AND FORAGING BEHAVIOR

Food in the wild not known. In the related Tulare subspecies (*D. h. tularensis*), food consists primarily of seeds of grasses and shrubs during the dry season, and grass and herb cuttings during the rainy season. Also, small amounts of insect material are taken seasonally (Tappe 1941, Fitch 1948). The Morro Bay subspecies probably stores small amounts of food material in its burrows, as reported for the Tulare subspecies (Fitch 1948). Captive Morro Bay kangaroo rats eat seeds and leaves of native plants found within their range, including those of *Lotus*, *Dudleya*, and *Bromus* (Stewart and Roest 1960).

SHELTER REQUIREMENTS

Like other heteromyid rodents, the Morro Bay kangaroo rat constructs its own burrow in sandy soil. Burrows are often located along low ridges near open space, particularly in areas of thick brush (Congdon and Roest 1975).

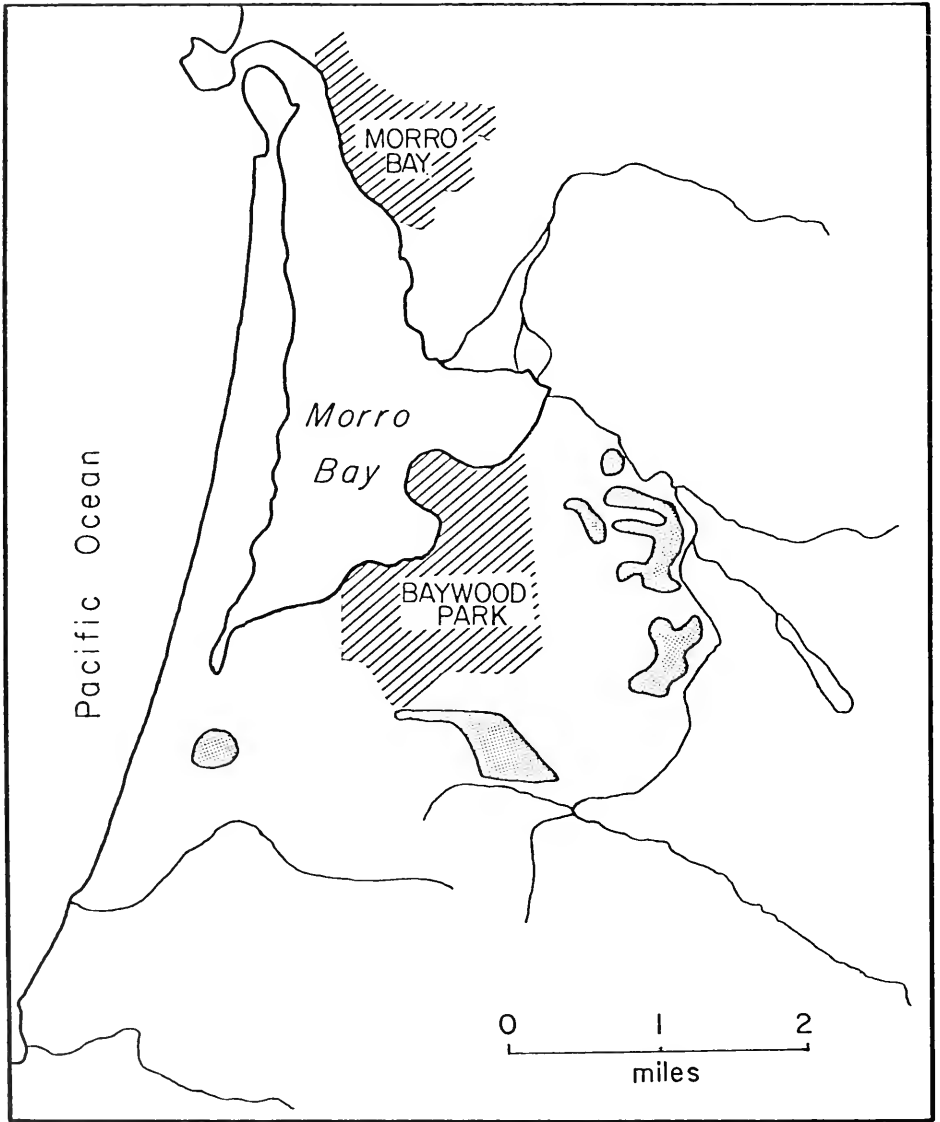
The burrow of *D. h. morroensis* consists of shallow tunnels (15 to 30 cm below the surface) measuring 1.8 to 3 m long, with two or three chambers and a similar number of escape tunnels, the latter terminating about 2.5 cm below ground level (Stewart and Roest 1960).

NESTING OR BEDDING

Nests are located in one of the chambers of the burrow systems (Stewart and Roest 1960). No description of the nest of this subspecies is available, but Tappe (1941) described the nest of the Tulare kangaroo rat as an ovoid chamber 12.7 by 15 cm and 10 cm high, which was lined with fine grass stems, fine grass roots, and husks of grass seeds. The nests were used only during the breeding season. A similar nest may be made by the Morro Bay kangaroo rat.

RITUAL REQUIREMENTS

The behavior of this free-living nocturnal rodent is not known. Information for the related great basin kangaroo rat (*D. microps*) indicates a need by members of the genus *Dipodomys* for open ground around the burrow (Kenagy 1976). In *D. microps*, courtship is limited to drumming



Current distribution of the Morro Bay kangaroo rats.

by the male around the burrow of the female. Receptive females emerge and copulation quickly commences in the vicinity of her burrow. Competing males interact, including bouts of locked fighting, near the female's burrow (Kenagy 1976).

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

The population density of other species of kangaroo rats has been shown to be inversely related to the density of shrubby vegetation (Rosenzweig 1973). This relationship reflects the requirements of saltatory locomotion and the erratic-leaping type of escape behavior that is highly developed in kangaroo rats. Kenagy (1976) suggests the leaping behavior may also function in reducing male-to-male physical contact during conflicts over access to females' burrows. Stewart and Roest (1960) report the invasion of a burned area by the Morro Bay kangaroo rat. Evidence indicates that open, sparsely vegetated habitat is a critical requirement for populations of this kangaroo rat.

POPULATION NUMBERS AND TRENDS

The population of this subspecies is directly related to both the quality and quantity of available habitat. The range was originally described by Grinnell (1922) as "less than 4 miles square" (41 km²). Stewart and Roest (1960) reported the area of remaining habitat to be less than 6.5 km². In 1960, the population numbered about 8,000 individuals (Congdon and Roest 1975). A 1971 study indicated a range of 3.6 km² and a population of 3,000 kangaroo rats Congdon 1971, *in* Congdon and Roest 1975). Roest (1977) indicated that the range is now reduced to 1.3 km² and the population numbers are between 1,500 and 2,000 individuals.

The density varies from 42 kangaroo rats per hectare in the most favorable habitat to an estimated 5 per hectare in marginal habitat. Territory size is estimated to be about 0.07 ha (Roest 1977). Roest (1977) indicates considerable seasonality in their activity, with little or no activity in January and February, and increasing activity through early summer. A decline in activity was noted in mid-summer, and a fall resurgence is suggested.

REPRODUCTION

Most young are probably born from February through August, but breeding may continue throughout the year with a possible second peak of breeding in the fall (Roest 1977). A similar concentration of breeding in the spring and summer months occurs in *D. h. tularensis*, which also may have multiple litters per year (Fitch 1946). Average litter size is probably just over three. Four recorded litters for the Morro Bay subspecies were 4, 3, 3, and 3 (Stewart and Roest 1960). Other subspecies of *D. heermanni* are reported to have average litter sizes of 2.6 to 3.7 (Fitch 1946).

MANAGEMENT AND CONSERVATION

A summary of management problems for this subspecies is presented in Congdon and Roest (1975). The most significant adverse factor is the loss of habitat, caused by conversion of parts of the former range into suburban housing developments. While kangaroo rats may be tolerant of the proximity of human dwellings (Stewart and Roest 1960), they are eliminated from developed land. A concomitant problem is predation by domestic cats near houses. A more serious problem in remaining prime habitat is the absence of wild fires, leading to higher shrub density and the development of a mature chaparral community. This subspecies may invade habitat created by burning (Stewart and Roest 1960). It disappears from fields as the shrub height and density increase (Congdon and Roest 1975). Management should thus be directed towards prevention of further loss of habitat by a moratorium on development of any remaining Morro Bay kangaroo rat habitat and maintenance of existing habitat in the early stages of succession, which constitutes the favored condition for this subspecies. Both these management programs could be most easily achieved within the confines of a publicly owned preserve. Recently, a 20-ha refuge for this animal was established by the California Department of Fish and Game for the westernmost ('Dunes') population (see range map)(Gustafson 1978). But the habitat in this refuge contains the lowest population density of Morro Bay kangaroo rats measured by Roest (1977). Other areas of prime habitat should be acquired. Areas of favorable habitat which are used by off-road vehicles are

likely to suffer severe deterioration (U.S. Department of the Interior 1973), and such use should be curtailed.

AUTHORITY

Aryan Roest
Biological Sciences Department
California Polytechnic State University
San Luis Obispo, California 93407

PREPARER'S COMMENTS

One reason for preserving this distinctive isolated population of kangaroo rats is its scientific status. From its first description in 1907 to the time of Boulware's publication (1943), it was recognized as a separate species. While no available evidence indicates that it should not be considered a subspecies of *D. heermanni*, Boulware (1943:393) found the characters of the Morro Bay kangaroo rat to be most different from its nearest neighbor (*D. h. jolonensis*) and most similar to a more removed southern relative (*D. h. arenae*). Further study on the taxonomic position of the Morro Bay kangaroo rat is indicated. The species has a high reproductive potential and collection of a few specimens for critical examination would present no danger to the population.

The population of this subspecies is continuously declining and without protective measures, 'the Morro Bay kangaroo rat is almost certainly doomed to extinction.' (Congdon and Roest 1970).

LITERATURE CITED/SELECTED REFERENCES

Boulware, J. T. 1943. Two new subspecies of kangaroo rats (genus *Dipodomys*) from southern California. Univ. California Publ. Zool. 46:391-396.

Congdon, J., and A. Roest. 1975. Status of the endangered Morro Bay kangaroo rat. J. Mammal. 56:679-683.

Csuti, B. A. 1971. Karyotypes of kangaroo rats from southern California. J. Mammal. 52: 202-206.

Fitch, H. S. 1948. Habits and economic relationships of the Tulare kangaroo rat. J. Mammal. 29:5-35.

Grinnell, J. 1922. A geographical study of the kangaroo rats of California. Univ. California Publ. Zool. 24:1-124.

Gustafson, J. 1978. Morro Bay kangaroo rat land acquisition. California Dep. Fish Game Nongame Wildl. Invest. Final rep. E-1-1. 3 pp.

Kenagy, G. J. 1976. Field observations of male fighting, drumming, and copulation in the Great Basin kangaroo rat (*Dipodomys microps*). J. Mammal. 57:781-785.

Merriam, C. H. 1907. Descriptions of ten new kangaroo rats. Proc. Biol. Soc. Washington 20:75-80.

Roest, A. 1977. Distribution and population estimate of the Morro Bay kangaroo rat. California Dep. Fish Game Nongame Wildl. Invest Final Rep. E-1-1. 19 pp.

Rosenzweig, M. L. 1973. Habitat selection experiments with a pair of coexisting heteromyid rodent species. Ecology 54:111-117.

Stewart, G. R. and A. I. Roest. 1960. Distribution and habits of kangaroo rats at Morro Bay. J. Mammal. 41:126-129.

Tappe, D. T. 1941. Natural history of the Tulare kangaroo rat. J. Mammal. 22:117-148.

U.S. Department of the Interior. 1973. Threatened wildlife of the United States. Resource Publ. 114. 289 pp.

PREPARED/UPDATED BY

National Fish and Wildlife Laboratory
1300 Blue Spruce Drive
Fort Collins, Colorado 80524

Biological Services Program

FWS/OBS-80/01.20
March 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States- **CALIFORNIA LEAST TERN**



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

FWS/OBS-80/01.20
March 1980

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—
CALIFORNIA LEAST TERN

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior

RANGE

The historical breeding range of the California least tern extended along the California coast from Moss Landing, Monterey County, to San Jose del Cabo in southern Baja California (Dawson 1924, Grinnell 1928, Grinnell and Miller 1944, A.O.U. 1957). Some least terns have nested in a number of locations farther north; between 1939 and 1954, they nested at the mouth of the Pajaro River, Santa Cruz County (Pray 1954, Wilbur 1974), and nesting near San Francisco Bay in Alameda, Alameda County, was confirmed in 1967 (Chandik and Baldrige 1967). There are numerous spring and summer records for this area (Grinnell and Wythe 1927, Allen 1934, Sibley 1952, DeBenedictis and Chase 1963, Chase and Paxton 1965). Wilbur (1974) suggests that nesting may have occurred here previously. In south San Francisco Bay, 60 were counted on 1 Sept 1968, and a breeding colony of 30 pairs was established on Bay Farm Island, Alameda County, in 1969 (Gill 1977). A colony of 15 pairs was also reported in 1969 from Bair Island, San Mateo County (Anderson 1970). The nesting range has apparently always been widely discontinuous, with the majority of birds nesting in southern California from southern Santa Barbara County south through San Diego County (Wilbur 1974). Known nesting sites in Baja California are Scammons Lagoon (Bancroft 1927, Grinnell 1928), San Jose del Cabo (Lamb 1927, Grinnell 1928), Ensenada (Bahia Todos Santos), and Bahia de San Quintin (Massey 1977).

The California least tern is migratory, usually arriving at its breeding area during the last week of April and departing again in August (Davis 1968, 1974; Massey 1971; Swickard 1971, 1973), although terns have been recorded as early as 13 March and as late as 31 October (Sibley 1952, Wilbur 1974).

There are six records north of San Francisco Bay and four records of single birds seen at Humboldt Bay, Humboldt County; two specimens were collected at Fort Stevens, Clatsop County, Oregon (DeSante et al. 1972, CLTRT, in prep.) Migrating least terns have also been recorded from the Colorado River valley (Grater 1939, Phillips et al. 1964) and at the Salton Sea, Imperial County (McCaskie and Cardiff 1965, McCaskie 1971).

The winter distribution of the California least tern is unknown. Least terns in Guatemala

(Griscom 1932) and Veracruz (Warner and Mengel 1951) have been identified as members of the subspecies *browni*. California least terns are thought to migrate to Peru, but Murphy (1936) doubts this. Recent efforts to find them in Peru have been unsuccessful.

RANGE MAP

Known nesting locations for the California least tern are shown on the accompanying map (from Wilbur 1974).

STATES/COUNTIES:

California: Alameda, Imperial, Los Angeles, Monterey, Orange, San Diego, San Mateo, Santa Barbara, Santa Cruz, Ventura.

Mexico: Locations of breeding colonies in Baja California south of Bahia de San Quintin are unknown.

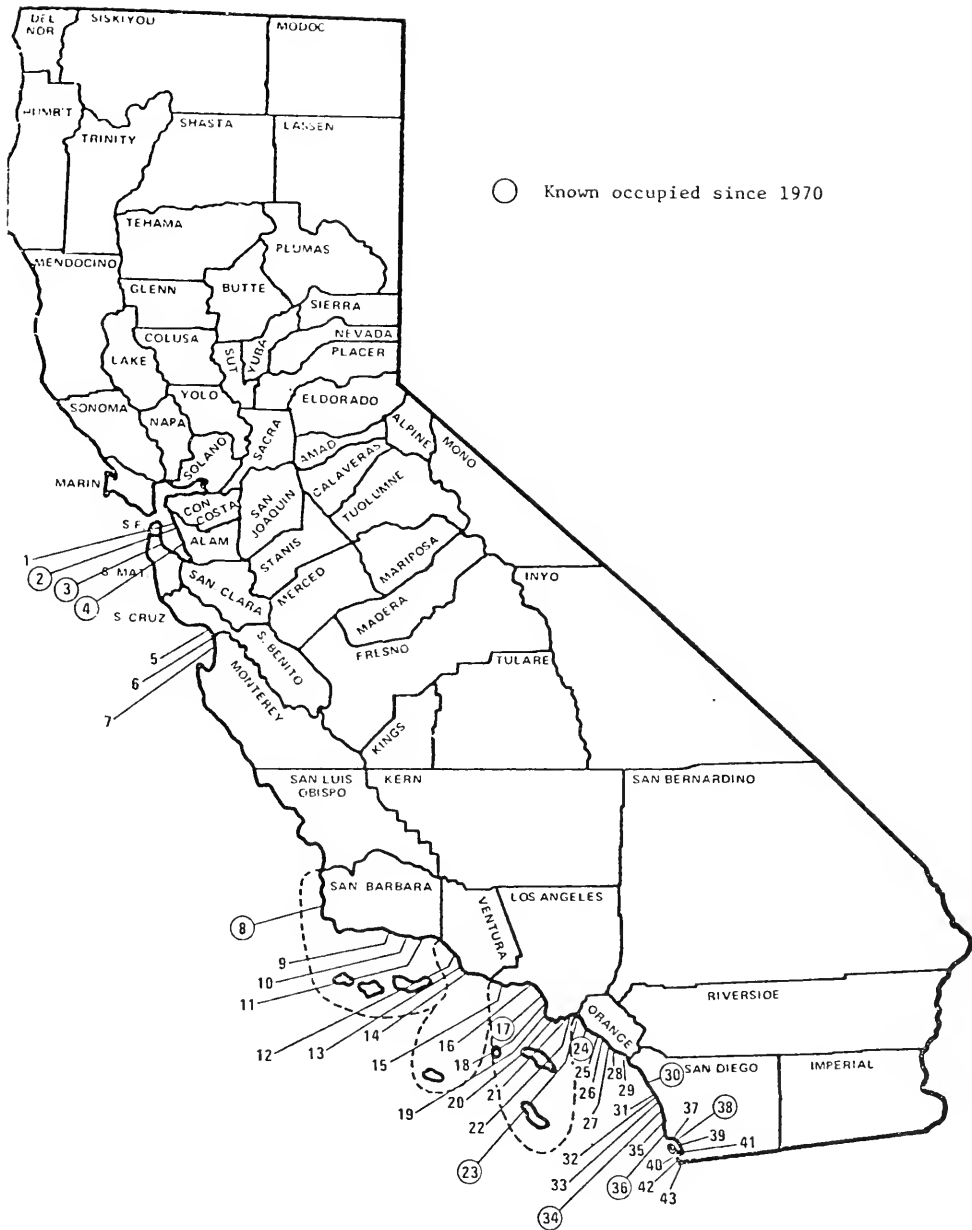
HABITAT

Nesting colonies require undisturbed flat areas with loose substrate, such as sandy upper sea beaches or open expanses of fill-dirt or dried mud characterized by little or no vegetation. For foraging, they need adjacent open ocean, surf-line, estuary or lagoon with a good supply of small fish (Grinnell and Miller 1944; Craig 1971; Massey 1971; Swickard 1971, 1973; Wilbur 1974).

FOOD AND FORAGING BEHAVIOR

Least terns often feed in small loose groups of 2 to 10 birds. While fishing, they hover above the water. If prey is sighted, the bird quickly plunges to the surface, usually breaking its fall just before reaching the water so it is only partially submerged instead of diving beneath the surface. Often, a series of short plunges and repeated hoverings will occur before the actual dive, which is then usually made from only a few centimeters above the water (Bent 1921, Hardy 1957).

They have not been seen eating anything but fish, including northern anchovy (*Engraulis mordax*), shiner perch (*Cymanogaster aggregata*), anchovy (*Anchoa compressa*), topsmelt (*Atherinops affinis*), killifish (*Fundulus parvipinnis*), jack-smelt (*Atherinopsis californiensis*), California grunion (*Leuresthes tenuis*) and mosquito fish



California least tern nesting locations.

(*Gambusia affinis*) (Swickard 1971; Massey 1972, 1974; CLTRT in prep). Other subspecies occasionally feed on crustacea, molluscs, sand eels (*Ammodytes*), annelid worms, and insects (Tompkins 1959).

SHELTER REQUIREMENTS

At first the young are weak and helpless. Adults brood chicks continuously the first day. By the second day, chicks make short walking trips from the nest. From the third day on, they become more active and are increasingly mobile (CLTRT in prep.)

NESTING OR BEDDING:

Nests are simple, shallow depressions in sand, dirt or gravel, usually without twigs or other materials. Bent (1921) states that on beaches where there are shells, the birds may encircle their scrapes with them. Likewise, Swickard (1971, 1973) reported finding one nest, located on flat ground, that was completely lined with small twigs; Massey (1974) reported that nearly 20% of the nests she studied were partly or completely shell-lined.

In sand, the bird scoops out the nest depression (Davis 1968, 1974; Massey 1971, 1974; Swickard 1971). But in hard soil, such as dried mud or fill, the nest can be any kind of natural or artificial depression, including a dried boot track (Swickard 1971).

Scrapes are circular, about 20 mm deep and 120 mm in diameter (Hardy 1957). Temporary scrapes are used for brooding when chicks begin to wander (Hardy 1957).

Least terns are colonial, but usually do not form dense concentrations (Wilbur 1974). The distance between nests is 3 to 5 m or more (Wolk 1954; Hardy 1957; Massey 1971, 1974). Nesting densities may be as low as 3 to 7 per ha (Swickard 1971, 1973), although they are often greater; 145 pairs nested on about 0.75 ha at FAA Island in Mission Bay, San Diego County, California.

RITUAL REQUIREMENTS

Nesting beaches are usually used as a parading ground during courtship (Hardy 1957, Wilbur 1974).

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

Open expanses free from human disturbance are necessary for courtship, resting, and nesting; adjacent unpolluted lagoons or estuaries are needed for feeding (Longhurst 1969, Craig 1971, Wilbur 1974).

POPULATION NUMBERS AND TRENDS

Thousands of terns once nested on the beaches and near the estuaries of the Pacific Coast of North America from Monterey Bay south to central Baja California. These flocks have dwindled rapidly in the last century. In 1970, the population in California was estimated at less than 300 pairs, scattered over 15 nesting colonies (Craig 1971), but this study was not made in the nesting season and did not attempt to obtain precise population data. The California Department of Fish and Game has since conducted annual censuses. In 1973, initial surveys estimated a population size of 624 pairs, with nesting activity at 19 sites (Bender 1973). The 1974 surveys estimated the breeding population at 582 pairs. Breeding activity was recorded at 20 sites, but nesting occurred at only 16 of them (Bender 1974). The estimated breeding population was 600 pairs in 1975 and 664 pairs in 1976 (Atwood et al. 1977).

In 1977, 775 breeding pairs were located at 29 colony sites, but 9 colonies were abandoned or had poor nesting success because of human disturbance, predation, or flooding (Atwood et al. 1977). This was the largest breeding population since the surveys began, but the greater numbers found are due in part to increased survey staff and more accurate survey methods (Atwood et al. 1977).

The breeding population of the California least tern is difficult to assess for several reasons. Birds may shift breeding sites from year to year, breeding dates may not be uniform, and age at first reproduction and longevity are unknown. Less standardized and concentrated censusing in the past no doubt missed nesting birds at some locations, and some censuses were too late or too early to find breeding birds.

Local perturbations compound the difficulty in estimating population trends. A colony at Huntington Beach (Sunset Aquatic Regional

Park), Orange County, had 51 nests in 1968 (Davis 1968), 25 in 1969 (Massey 1971), 12 in 1970 (Massey 1971) and only 1 or 2 in 1972 (Bender 1973, 1974). At this site, fencing was installed and vegetation removed to improve nesting success, but the birds gradually stopped nesting there for unknown reasons, and had not returned as of 1978. In 1969, a colony of 15 pairs was reported from Bair Island, San Mateo County (Anderson 1970). The birds did not use this area in 1971, but were present again from 1972 to 1975; 14 active scrapes were located in July 1975 (Gill 1977).

REPRODUCTION

California least terns are sociable and colonial nesters (Davis 1974). They are easily disturbed on the nest and will take flight for aerial territorial defense. If repeatedly disturbed, they abandon their nests (Hardy 1957, Davis 1974, Wilbur 1974). Eggs are small, measuring about 31 by 24 mm, and are buff-colored with various brown and purple streaks and specks. One to four are laid, with two to three the most common clutch size (Davis 1968, 1974; Anderson 1970; Swickard 1971, 1973; Massey 1972). Eggs are laid late in the morning on consecutive days (Davis 1968, Massey 1971, 1974).

Nesting starts in mid-May, with most of the nests completed by mid-June (Bent 1921, Davis 1968, Swickard 1971, Massey 1974). Late season (July and August) nests may be re-nests (Wilbur 1974). Chambers (1908) believed that terns often reared more than one brood per season, but other authorities do not consider the least tern a multiple-nesting species (Wilbur 1974).

Incubation, which begins with the laying of the first egg, is irregular at first, but become regular once the clutch is completed (Davis 1968, Swickard 1971, Massey 1972). The female does most of the incubating, but both parents participate (Davis 1968, 1974).

The incubation period varies from 17 to 28 days; the normal length is 20 to 25 days (Hagar 1937; Hardy 1957; Davis 1968, 1974; Swickard 1971; Massey 1972). An incubation period of 14 to 16 days given by Bent (1921) apparently is in error. Eggs hatch on consecutive days. Chicks are initially weak, but become strong and mobile by the third day (Davis 1968, 1974).

In two colonies, hatching success was 80% to

90%, and fledging rates varied between 11% and 50% (Swickard 1971, Massey 1972). Infertility appears to be a minor cause of egg failure (Wilbur 1974). Predation pressures appear to be high on both eggs and fledglings. Domestic predators (house cats and dogs) and Norway rats (*Rattus norvegicus*) are often implicated (Chambers 1908; Edward 1919; Craig 1971; Swickard 1971, 1973; Pentis 1972; Atwood et al. 1977).

In the past, high tides caused heavy losses of California least tern eggs (Shepardson 1909, Sechrist 1915). Now few colonies are found in areas where tides are a problem. However, in areas with soil less permeable than beach sands, summer rains can cause serious nest losses. Swickard (1971) noted that birds nesting on salt flats had only 43% hatching success after flooding from heavy rains, while on adjacent beach sands, rain water percolated through the nests and there was a 90% hatching success.

MANAGEMENT AND CONSERVATION

The least tern can tolerate some kinds of human activities; they have nested successfully between runways on military air fields (Atwood et al. 1977), in a small fenced enclosure on a public beach (Anon 1970, Massey 1972), beside a shopping center parking lot (Atwood et al. 1977), and on man-made fill alongside coastal lagoons and estuaries (Massey 1972, Pentis 1972). However, use of any site depends on a nearby body of water containing abundant small fishes and on protection from harassment and predation (Wilbur 1974). Fencing, posting and educational displays, and limited predator control provide protection for nesting birds (Craig 1971; Massey 1972; Bender 1973, 1974; Atwood et al. 1977). Suitable feeding areas appear to be in critically short supply. Protecting those few that remain and restoring others that no longer support adequate fish populations because of reduced tidal flow or pollution may be the most significant management plan for the tern (Wilbur 1974).

Since least terns require open nesting areas, natural succession tends to eliminate suitable nesting areas, particularly on man-made sites. Vegetation removal is advocated to encourage the continued use of those nesting beaches undergoing succession.

At Bair Island, the substrate is sandy loam which, when wet, sticks to tern eggs. In 1977,

artificial dry sand mounds about 1 m in diameter were distributed in the colony as an alternative nesting substrate (Atwood et al. 1977). Elsewhere, clay pipes, clay roofing tiles, and special concrete blocks strategically placed in nesting areas have been used successfully by chicks for shade and protection (Atwood et al. 1977).

Continued banding projects will be useful to determine postbreeding movements to wintering areas, to understand site-faithfulness, intercolony aggregations, and age at sexual maturity (Rypka 1977).

A recovery plan has been developed by the California Least Tern Recovery Team and is currently being reviewed by the Fish and Wildlife Service. The plan lists proposed actions for each colony.

AUTHORITIES

Sanford R. Wilbur
Patuxent Wildlife Research Center
California Field Station
Ojai, California 93023

Alan Craig
California Dept. of Fish and Game
1416 Ninth Street
Sacramento, California 95814

PREPARER'S COMMENTS

It is unclear whether the number of California least terns is actually increasing or if the apparent increase is a function of the increased level of research on this subspecies. Overall trends are difficult to elucidate from the cursory survey data that is currently available. Better coordination is needed to standardize the censusing of colonies.

Least terns are adaptable and even small colonies could form the basis of substantial new colonies. Thus all colonies, regardless of their size, should be protected as much as possible from human harassment and predation. At present, the concentration of birds in a few breeding locations (33% of the total population is at two locations in San Diego County) makes the future of this species precarious.

LITERATURE CITED / SELECTED REFERENCES

Allen, A. 1934. The season: San Francisco region.

Bird Lore 36(4):316.

American Ornithologists. Union. 1957. Check list of North American birds. 5th edition. 691 pp.

Anderson, W. 1970. The California least tern breeding in Alameda and San Mateo Counties. California Fish and Game 56(2):136-137.

Anonymous. 1970. Least tern. Wandering Tattler 17(9):4.

Atwood, J. L., P. D. Jorgenson, R. M. Jurek, and T. D. Manolis. 1977. California least tern census and nesting survey, 1977. California Department of Fish and Game Nongame Wildlife Investigations, E-1-1, Job V-2.11, Job Final Report. 35 pp.

Bancroft, G. 1927. Breeding birds of Scammons Lagoon, Lower California. Condor 29(1):29-57.

Bender, K. 1973. California least tern census and nesting survey, 1974. California Department of Fish and Game Nongame Wildlife Investigation W-54-R, Progress Report. 47 pp.

———. 1974. California least tern population and nesting survey, 1974. California Department of Fish and Game Nongame Wildlife Investigation W-54-R, Job Final Report. 17 pp.

Bent, A. C. 1921. Life history of North American gulls and terns. Nat. Mus. Bull. 13.

Burleigh, T. D. and G. H. Lowery, Jr. 1942. An inland race of *Sterna albifrons*. Occas. Pap. Mus. Zool. Louisiana State Univ. 10:173-177.

Chambers, W. L. 1908. The present status of the least tern in southern California. Condor 10 (6):237.

Chandik, T. and A. Baldrige. 1967. Nesting, middle Pacific coast region. Audubon Field Notes 21(5):600-603.

Chase, T. and R. O. Paxton. 1965. Middle Pacific coast region. Audubon Field Notes 19(5): 574-576.

Craig, A. M. 1971. Survey of California least tern nesting sites. California Department of Fish and Game Project W-54-R-4, Job 11-5.1. Job Completion Report. 55 pp.

- Davis, M. E. 1968. Nesting Behavior of the least tern (*Sterna albifrons*). M. Sc. thesis, Univ. Calif., Los Angeles. 72 pp.
- . 1974. Experiments in the nesting behavior of the least tern *Sterna albifrons browni*. Proc. Linnaean Soc. N.Y. 72:25-43.
- Dawson, W. L. 1924. The birds of California. South Moulton County, San Diego. 2,162 pp.
- De Benedictis, P. and T. Chase, Jr. 1963. Middle Pacific Coast Region. Audubon Field Notes 17(5):480-483.
- DeSante, D., R. Le Valley, and R. Stallcup. 1972. Middle Pacific coast region. American Birds 26(1):112-118.
- Edwards, H. A. 1919. Losses suffered by breeding birds in southern California. Condor 21(2): 65-68.
- Gill, R. Jr. 1977. Breeding avifauna of the south San Francisco Bay estuary. Western Birds 8:1-12
- Grater, R. K. 1939. New bird records for Nevada. Condor 41(1):30.
- Grinnell, J. 1928. A distributional summation of the ornithology of Lower California. Univ. Calif., Publ. Zool. 32(1):1-300.
- Grinnell, J. and A. Miller. 1944. The distribution of the birds of California. Pacific Coast Avifauna 27:1-608.
- Grinnell, J. and M. W. Wythe. 1927. Directory of the bird-life of the San Francisco Bay region. Pacific Coast Avifauna 18:1-160.
- Griscom, L. 1932. The distribution of bird-life in Guatemala. Bull. Amer. Mus. Nat. Hist. 64:1-439.
- Hagar, J. A. 1937. Least tern studies — 1935 and 1936. Bull. Mass. Audubon Soc. 21(4):5-8.
- Hardy, J. W. 1957. The least tern in the Mississippi valley. Publ. of Museum, Mich. State Univ., Biol. Series 1(1):1-60.
- Lamb C. C. 1927. Notes on some birds of the southern extremity of Lower California. Condor 29(3):155-157.
- Leach, H. R. and L. O. Fisk. 1972. At the crossroads: a report on California's endangered and rare fish and wildlife. Calif Dept. of Fish and Game. 99 pp.
- Longhurst, A. R. 1969. The status of an endangered bird (*Sterna albifrons*) in San Diego County, 1969. U.S. Bur. Commer. Fish., La Jolla. Unpubl. Rep. 7 pp.
- McCaskie, G. 1971. Southern Pacific Coast Region. American Birds 25(5):905-908.
- McCaskie, G. and E. A. Cardiff. 1965. Notes on the distribution of the parasitic jaeger and some members of the Laridae in California. Condor 67(6):542-544.
- Massey, B. W. 1971. A breeding study of the California tern. California Dept. Fish and Game Wildlife Manage. Branch. Admin. Rep. 71-9. 22 pp.
- . 1972. Breeding biology of the California least tern. M.Sc. thesis, California State Univ. at Long Beach. 101 pp.
- . 1974. Breeding biology of the California least tern. Proc. Linnaean Soc. N.Y. 72:1-24.
- . 1977. Occurrence and nesting of the least tern and other endangered species in Baja California, Mexico. Western Birds 8: 67-71.
- Murphy, R. C. 1936. Oceanic Birds of South America. Macmillan, N.Y. 1,245 pp.
- Pentis, A. 1972. Who will save the least tern? Environment Southwest 446:6-8
- Phillips, A., J. Marshall, and G. Monson. 1964. The birds of Arizona. Univ. Arizona Press, Tucson. 212 pp.
- Pray, R. H. 1954. Middle Pacific coast region. Audubon Field Notes 8(5):326-327.
- Ridgway, R. 1919. The birds of North and Middle America, part VIII. Bull. U.S. Nat Mus. 50: 1-793.
- Rypka, D. D. 1977. California least tern banding project, 1977. Calif Dept. Fish and Game, Nongame Wildlife Investigations Project E-1-1, Job 2.12, Job Final Report. 7 pp.
- Sechrist, E. E. 1915. Least Tern. Oologist 32 (1):18.
- Shepardson, D. I. 1909. Notes on the least tern.

- Oologist 26(9):152.
- Sibley, C. G. 1952. The birds of the south San Francisco Bay region. Unpubl. Rep. 42 pp. (Copy at Oakland Public Museum).
- Swickard, D. 1971. The status of the California least tern at Camp Pendleton, 1971. Camp Pendleton Marine Corps base. Unpubl. Rep. 30 pp.
- . 1973. Status of the least tern at Camp Pendleton, California. California Birds 3(3): 49-58.
- Tompkins, I. R. 1959. Life history notes on the least tern. Wilson Bulletin 71(4):313-322.
- Warner, D. W. and R. M. Mengel. 1951. Notes on birds from the Veracruz coastal plain. Wilson Bulletin 63(4):288-295.
- Wilbur, S. R. 1974. The literature of the California least tern. Bur. Sport Fish Wildl. Spec. Sc. Report—Wildlife 175. 18 pp.
- Wolk, R. G. 1954. Some Preliminary observations on the reproductive behavior of the least tern (*Sterna albifrons antillarum* Lesson). M.Sc. thesis, Cornell Univ., Ithaca, N.Y. 42 pp.

ACCOUNT PREPARED/UPDATED BY

National Fish and Wildlife Laboratory
1300 Spruce Drive
Fort Collins, Colorado 80524

Biological Services Program

FWS/OBS-80/01.21

March 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States- KIRTLAND'S WARBLER



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES

KIRTLAND'S WARBLER

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: MICHIGAN DEPT. OF NATURAL RESOURCES

KIRTLAND'S WARBLER

Dendroica kirtlandii (Baird)

KINGDOMAnimalia
 CLASSAves
 ORDER..... Passeriformes
 FAMILY..... Parulidae
 OTHER COMMON NAMES.....Jack pine warbler

DATE

Entered into SWIS.....To be determined
 Updates..... 24 Oct 1977, 10 Jan. 1978

LEGAL STATUS

Federal Endangered (32 FR 4001, 11 Mar 1967; 35 FR 18320, 2 Dec 1970).
 States Endangered: Florida, Georgia, Michigan, North Carolina, South Carolina.

REASONS FOR CURRENT STATUS

Small population size, restricted geographic

distribution, and extremely narrow habitat requirements are the major causes of this species' precarious position. Prevention of fire and other forest management practices have eliminated much suitable breeding habitat. Nest parasitism by the brown-headed cowbird (*Molothrus ater*) has also contributed to past population declines. A possible, but as yet unknown, factor may be operating against Kirtland's warbler on the wintering grounds in the Bahama Islands (KWRT 1976).

PRIORITY INDEX

Not assigned.

DESCRIPTION

The adult male has upper parts of bluish slate gray, streaked with black, a black mask and white eye ring, underparts dull yellow, sides streaked with black, and fuscous wings without bars. The adult female has upper parts bluish gray with fuscous streaks, underparts of pale yellow, and fuscous speckling on the breast. It is large for a warbler—14 to 15 cm long, with a short, stout bill.

Color illustrations appear in Mayfield (1960) and the various field guides.

RANGE

Kirtland's warbler breeds in the northern Lower Peninsula of Michigan and winters in the Bahama Islands (Mayfield 1960). Strays have recently (1977, 1978) been observed near Petawawa, Ontario, Kazabazua, Quebec, and Black River Falls, Wisconsin (Ryel 1978b). Lane (1975) observed a male and female near Veracruz, Mexico in 1974. The strays are not believed to be evidence of additional populations (H. Mayfield, pers. comm.).

RANGE MAP

The known distribution of the Kirtland's warbler is depicted on the following map (KWRT 1976).

STATES/COUNTIES

Breeding

Michigan Alcona*, Alpena*, Clare*, Crawford, Iosco, Kalkaska, Montmorency*, Ogemaw, Oscoda, Otsego*, Presque Isle*, Roscommon, Wexford.

*historical breeding localities in which the warbler has not been recorded since the 1972 breeding survey (Ryel 1978a).

HABITAT

This warbler has very specific breeding habitat requirements, including stands of jack pine (*Pinus banksiana*) 2 to 6 m high (8 to 21 years old) interspersed with many small openings, minimal ground cover, and little or no hardwoods. The stands are usually on Grayling sands which drain very rapidly. Jack pine stands supporting breeding Kirtland's warblers are usually 30 ha or more in area. Historically, fire maintained the habitat by killing mature jack pines and opening up the forest for natural regeneration. The warbler then used these immature stands until they became too old.

The preferred wintering habitat on the Bahama Islands is not known, but Radabaugh (1974)

suggests use of low, broad-leaved scrub, the prevailing form of vegetation.

FOOD AND FORAGING BEHAVIOR

A variety of insects are taken from the ground, air, or pine foliage. Kirtland's warblers often hover at the ends of branches as they pluck insects out of the pine needle clusters. They also eat berries.

SHELTER REQUIREMENTS

Not known.

NESTING OR BEDDING

The ground nest is built of sedges and grasses, rounded in shape with an inside diameter of 50 to 60 mm. Although a cover is not built, the placement of the nest under a grass tussock provides a canopy and often a tunnel entrance.

RITUAL REQUIREMENTS

Males call from perches or from the ground.

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

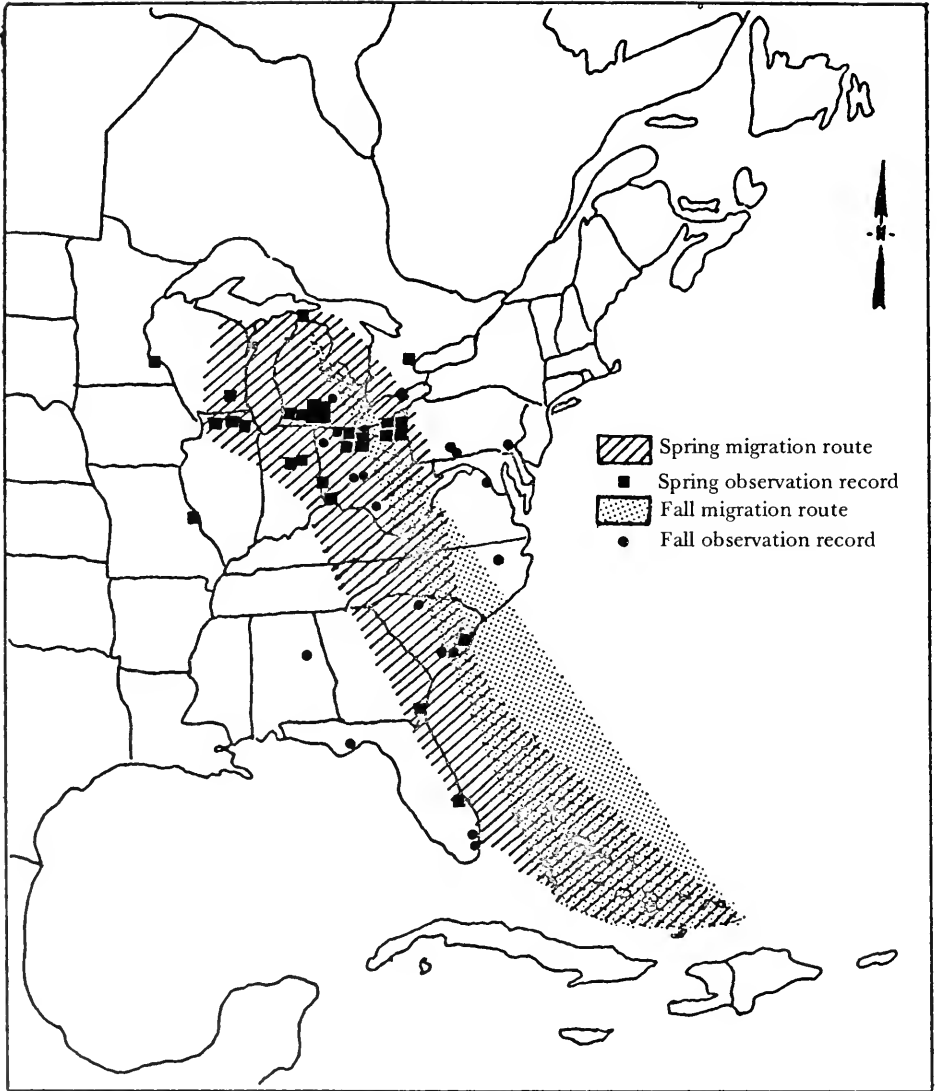
A breeding pair requires about 12 ha of young jack pine habitat for their territory (KWRT 1976).

POPULATION NUMBERS AND TRENDS

In 1951, there were an estimated 432 singing males; in 1961, 502; and in 1971, 201. In the 7 years since then (1972-78), there have been 200, 216, 167, 179, 200, 218, and 196 singing males counted on the breeding ground (Mayfield 1975, Ryel 1978b). In 1974 and 1978, there were unexplained declines in singing males (Ryel 1978b). Mayfield (1953) stated that females and males are about equal in numbers; thus, the 1978 total for the species could be estimated at 400 individuals.

REPRODUCTION

They generally lay five eggs, which hatch in mid-June. Prior to cowbird control, nesting success averaged 1.4 fledglings per pair. After the cowbirds were trapped, the success rate rose to 4 fledglings per pair.



Known distribution of the Kirtland's warbler.

MANAGEMENT AND CONSERVATION

The State of Michigan in 1957 set aside three tracts of 1,040 ha each (Mayfield 1963, Radtke and Byelich 1963). Two were planted with open stands of jack pine, and all have attracted Kirtland's warblers (KWRT 1976).

The Kirtland's Warbler Management Area, established by the U.S. Forest Service in 1961, consists of some 1,620 ha of jack pine forest which is being managed for the warblers. Management activities on these refuges have included selective cutting, burning, and replanting to achieve the desired habitat type. The warblers have nested successfully in each of these areas (KWRT 1976).

An intensive program to eliminate nest parasitism by the brown-headed cowbird was begun in 1972 and has proven immensely successful.

The Kirtland's Warbler Recovery Team drafted a Recovery Plan (1976) whose primary objective is to reestablish a wild population throughout the former range at a minimum level of 1,000 pairs. Five steps are necessary to reach the primary objective:

1. Maintain and develop suitable nesting habitat throughout the former range
2. Protect the species on its wintering grounds and along the migration route
3. Reduce key factors adversely affecting reproduction and survival
4. Monitor breeding populations to evaluate responses to management practices and environmental changes
5. Reintroduce the species into the Upper Peninsula of Michigan or in other States to establish independent, self-sufficient populations.

AUTHORITIES

John Byelich (Recovery team leader)
P.O. Box 306
Mio, Michigan 48647

George W. Irvine (Recovery Team)
Huron-Manistee National Forest
421 South Mitchell Street
Cadillac, Michigan 49601

Nels Johnson (Recovery Team)
Regional Biologist

Michigan Department of Natural Resources
P.O. Box 128
Roscommon, Michigan 48653

Wesley R. Jones (Recovery Team)
U.S. Fish and Wildlife Service
Federal Building, Fort Snelling
Twin Cities, Minnesota 55111

Harold Mayfield (Recovery Team)
9235 River Road
Waterville, Ohio 43566

Robert Radtke (Recovery Team)
U.S. Forest Service
633 West Wisconsin Avenue
Milwaukee, Wisconsin 53203

L. H. Walkinshaw
4691 Timberlane Road
Lake Wales, Florida 33853

Richard Winters (Recovery Team)
U.S. Fish and Wildlife Service
301 Manley Miles Building
1405 South Harrison Road
East Lansing, Michigan 48823

PREPARER'S COMMENTS

None.

LITERATURE CITED/SELECTED REFERENCES

- KWRT (Kirtland's Warbler Recovery Team). 1976. Kirtland's warbler recovery plan. pp.
- Lane, J. 1975. Kirtland's warbler in Mexico. *Am. Birds* 29(1):144.
- Mayfield, H. F. 1953. A census of the Kirtland's warbler. *Auk* 70:17-20.
- . 1960. The Kirtland's warbler. *Cranbrook Inst. Sci., Bloomfield Hills, Mich.* pp.
- . 1962. 1961 decennial census of the Kirtland's warbler. *Auk* 79:173-182, 263-268.
- . 1963. Establishment of preserves for the Kirtland's warbler in the state and national forests of Michigan. *Wilson Bull.* 75:216-220.
- . 1972. Third decennial census of Kirtland's warbler. *Auk* 89:263-268.
- . 1973a. Census of Kirtland's warbler in

1972. *Auk* 90:684-685.
- . 1973b. Kirtland's warbler census. *Am. Birds* 27:950-952.
- . 1975. Numbers of Kirtland's warblers. *Jack-Pine Warbler* 53:39-47.
- Orr, C. D. 1975. 1974 breeding success of the Kirtland's warbler. *Jack-Pine Warbler* 53:59-66.
- Radabaugh, B. E. 1974. Kirtland's warbler and its Bahama wintering grounds. *Wilson Bull.* 96:374-383.
- Radtke, R., and John Byelich. 1963. Kirtland's warbler management. *Wilson Bull.* 75:208-215.
- Ryel, L. A. 1976. 1975 census of Kirtland's warbler. *Jack-Pine Warbler* 54:2-6.
- . 1978a. How to see a Kirtland's warbler. *Birding* 10:53-58.
- . 1978b. Kirtland's warbler status, June 1978. Michigan Dep. Nat. Resour. Surveys Statistical Serv. Rep. 167.
- Shake, W. F., and J. P. Mattsson. 1975. Three years of cowbird control: an effort to save the Kirtland's warbler. *Jack-Pine Warbler* 53:48-53.
- Walkinshaw, L. H. 1972. Kirtland's warbler—endangered. *Am. Birds* 26:3-9.
- Walkinshaw, L. H., and W. R. Faust. 1974. Some aspects of Kirtland's warbler breeding biology. *Jack-Pine Warbler* 52:64-75.
- . 1975. 1974 Kirtland's warbler nesting success in northern Crawford County, Michigan. *Jack-Pine Warbler* 53:54-58.
- Zimmerman, D. A. 1956. Jack pine association in the Lower Peninsula of Michigan: its structure and composition. Ph.D. thesis, Univ. Mich., Ann Arbor.

PREPARED/UPDATED BY

National Fish and Wildlife Laboratory
412 N.E. 16th Avenue, Rm. 250
Gainesville, Florida 32601

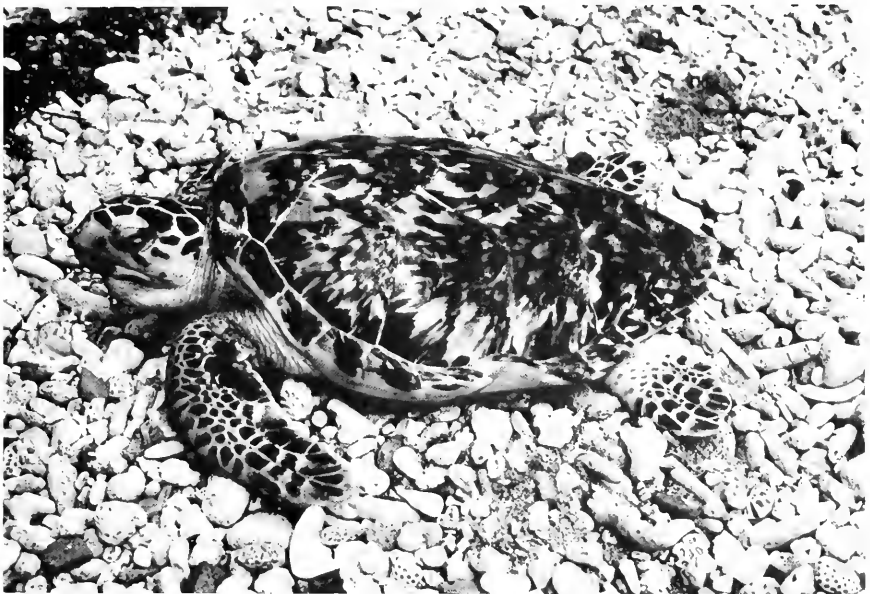
Biological Services Program

FWS/OBS-80/01.22

March 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States-

HAWKSBILL TURTLE



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

FWS/OBS-80/01.22
March 1980

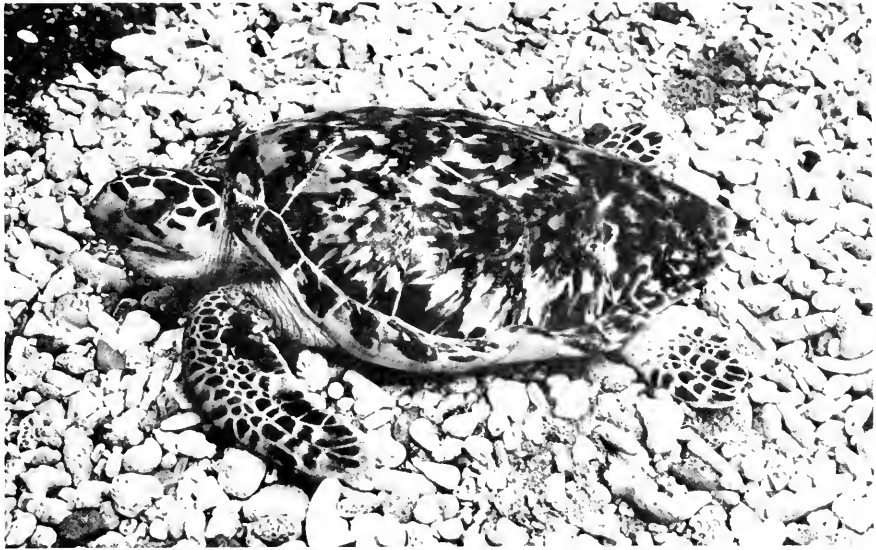
SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES

HAWKBILL TURTLE

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: P. C. H. PRITCHARD

HAWKSBILL TURTLE

Eretmochelys imbricata Linnaeus

KINGDOM Animalia
 CLASS Reptilia
 ORDER Testudinata
 FAMILY Cheloniidae
 OTHER COMMON NAMES carey

DATES

Entered into system To be determined
 Updates. . 22 September 1976; 14 February 1977
 22 May 1979

LEGAL STATUS

Federal: Endangered (35 FR 8491; 2 June 1970).
 States: Endangered: Florida, Georgia, Maryland, Mississippi, New York, Texas.
 Protected: Alabama, North Carolina

REASONS FOR CURRENT STATUS

The hawksbill turtle is clearly being extir-

pated from Atlantic and Caribbean waters (Carr and Stancyk 1975). The major cause is exploitation for the shell, but meat and skin are also used. Eggs are harvested by man and other predators.

Relatively undisturbed beaches are required for nesting. Increasing development and modification of beaches are incompatible with sea turtle reproduction. For example, illumination of beaches at night can result in distraction of hatchlings away from the sea (McFarlane 1963).

Other causes contribute to low total numbers. These include increased numbers of snorkelers and scuba divers who spear turtles for sport and prize (Carr and Stancyk 1975). Littering of seas, according to Rebel (1974), may cause fatalities (e.g. if a plastic bag is mistaken for a jellyfish and consumed). Also, tremendous predation of hatchlings and eggs by carnivorous ants, crabs, fishes, reptiles, birds, and mammals limits recruitment (Rebel 1974).

PRIORITY INDEX

Not assigned

DESCRIPTION

The hawksbill is a small sea turtle with an elongated, oval shell with overlapping scutes on the carapace. The head is relatively small; flippers have two claws. Barnacles are often found on the carapace and plastron. General coloration is brown with numerous splashes of yellow, orange, or reddish-brown on the carapace. The plastron is yellowish with black spots on intergular and post-anal scales. Juveniles are black or very dark brown with light brown or yellow on edge of shell, limbs, and raised ridges on carapace. Adults are 76 to 89 cm long, and weigh 43 to 75 kg.

It is the only sea turtle with two pairs of pre-frontal scales on the head and four costal plates on each side of the carapace.

Illustrated in Carr (1952, 1967), Ernst and Barbour (1972), Bustard (1973), Rebel (1974), and Riedman and Witham (1974).

RANGE

The hawksbill is scattered throughout the world's tropical waters. Distribution in the Atlantic Ocean extends from southern Brazil to Massachusetts.

They nest on scattered islands and shores generally between 25° latitude north and south. Some western hemisphere nesting sites include: the tropical Gulf Coast of Mexico, West Indies, Bahamas, and scattered beaches off Central and South America. Continental United States nesting is limited to infrequent Florida nestings. Maps of prominent nesting beaches are compiled in Survival Service Commission (1969).

The sea turtle's range probably has not changed significantly, but numbers have declined considerably. Many nesting beaches have been abandoned either due to natural disaster (hurricanes, erosion, etc.), alteration of habitat, or commercial use by man.

RANGE MAP

Distribution in waters off the continental United States is illustrated by shading of adjacent coastal States and counties. Nesting records are depicted by dots.

STATES/COUNTIES

Alabama: Baldwin, Mobile.

Delaware: Sussex.

Florida: Bay, Brevard, Broward, Charlotte, Citrus, Collier, Dade, Dixie, Duval, Flagler, Franklin, Gulf, Hernando, Hillsborough, Indian River, Jefferson, Lee, Levy, Manatee, Martin, Monroe, Nassau, Okaloosa, Palm Beach, Pasco, Pinellas, St. James, St. Lucie, Santa Rosa, Sarasota, Volusia, Wakulla, Walton.

Georgia: Bryan, Camden, Chatham, Glynn, Liberty, McIntosh.

Louisiana: Cameron, Iberia, Jefferson, Lafourche, (Parishes) Plaquemines, St. Bernard, St. Mary, Terrebonne, Vermilion.

Maryland: Worcester.

Massachusetts: Barnstable, Dukes, Essex, Middlesex, Nantucket, Norfolk, Plymouth.

Mississippi: Hancock, Harrison, Jackson.

New Jersey: Atlantic, Cape May, Monmouth, Ocean.

New York: Nassau, Suffolk.

North

Carolina: Brunswick, Carteret, Currituck, Dare, Hyde, New Hanover, Onslow, Pender.

Rhode

Island: Newport, Washington.

South

Carolina: Beaufort, Charleston, Colleton, Georgetown, Horry.

Texas: Aransas, Brazoria, Calhoun, Cameron, Chambers, Galveston, Jefferson, Kenedy, Kleberg, Matagorda, Nueces, Willacy.

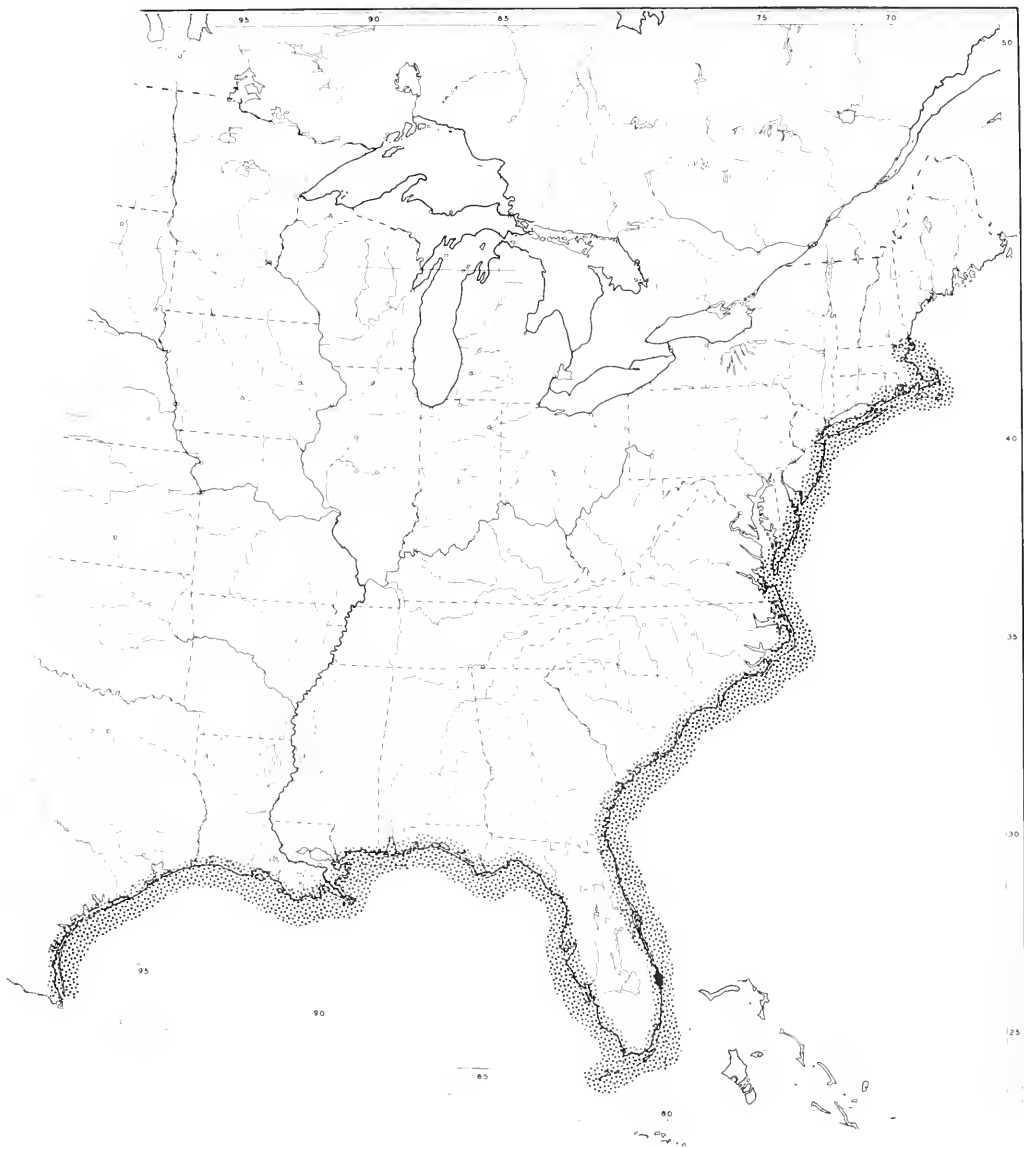
Virginia: Accomack, Northampton.

HABITAT

Hawkbills frequent rocky areas, reefs, shallow coastal areas, lagoons of oceanic islands, and narrow creeks and passes (Carr 1952). They are generally found in water less than 20m deep. Hatchlings are often found floating in masses of sea plants (Pope 1939).

FOOD AND FORAGING BEHAVIOR

Work by Carr et al. (1966) demonstrates that



United States distribution (shading) and nesting records (dots) for the hawksbill turtle.

Critical Habitat has been proposed for beaches on Culebra and Mona Islands, Puerto Rico (43 FR 22224-22225, 24 May 1978).

The species adapts well to captivity and the chances for captive breeding are good, but the cost may be prohibitive (Witham 1976).

AUTHORITIES

Archie Carr
Department of Zoology
University of Florida
Gainesville, FL 32611

George Hughes
Oceanographic Research Institute
P.O. Box 736
Durban,
Natal, South Africa

Frank Lund
P.O. Box 541
Jupiter Island, FL 33458

Bernard Nietschmann
Department of Geology
University of Michigan
Ann Harbor, MI 48104

Peter Pritchard
Florida Audubon Society
P.O. Drawer 7
Maitland, FL 32751

PREPARER'S COMMENTS

None.

LITERATURE CITED/SELECTED REFERENCES

- Bustard, R. 1973. Sea turtles, natural history and conservation. Taplinger Publ., New York. 220 pp.
- Carr, A. F. 1952. Handbook of turtles. Turtles of the United States, Canada, and Baja California. Comstock Publ. Assoc., Univ. Cornell Press, Ithaca, N.Y. 542 pp.
- . 1967. So excellent a fish. The Natural History Press, Garden City, N.Y. 248 pp.
- . 1972. Great reptiles, great enigmas. Audubon March: 24-35.
- Carr, A. F., H. F. Hirth, and L. Ogren. 1966. The ecology and migrations of sea turtles, 6. The

hawksbill turtle in the Caribbean Sea. Amer. Mus. Nov. 2248. 29 pp.

- Carr, A. F., and A. R. Main. 1973. Report on an inquiry into ecological implications of a turtle farming project. In Turtle farming project in northern Australia. Union Offset Co., Pty, Limited, Canberra, Australia. 80 pp.
- Carr, A. F., and S. Stancyk. 1975. Observations on the ecology and survival outlook of the hawksbill turtle. Biol. Conserv. (8): 161-172.
- Deraniyagala, P. E. P. 1939. Tetrapod reptiles of Ceylon. Vol. 1. Columbo Mus. Publ. Ceylon. 412 pp.
- Ernst, C. H., and R. W. Barbour. 1972. Turtles of the United States. Univ. of Kentucky Press, Lexington. 347 pp.
- IUCN. 1968. Red data book. Vol. 3. Amphibia and reptilia. Compiled by R. E. Honegger. IUCN. Morges, Switzerland.
- Lund, F. 1979. Atlantic hawksbill. Pages 24-25 in R. W. McDiarmid, ed., Rare and endangered biota of Florida, Vol. 3, Amphibians and reptiles. Univ. Presses of Florida, Gainesville.
- Marquez M., R. 1976. Reservas naturales para la conservacion de las tortugas marinas en Mexico. INP/SI83:1-22.
- McFarlane, R.W. 1963. Disorientation of loggerhead hatchlings by artificial road lighting. Copeia 1963(1):153.
- Montoya, A.E. 1969. Programas de investigacion y conservacion de las tortugas marinas en Mexico. Pages 34 to 53 in Marine turtles. IUCN New Publ. Ser. Suppl., Paper 20.
- Pope, C. H. 1939. Turtles of the United States and Canada. Alfred A. Knopf, Inc., New York. 343 pp.
- Pritchard P. C. H. 1969. Summary of world sea turtle survival situation. IUCN Bull. 2(11):90-91.
- Rainey, W. E., and P. C. H. Pritchard. 1972. Distribution and management of Caribbean sea turtles. Trans. N. Am. Wildl. Nat. Resour. Conf. 37:1-17.
- Rebel, T. P. 1974. Sea turtles and the turtle industry of the West Indies, Florida, and the Gulf of Mexico. Rev. ed. Univ. of Miami Press, Coral Gables. 250 pp.

- Riedman, S. R., and R. Witham. 1974. Turtles: extinction or survival? Abelard-Schumann New York. 156 pp.
- Schmidt, S., and R. P. Witham. 1961. In defense of the turtle. *Sea Frontiers* 7(4):211-219.
- Survival Service Commission. 1969. Marine turtles. Proc. working meeting of marine turtle specialists organized by IUCN at Morges, Switzerland.
- U.S. Department of Commerce. 1976. Proposed listing of the green sea turtle (*Chelonia mydas*), Loggerhead (*Caretta caretta*), and pacific ridley sea turtle (*Lepidochelys olivacea*) as threatened species under the Endangered Species Act of 1973. Draft EIS. Natl. Oceanic Atm. Admin., Natl. Marine Fish. Ser., Washington, D.C.
- Walker, W. F. 1971. Swimming in sea turtles of the family Cheloniidae. *Copeia* 1971(2):229-233.
- Witham, R. P. 1976. *Eretmochelys imbricata* account. In H. O. Hillestad, D. B. Means, and W. W. Baker, eds. Endangered and threatened vertebrates of the southeastern United States. Tall timbers Res. Stn. Misc. Publ. 4.
- Zim, H. S., and H. M. Smith. 1953. Reptiles and amphibians: A guide to familiar American species. Simon and Schuster, New York. 147 pp.

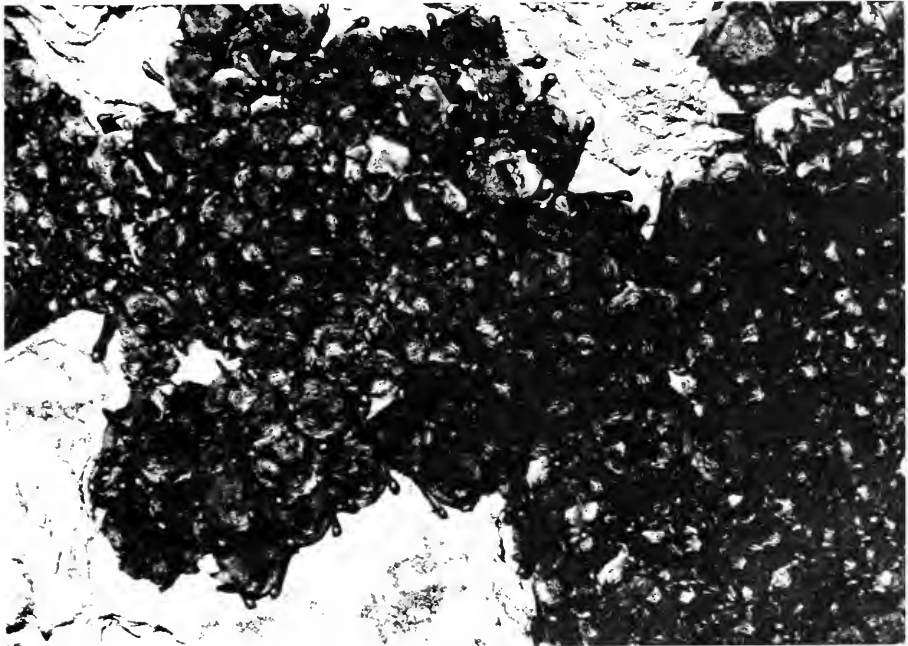
Biological Services Program

FWS/OBS-80/01.23

March 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States-

THE INDIANA BAT



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

FWS/OBS-80/01.23
March 1980

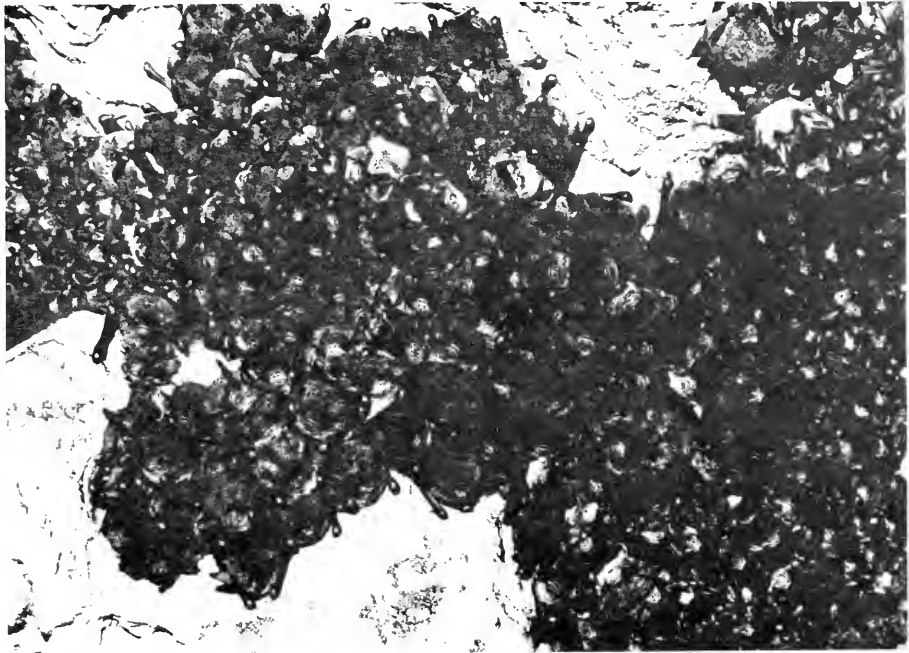
SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—

THE INDIANA BAT

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: STEVEN R. HUMPHREY

INDIANA BAT

Myotis sodalis Miller and Allen

KINGDOM Animalia
CLASS Mammalia
ORDER Chiroptera
FAMILY Vespertilionidae

OTHER COMMON

NAMES Indiana myotis, social bat,
 Kentucky brown bat

DATE

Entered into SWIS. to be determined
 Updates. 28 April 1978

LEGAL STATUS

Federal: Endangered (32 FR 4001, 11 March 1977)

States: Endangered: Florida, Georgia, Indiana, Illinois, Michigan, Mississippi, Missouri, New Jersey, New York, North Carolina, Ohio, South Carolina, Tennessee, Vermont.

REASONS FOR CURRENT STATUS

Approximately 87% of the entire species population winters in only seven caves (Humphrey 1978). Disturbance or vandalism by man disrupts hibernation and results in deaths and abortions of young (Hall 1902, Humphrey and Scudder 1978). Intrusion by vandals, spelunkers, and biologists have accounted for losses (IBRT 1975). Hall (1962) discusses clustering behavior of Indiana bats in caves and states that frequent disruption of congregations could lead to extinction.

Loss of habitat has caused 50% of the decline over recent years (Humphrey 1978). Some hibernation sites have been rendered unsuitable as a result of blocking or impeding air flow into the caves, thus changing the cave's climate (Humphrey 1978). Urbanization and deforestation have contributed to the species decline (Mohr 1972). Humphrey et al. (1974) found that females breed in scattered nurseries in trees and suggests that losses of large amounts of summer habitat could be catastrophic.

Natural factors such as a low population

growth rate (Humphrey and Cope 1977), floods (Griffin 1953, DeBlase et al. 1965), freezes (Humphrey 1978), and cave-ins (Hall 1962) tend to inhibit recovery.

PRIORITY INDEX

None designated.

DESCRIPTION

Adults are 41 to 49 mm long and weigh 6 to 9 g. The fur is buffy-brown on shoulders and sepia brown dorsally; underparts are pinkish white. Wing membrane and ears are blackish brown. Dark, fuscous brown hairs on and between toes do not extend beyond the tips of the claws. The calcar is keeled. Flight-age young lack distinguishing markings. Barbour and Davis (1969), Humphrey (1975, 1977), and IBRT (1975) contain illustrations.

RANGE

Indiana bats range throughout most of the eastern U.S. from New Hampshire to Iowa to eastern Oklahoma, and southeast to the panhandle of Florida. Their winter range is much smaller, being restricted primarily to Alabama, Tennessee, Kentucky, Indiana, Missouri, and West Virginia.

RANGE MAP

Dots on the following map represent winter caves; cross-hatched area is summer range (Humphrey 1978).

STATES/COUNTIES

Alabama: Blount, Calhoun, Cherokee, Cullman, DeKalb, Etowah, Jackson, Limestone, Madison, Marshall, Morgan.

Arkansas: Baxter, Benton, Carroll, Clark, Clay, Cleburne, Conway, Craighead, Crawford, Faulkner, Franklin, Fulton, Garland, Greene, Hot Spring, Howard, Independence, Izard, Jackson, Johnson, Lawrence, Logan, Lonoke, Madison, Marion, Montgomery, Newton, Perry, Pike, Polk, Pope, Prairie, Pulas-ki, Randolph, Saline, Scott, Searcy, Sebastian, Sevier, Sharp, Stone, Van Buren, Washington, White, Woodruff, Yell.

Con-necticut: Fairfield, Hartford, Litchfield, Middlesex, New Haven, Tolland, Windham.

Florida: Jackson.

Georgia: Bartow, Catoosa, Chattooga, Cherokee, Cobb, Dade, Dawson, Fannin, Floyd, Gilmer, Gordon, Haralson, Lumpkin, Murray, Paulding, Pickens, Polk, Towns, Union, Walker, White, Whitfield.

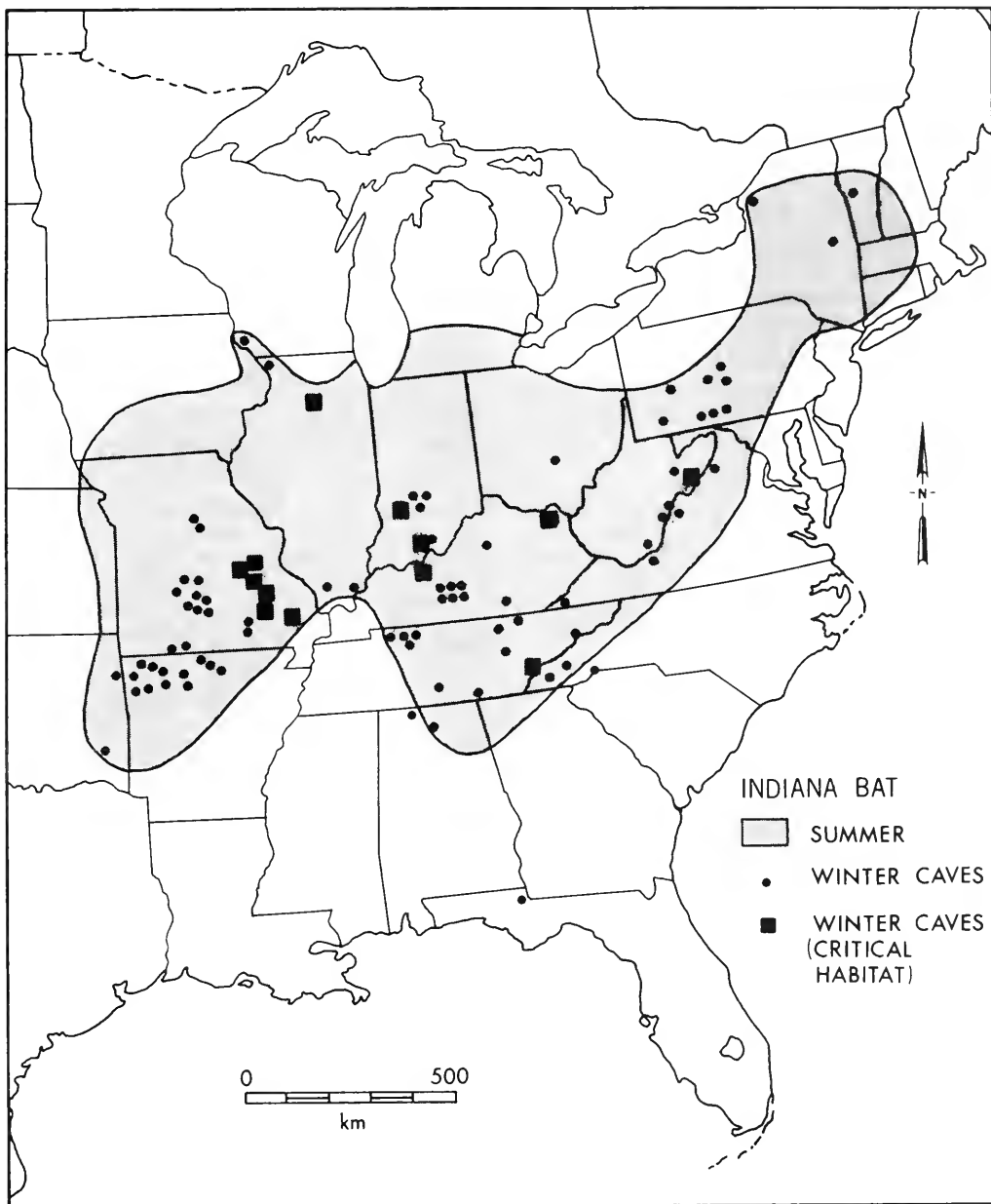
Illinois: Adams, Bond, Brown, Bureau, Calhoun, Carroll, Cass, Champaign, Christian, Clark, Clay, Clinton, Coles, Cook, Crawford, Cumberland, DeKalb, DeWitt, Douglas, DuPage, Edgar, Edwards, Effingham, Fayette, Ford, Franklin, Fulton, Gallatin, Greene, Grundy, Hamilton, Hancock, Hardin, Henderson, Henry, Iroquois, Jackson, Jasper, Jefferson, Jersey, Jo Daviess, Johnson, Kane, Kankakee, Kendall, Knox, Lake, LaSalle, Lawrence, Lee, Livingston, Logan, McDonough, McLean, Macon, Macoupin, Madison, Marion, Marshall, Mason, Menard, Mercer, Monroe, Montgomery, Morgan, Moultrie, Ogle, Peoria, Perry, Piatt, Pike, Pope, Putnam, Randolph, Richland, Rock Island, St. Clare, Saline, Sangamon, Schuyler, Scott, Shelby, Stark, Stephenson, Tazewell, Union, Vermilion, Wabash, Warren, Washington, Wayne, White, Whiteside, Will, Williamson, Woodford.

Indiana: All counties.

Iowa: Adair, Adams, Appanoose, Cedar, Clarke, Clayton, Clinton, Dallas, Davis, Decatur, Des Moines, Dubuque, Fremont, Henry, Iowa, Jackson, Jasper, Jefferson, Johnson, Jones, Keokuk, Lee, Louisa, Lucas, Madison, Mahaska, Marion, Monroe, Montgomery, Muscatine, Page, Polk, Poweshiek, Ringgold, Scott, Taylor, Union, Van Buren, Wapello, Warren, Washington, Wayne.

Kansas: Atchison, Bourbon, Brown, Cherokee, Crawford, Doniphan, Jefferson, Johnson, Leavenworth, Linn, Miami, Wyandotte.

Kentucky: Adair, Allen, Anderson, Barren, Bath, Bell, Bourbon, Boyd, Boyle,



Map showing the range, winter caves and critical habitat of the Indiana bat.

- Bracken, Breathitt, Breckenridge, Bul-
litt, Butler, Caldwell, Campbell, Car-
roll, Carter, Casey, Christian, Clark,
Clay, Clinton, Crittenden, Cumber-
land, Daviess, Edmonson, Elliott, Es-
till, Fayette, Fleming, Floyd, Franklin.
Gallatin, Garrard, Grant, Grayson,
Green, Greenup, Hancock, Hardin,
Harlan, Harrison, Hart, Henderson,
Henry, Hopkins, Jackson, Jefferson,
Jessamine, Johnson, Kenton, Knott,
Knox, Larue, Laurel, Lawrence, Lee,
Leslie, Letcher, Lewis, Lincoln,
Livingston, Logan, Lyon, McCreary,
McLean, Madison, Magoffin, Marion,
Martin, Mason, Meade, Menifee, Mer-
cer, Metcalfe, Monroe, Montgomery,
Morgan, Muhlenberg, Nelson, Nicholas,
Ohio, Oldham, Owen, Owsley, Pendle-
ton, Perry, Pike, Powell, Pulaski,
Robertson, Rockcastle, Rowan, Rus-
sell, Scott, Shelby, Simpson, Spencer,
Taylor, Todd, Trigg, Trimble, Union,
Warren, Washington, Wayne, Webster,
Whitley, Wolfe, Woddford.
- Maryland: Allegany, Carroll, Frederick, Garrett,
Montgomery, Washington.
- Massa-
chusetts: Berkshire, Franklin, Hampshire,
Hampden, Middlesex, Worcester,
- Michigan: Allegany, Barry, Berrien, Branch, Cal-
houn, Cass, Clinton, Eaton, Genesee,
Hillsdale, Ingham, Iron, Jackson, Kala-
mazoo, Kent, Lenawee, Livingston,
Ottawa, St. Joseph, Shiawassee, Van
Buren, Washtenaw, Wayne.
- Missouri: Adair, Andrew, Atchison, Audrain,
Barry, Barton, Bates, Benton, Bol-
linger, Boone, Buchanan, Butler, Cald-
well, Callaway, Camden, Cape Girar-
deau, Carroll, Carter, Cass, Cedar,
Chariton, Christian, Clark, Clay, Clin-
ton, Cole, Cooper, Crawford, Dade,
Dallas, Daviess, DeKalb, Dent, Doug-
las, Franklin, Gasconade, Gentry,
Greene, Grundy, Harrison, Henry,
Hickory, Holt, Howard, Howell, Iron,
Jackson, Jasper, Jefferson, Johnson,
Knox, Laclede, Lafayette, Lawrence,
Lewis, Lincoln, Linn, Livingston,
- McDonald, Macon, Madison, Maries,
Mercer, Miller, Moniteau, Monroe,
Montgomery, Morgan, Newton, Nada-
way, Oregon, Osage, Ozark, Perry,
Pettis, Phelps, Pike, Platte, Polk,
Pulaski, Putnam, Ralls, Randolph,
Ray, Renolds, Ripley, St. Charles,
St. Claire, St. Francois, Ste. Gene-
vieve, St. Louis, St. Louis City, Saline,
Schuyler, Scotland, Scott, Shannon,
Shelby, Stoddard, Stone, Sullivan,
Taney, Texas, Vernon, Warren, Wash-
ington, Wayne, Webster, Worth,
Wright.
- Nebraska: Nemaha, Pawnee, Richardson.
- New
Hampshire: Cheshire, Grafton, Hillsborough,
Merrimack, Sullivan.
- New Jersey: Bergen, Passaic, Sussex, Warren.
- New York: Albany, Broome, Cayuga, Chemung,
Chenango, Columbia, Cortland, Dela-
ware, Dutchess, Essex, Franklin, Ful-
ton, Genessee, Hamilton, Herkimer,
Jefferson, Lewis, Madison, Montgo-
mery, Oneida, Onondaga, Orange, Os-
wego, Otsego, Putnam, Rensselaer, St.
Lawrence, Saratoga, Schenectady,
Schoharie, Sullivan, Tioga, Tompkins,
Ulster, Warren, Washington.
- North
Carolina: Alleghany, Ashe, Avery, Buncombe,
Burke, Caldwell, Cherokee, Graham,
Haywood, Jackson, McDowell,
Macon, Madison, Mitchell, Surrey,
Swain, Tatauga, Wilkes, Yancey.
- Ohio: Adams, Allen, Ashland, Athens, Aug-
laize, Belmont, Brown, Butler, Car-
roll, Champaign, Clark, Clermont,
Clinton, Columbiana, Coshocton,
Crawford, Darke, Defiance, Delaware,
Erie, Fairfield, Fayette, Franklin, Ful-
ton, Gallia, Greene, Guernsey, Hamil-
ton, Hancock, Hardin, Harrison,
Henry, Highland, Hocking, Holmes,
Huron, Jackson, Jefferson, Knox,
Lawrence, Licking, Logan, Lorain,
Lucas, Madison, Marion, Medina,
Meigs, Mercer, Miami, Monroe, Mont-

gomery, Morgan, Morrow, Muskingum, Noble, Ottawa, Paulding, Perry, Pickaway, Pike, Preble, Putnam, Richland, Ross, Sandusky, Scioto, Seneca, Shelby, Stark, Summit, Tuscarawas, Union, Van Wert, Vinton, Warren, Washington, Wayne, Williams, Wood, Wyandot.

Oklahoma: Adair, Cherokee, Craig, Delaware, Haskell, Latimer, Le Flore, Mayes, McCurtain, McIntosh, Muskogee, Ottawa, Pittsburg, Pushmataha, Sequoyah, Wagon.

Pennsylvania: Adams, Allegheny, Armstrong, Beaver, Bedford, Berks, Blair, Bradford, Butler, Cambria, Carbon, Centre, Clearfield, Clinton, Columbia, Cumberland, Dauphin, Fayette, Franklin, Fulton, Greene, Huntingdon, Indiana, Jefferson, Juniata, Lackawanna, Lancaster, Lawrence, Lebanon, Luzerne, Lycoming, Mifflin, Monroe, Montour, Northumberland, Perry, Pike, Schuylkill, Snyder, Somerset, Sullivan, Susquehanna, Tioga, Union, Washington, Wayne, Westmoreland, Wyoming, York.

Tennessee: Anderson, Bedford, Bledsoe, Blount, Bradley, Campbell, Cannon, Carter, Cheatham, Claiborne, Clay, Cocke, Coffee, Cumberland, Davidson, DeKalb, Dickson, Fentress, Franklin, Grainger, Greene, Grundy, Hamblen, Hamilton, Hancock, Hickman, Jackson, Jefferson, Johnson, Knox, Lincoln, Loudon, McMinn, Macon, Marion, Marshall, Maury, Meigs, Monroe, Montgomery, Moore, Morgan, Overton, Pickett, Polk, Putnam, Rhea, Roane, Robertson, Rutherford, Scott, Sequatchie, Sevier, Smith, Stewart, Sullivan, Summer, Trousdale, Unicoi, Union, Van Buren, Warren, Washington, White, Williamson, Wildon.

Virginia: Albemarle, Alleghany, Amherst, Appomattox, Augusta, Bath, Bedford, Bland, Botetourt, Buchanan, Buckingham, Campbell, Carroll, Clarke, Craig, Culpeper, Cumberland, Dickenson, Fauquier, Floyd, Fluvanna, Franklin, Frederick, Giles, Goochland, Grayson,

Greene, Henry, Highland, Lee, Loudoun, Louisa, Madison, Montgomery, Nelson, Orange, Page, Patrick, Pittsylvania, Prince William, Pulaski, Rappahannock, Roanoke, Rockbridge, Rockingham, Russell, Scott, Shenandoah, Smyth, Spotsylvania, Tazewell, Warren, Washington, Wise, Wythe.

West

Virginia: All counties.

Wisconsin: Crawford, Grant, Green, Iowa, Lafayette, Richland.

HABITAT

Winter hibernation is restricted to caves with specific climatic conditions, namely, temperature 4° to 8° C and relative humidity from 66% to 95% (Barbour and Davis 1969, Humphrey 1978). These requirements are met only in a narrow zone close to a cave entrance (Hall 1962).

Sexes and age classes diverge in summer. Females and juveniles live in stream bank and floodplain areas, roosting under the bark of trees (Humphrey et al. 1977). Males use floodplain ridges and hillside forests and usually roost in caves (LaVal et al. 1976, 1977).

FOOD AND FORAGING BEHAVIOR

Females and juveniles eat mainly small, soft-bodied flying insects, primarily Diptera (J. J. Belwood and S. R. Humphrey personal communication). In early summer, females and juveniles forage along stream banks most of the time, and shift later to include trees and the edges of floodplain forests (Humphrey et al. 1977). Foraging areas average 1.47 ha per animal in early summer, and 4.54 ha per animal by mid-summer (Humphrey et al. 1977). Males forage in densely wooded areas at tree-top height (LaVal et al. 1976, 1977).

SHELTER REQUIREMENTS

Winter caves have stable, cool temperatures (usually 4° to 8° C, but sometimes as low as 1° C), and high humidity (Humphrey and Scudder 1979, LaVal et al. 1976).

NESTING OR BEDDING

Summer nursery roosts are located under the bark of live or dead hardwoods, which serves as a buffer against sudden temperature changes, shelters the bats from weather and predators, and acts as a solar heat collector (Humphrey et al. 1977).

RITUAL REQUIREMENTS

The bats swarm near caves from August to November in Missouri and from mid-August to the end of October in Indiana and Kentucky (Cope and Humphrey 1977). Swarming is described as a phenomenon in which large numbers of bats fly in and out of a cave entrance from dusk to dawn, while relatively few roost in the cave during the day (Humphrey and Cope 1976). The significance of this activity is not known; it has been suggested that it relates to mate selection and copulation, adjustment to and familiarization with seasonal ranges, and/or rest stops during migration (IBRT 1975, M. D. Tuttle personal communication).

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

It is possible that in some instances, the gray bat (*Myotis grisescens*), another Federally listed endangered species, may compete for roosting space in winter caves (Hall 1962) and could possibly displace the Indiana bat from them.

POPULATION NUMBERS AND TRENDS

The recent discovery of two new winter caves has brought estimates of total population to 509,000 (Richter et al. 1978). The bat once numbered 1 million, but major catastrophies, primarily flooding, killed many in wintering caves (Hall 1962, IBRT 1975).

Humphrey (1978) recorded a 28% decline in total numbers from 1960 to 1975 (Table 1).

Table 1. Population estimates and trends for the Indiana bat, by state

State	1960 population	1975 population	Trend percentage
Missouri	311,433	285,983	-8.2
Kentucky	209,796	55,782	-73.4
Tennessee	----	7,554	----
Arkansas	----	1,700	----
Indiana	102,823	104,824	+1.9
Illinois	339	194	-42.8
Virginia	----	580	----
West Virginia	----	1,757	----
Pennsylvania	1,002	----	----
New York	----	500	----
Vermont		...not censused...	
Totals	625,393	458,874	-26.6

The decline in Kentucky was due to flooding, disturbance, and man-caused alteration of cave climate. Humphrey (1976) believes the Indiana bat is headed for extirpation in Kentucky. Missouri reductions are a result of winter weather variation. Incidents of vandalism and the collapse of a mine contributed to the decline in Illinois (Mohr 1962, Humphrey 1978). The overall trend at present will lead to the species' extinction in 50 years, but most losses of winter habitat are reversible and this eventuality can be avoided (Humphrey 1978).

REPRODUCTION

Copulation occurs in the fall with the females storing the sperm over the winter (Barbour and Davis 1969). The females form nursery colonies under the bark of trees in late spring (usually May) and give birth to one young in late June or early July (Humphrey et al. 1977). Only females and young occupy the nursery roost (Humphrey et al. 1977). The longevity record for males is 13.5 years; for females, 14.8 years. The survival rate for females is high for the first 10 years, and for males, for the first 6 years only (Humphrey and Cope 1977).

MANAGEMENT AND CONSERVATION

The primary conservation effort to date has been to control human access to caves by the use of gates. The National Park Service, the U.S. Forest Service, and some State agencies have installed gates on several caves. The Recovery Team suggests the gating of several more caves and mines, which will give protection to 99% of the bats (IBRT 1975). In one instance (Colossal Cave, Kentucky), a gate modified cave microclimate and made it unsuitable for bats (Humphrey 1978). Gates or fences have also increased the bats' susceptibility to predation at the entrances (Tuttle 1977). Other conservation efforts include a moratorium on issuance of bat bands by the U.S. Fish and Wildlife Service and restrictions on use of pesticides such as DDT. The National Speleological Society has appointed a Bat Conservation Task Force and has taken some specific measures to protect bats.

The original Recovery Team (since disbanded) outlined a Recovery Plan (IBRT 1975) listing three objectives critical to preservation of the species: (1) protecting winter habitat by securing caves and mines and restricting entry; (2) initiating a public information and education pro-

gram; and (3) monitoring population levels and habitat quality. A new Recovery Team is being formed (J. M. Engel personal communication).

Other management needs include protection of the summer riparian environment (Martin 1973, Humphrey 1978).

The majority of the species winters in publicly owned caves, but many private caves are also used (R. K. LaVal personal communication). Public acquisition of certain of the latter, including four in Missouri and one in West Virginia, is being sought at present (R. LaVal personal communication, J. Rawson personal communication).

Table 2 lists pertinent information on publicly owned wintering caves.

Dr. Tom Kunz (Recovery Team)
Department of Biology
Boston University
2 Cummington
Boston, Massachusetts 02215

Dr. Don Wilson (Recovery Team)
National Fish and Wildlife Laboratory
National Museum of Natural History
Washington, D.C. 20560

Dr. Merlin Tuttle (Recovery Team)
Vertebrate Division
Milwaukee Public Museum
Milwaukee, Wisconsin 53233

AUTHORITIES

J. T. Brady (Recovery Team)
Biologist
U.S. Army Corps of Engineers
210 N. 12th Street, Room 853
St. Louis, MO 63101

J. B. Cope
Joseph Moore Museum
Earlham College
Richmond, IN 47374

J. M. Engel
U.S. Fish and Wildlife Service
Federal Building, Fort Snelling
Twin Cities, MN 55111

S. R. Humphrey
Florida State Museum
Museum Road
Gainesville, FL 32611

R. K. LaVal (Recovery Team Leader)
Missouri Department of Conservation
Fish and Wildlife Research Center
1110 College Avenue Columbia,
Columbia, MO 65201

R. Z. Mumford
Dept. of Forestry and Conservation
Purdue University
Lafayette, IN 47904

A. Richter
Joseph Moore Museum
Earlham College
Richmond, IN 47374

PREPARER'S COMMENTS

None.

Table 2. Ownership of caves, Critical Habitat,¹ and recent (1975) population estimates for Indiana bat caves (Humphrey 1978, Richter et al. 1978).

[F=Federal, P=Private, S=State, CH=Critical Habitat.]

State	County	Cave	Ownership	Population estimate
Alabama	?	Santa ²	F	-----
	?	Several caves in Sylamore Forestry Dist.	F	700
Illinois	Madison	Denney	?	1,000
	LaSalle	Blackball Mine	(CH), S	192
Kentucky	?	No. 111	S	50,000
	?	No. 175	S	1,250
	?	No. 376	S	100,000
	Crawford	Wyandotte	(CH), S	1,460
	Crawford	Salt peter	S	95
Missouri	Greene	Ray's	(CH), P	2,700
	Carter	Bat	(CH), S	40,000
	Edmonson	Coach	(CH), P	4,500
	Edmonson	Dixon	F	3,600
	Edmonson	Long's	F	7,600
	Edmonson	Colossal	F	14
	Edmonson	Wilson	F	0
	Edmonson	Bat	F	68
Missouri	?	Carter	S	-----
	Iron	Pilot Knob	(CH), P	-----
	Shannon	No. 047	(CH),)	46,000
	Washington	No. 029	(CH), S	81,800
	Crawford	No. 021	(CH), F	12,850
	Franklin	No. 009	(CH), S	21,000
	Franklin	No. 017	S	-----
Camden	No. 053	S	-----	

Tennessee Blount	White Oak Blowhole	(CH), F	6,050
?	Nicajack	F	-----
Anderson	Norris Dam	F	-----
West Virginia	Pendelton Hellhole	(CH), P	1,500
	Tucker Big Springs (Blowing Cave)	F	150
	Tucker Cave Hollow	F	23

¹Per 42 FR 40687, 11 August 1977.

²Tutté, personal communication, 1978.

LITERATURE CITED/SELECTED REFERENCES

- Barbour, R. W., and W. H. Davis. 1969. Bats of America. Univ. Press, Kentucky, Lexington. 286 pp.
- Cope, J. B., and S. R. Humphrey. 1977. Spring and autumn swarming behavior in the Indiana bat, *Myotis sodalis*. J. Mammal. 58:93-95.
- DeBlase, A. F., S. R. Humphrey, and K. S. Drury. 1965. Cave flooding and mortality in bats in Wind Cave, Kentucky. J. Mammal. 46:96.
- Engel, J. M. 1976. The Indiana bat, *Myotis sodalis*, a bibliography. U.S. Fish Wildl. Serv., Spec. Sci. Rep. 196. 11 pp.
- Griffin, D. G. 1953. Deluge underground. Bull. Natl. Speleol. Soc. 15:34-37.
- Hall, J. S. 1962. A life history and taxonomic study of the Indiana bat, *Myotis sodalis*. Reading Pub. Mus. and Art Gallery Sci. Publ. 12:3-68.
- . 1972. The status of *Myotis sodalis*, the West Virginia Dep. Natur. Resour. Elkins. 5 pp.
- Hall, E. R., and K. R. Kelson. 1959. The mammals of North America. Vol. 1. Ronald Press, New York. 546 pp.
- Humphrey, S. R. 1975. Cover photo. Bioscience 25(9).
- . 1977. Keep 'em flying. Animal Kingdom 89(5).
- . 1978. Status, winter habitat, and management of the endangered Indiana bat, *Myotis sodalis*. Q. J. Florida Acad. Sci. 41(2):65-76.
- Humphrey, S. R., and J. B. Cope. 1976. Population ecology of the little brown bat, *Myotis lucifugus*, in Indiana and north-central Kentucky. Am. Soc. Mammal. Spec. Publ. 4:1-81.
- . 1977. Survival rates of the endangered Indiana bat, *Myotis sodalis*. J. Mammal. 58:32-36.
- Humphrey, S. R., J. B. Cope, A. R. Richter, and P. P. Humphrey. 1974. Summer ecology of the endangered Indiana bat. Fifth Am. Symp. Bat Res., Texas Tech. Univ., Lubbock.
- Humphrey, S. R., A. R. Richter, and J. B. Cope. 1977. Summer habitat and ecology of the endangered Indiana bat, *Myotis sodalis*. J. Mammal. 58:334-346.
- Humphrey, S. R., and S. J. Scudder. 1979. Indiana bat. Pages 3-4 in J. N. Layne, ed. Rare and endangered biota of Florida, Vol. 1, Mammals. Univ. Presses of Florida, Gainesville.
- IBRT (Indiana Bat Recovery Team). 1975. Recovery plan for the Indiana bat. Draft. U.S. Dep. Interior, Fish Wildl. Serv. 34 pp.
- LaVal, R. K., R. L. Clawson, W. Caire. L. R. Wingate, and M. L. LaVal. 1976. An evaluation of the status of Myotine bats in the proposed Meromec Park and Union Lake project areas, Missouri. School of Forestry, Fisheries, and Wildlife, Univ. of Missouri, Columbia. 136 pp.
- LaVal, R. K., R. L. Clawson, M. L. LaVal, and W. Caire. 1977. Foraging behavior and nocturnal activity patterns of Missouri bats, with emphasis on the endangered species *Myotis grisescens* and *Myotis sodalis*. J. Mammal. 58:592-599.
- Martin, R. L. 1973. The current status of bat protection in the United States of America. Period. Biol. 75:153-54.
- Mohr, C. E. 1972. The status of threatened species of cave-dwelling bats. Bull. Natl. Speleol. Soc. 34:33-37.
- Mumford, R. E. 1974. The status of the Indiana bat and the eastern wood rat on the Wayne-Hoosier National Forest, Indiana. Purdue Univ. Dep. Forestry and Conserv. Spec. Study.
- Richter, A. R., D. A. Scerley, J. B. Cope, and J. H. Keith. 1978. A newly discovered concentration of hibernating Indiana bat, *Myotis sodalis*, in southern Indiana. J. Mammal. 59:191.
- Tuttle, M. D. 1977. Gating as a means of protecting cave dwelling bats. Pages 77-82 in National Cave Management Symposium Proc. 1976. Speleobooks, Albuquerque. 106 pp.

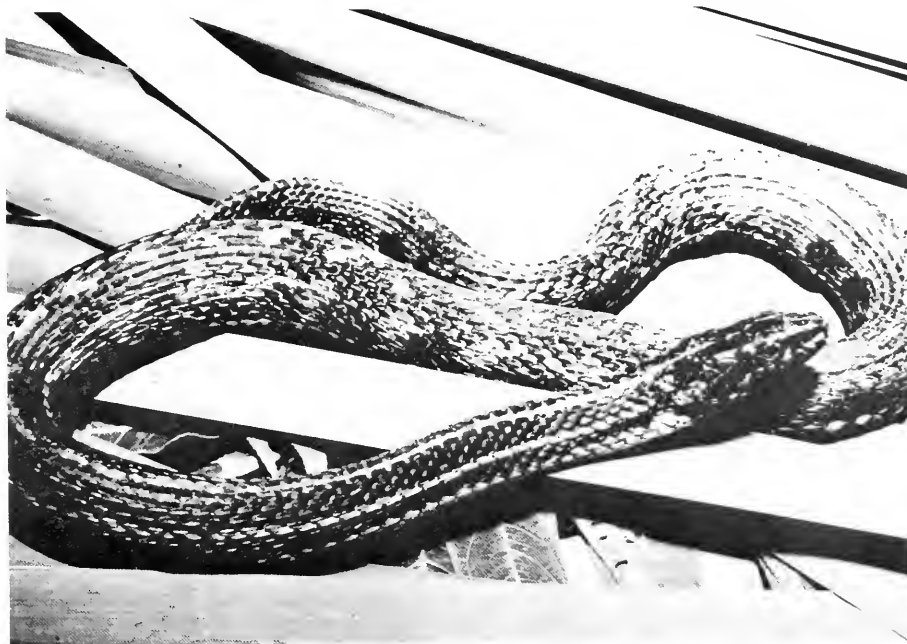
Biological Services Program

FWS/OBS-80/01.24

March 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States-

THE ATLANTIC SALT MARSH SNAKE



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

FWS/OBS-80/01.24
March 1980

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—

THE ATLANTIC SALT MARSH SNAKE

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior

series of blotches. Its sides have a row of dark blotches that may merge to form short stripes in the neck region. The belly is reddish-brown to black with a median row of yellowish spots.

Color photograph is in Dodd (1978); black and white photographs in Carr and Goin (1942), Wright and Wright (1957) and Kochman and Christman (1979a).

RANGE

This species is endemic to the following localities on the Atlantic coast of Florida:

Volusia County – vicinity of National Gardens, Daytona Beach, and New Smyrna Beach
Brevard County – Merritt Island National Wildlife Refuge at Playalinda Beach (R. Demmer personal communication) and vicinity of Micco (Kochman and Christman 1979a)

Indian River County – Gifford (H. Kochman unpublished data) and vicinity of Vero Beach (Kochman and Christman 1979a).

Snakes exhibiting various degrees of intermediacy between the Atlantic salt marsh snake, the Florida water snake, and the mangrove water snake (*Nerodia fasciata compressicauda*) occur at various localities throughout the known range of *N. f. taeniata* (Neill 1958, Kockman 1977).

There is no evidence to suggest that the range of this species has changed significantly (42 FR 60743-60745; 29 November 1977).

RANGE MAP

Dots on the following map represent specific localities or general areas from which one or more specimens have been taken (adapted from Kochman and Christman 1979a).

STATES/COUNTIES

Florida: Brevard, Indian River, Volusia.

HABITAT

The Atlantic salt marsh snake inhabits coastal salt marshes and mangrove swamps. It has been specifically reported along shallow tidal creeks and pools in association with glasswort (*Salicornia perennis*) (Carr and Goin 1942), blackrush (*Juncus roemerianus*) (Niell 1958), and black mangrove (*Avicennia germinans*) (H. Kale personal communication, H. Kochman unpublished data). It occurs in saline environments ranging from brackish to full strength seawater.

FOOD AND FORAGING BEHAVIOR

The species is ecologically and behaviorally similar to the Gulf salt marsh snake (*N. f. clarki*). It forages in shallow water during low tidal stages (Carr and Goin 1942, Neill 1958, Kochman and Christman 1979a), apparently feeding upon dense congregations of small fishes that become entrapped during the falling tide (Neill 1958). A similar feeding strategy has also been reported for the Gulf salt marsh snake (Pettus 1956).

Although primarily regarded as nocturnal (Carr and Goin 1942, Kochman and Christman 1979a), Atlantic salt marsh snakes may be strongly influenced by tidal rhythms and have been reported to forage in daylight during favorable tides (Neill 1958). They are also known to enter minnow traps in shallow water (H. Kale personal communication).

SHELTER REQUIREMENTS

Little specific information is available. One specimen reportedly withdrew into a fiddler crab (*Uca*) burrow when approached during daylight (Carr and Goin 1942).

NESTING OR BEDDING

Not known.

RITUAL REQUIREMENTS

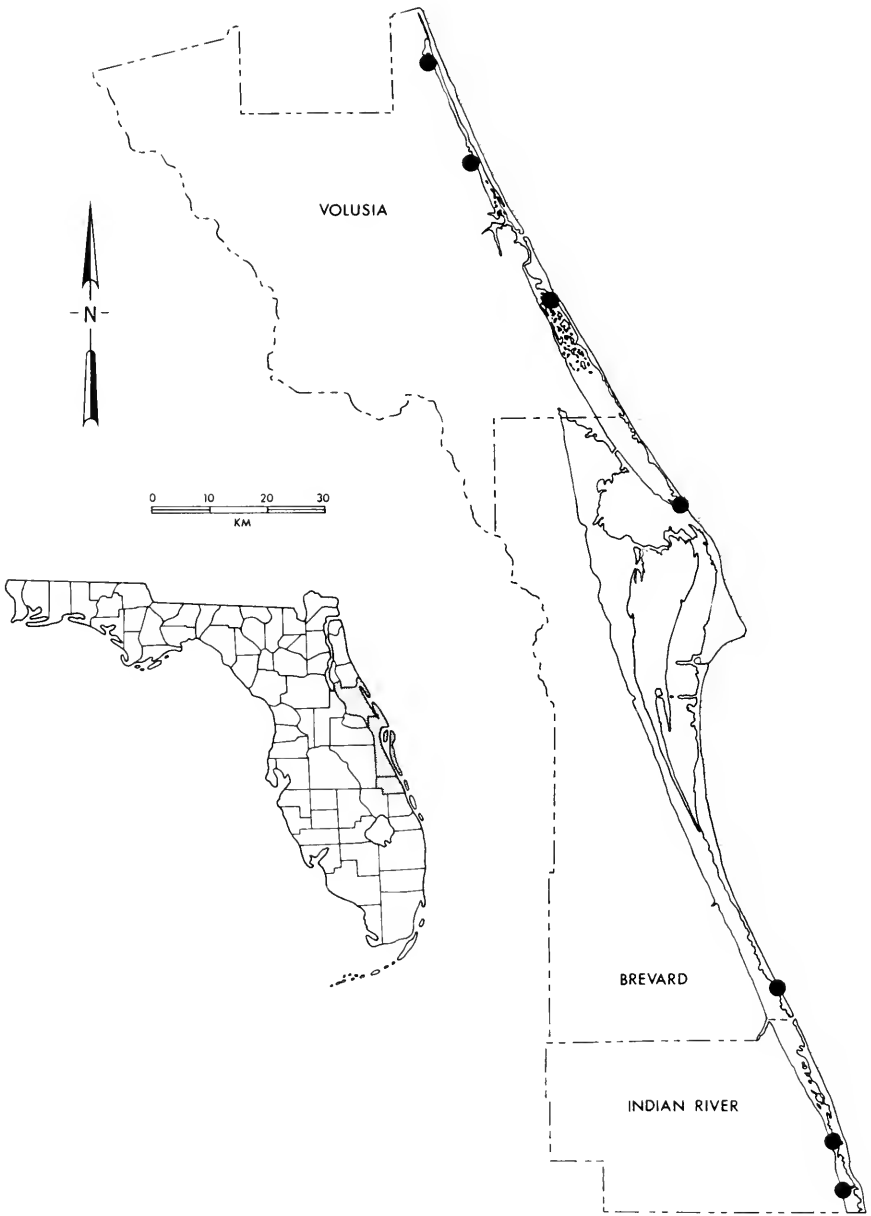
Not known.

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

Coastal races of *N. fasciata* are reproductively compatible with adjacent freshwater populations and require ecological isolation to maintain genetic integrity (Pettus 1956, 1963; Conant 1975, Kochman 1977). The Atlantic salt marsh snake appears to hybridize freely with the Florida water snake in ecotonal areas of distributional overlap (Kochman 1977). It can remain genetically distinct only if hybridization is limited to narrow zones of ecological transition between freshwater and saline habitats. Alteration of coastal wetlands through drainage and diking enhances hybridization and promotes genetic introgression, i.e. swamping, by the Florida water snake (Kochman and Christman 1979a; 42 FR 60743-60745; 29 November 1977).

POPULATION NUMBERS AND TRENDS

No population estimates are available. Approximately 50 specimens are known to science (H. Kochman unpublished data).



Map indicating the range of the Atlantic salt marsh snake along the eastern coast of Florida. Dots represent sites where specimens have been collected.

REPRODUCTION

Very little information is available. One captive female gave birth to nine young (eight alive and one stillborn) in late August (H. Kochman unpublished data). Their reproductive biology is probably similar to the Gulf salt marsh snake: 2 to 14 live young born during midsummer (Kochman and Christman 1979a, 1979b), with an average litter size of 6 to 7 (H. Kochman unpublished data).

MANAGEMENT AND CONSERVATION

Portions of their known range include State and Federal lands along the Atlantic coast of Florida: Tomoka State Park (Volusia County), Merritt Island National Wildlife Refuge (Volusia and Brevard Counties), Cape Kennedy Air Force Station (Brevard County), Patrick Air Force Base (Brevard County), and the Pelican Island National Wildlife Refuge (Indian River County).

In a letter to the U.S. Fish and Wildlife Service, Office of Endangered Species (December 1976), H. Kochman emphasized that habitat alteration and subsequent hybridization pose the chief threats to the Atlantic salt marsh snake. In view of *N. fasciata*'s high variability along Florida's Atlantic coast, it was concluded that conservation measures must be oriented toward safeguarding habitats and populations rather than a specific phenotype.

The designation of Critical Habitat in coastal areas of Volusia, Brevard and Indian River counties has been recommended by representatives of various Federal, State and private organizations (42 FR 60743-60745; 29 November 1977).

No formal advisory committee or recovery team has been established.

AUTHORITIES

Archie F. Carr
Department of Zoology
University of Florida
Gainesville, FL 32611

Richard Demmer
District V Naturalist
Division of Recreation and Parks
Florida Department of Natural Resources
Route 1, Box 107AA
Clermont, FL 32711

Howard I. Kochman
National Fish and Wildlife Laboratory
412 N. E. 16th Avenue, Room 250
Gainesville, FL 32612

PREPARER'S COMMENTS

The distribution and status of the Atlantic salt marsh snake remain essentially unknown. Further study may extend its known home range northward and southward along the Atlantic coast of Florida. Potentially suitable habitat should be surveyed for undiscovered populations, followed by designation of Critical Habitat in appropriate areas. A special interagency advisory committee with recovery team functions should be established to evaluate alternatives for effective conservation and management.

Water snakes from scattered localities along the Gulf coast may exhibit a pattern of striping and spotting similar to the Atlantic salt marsh snake (Conant 1975). In many instances, this is the result of hybridization between the longitudinally striped Gulf salt marsh snake and adjacent cross-banded races (Pettus 1956, 1963). It has been suggested that the Atlantic salt marsh snake may likewise be the product of hybridization dating back to Pleistocene contact of striped and banded populations (Kochman 1977, Kochman and Christman 1979a). Dunson (in preparation) does not consider the Atlantic salt marsh snake sufficiently distinct from the mangrove water snake to warrant subspecific status.

LITERATURE CITED/SELECTED REFERENCES

- Carr, A. F., and C. J. Goin. 1942. Rehabilitation of *Natrix sipedon taeniata* Cope. Proc. New England Zool. Club 21:47-54.
- Conant, R. 1975. A field guide to reptiles and amphibians of eastern and central North America. Houghton Mifflin Co., Boston 429 pp.
- Dodd, C. K., Jr. 1978. Amphibians & reptiles, the declining species. Water Spectrum 10(1):24-32.
- Dunson, W. A. Occurrence of partially striped forms of the mangrove snake *Nerodia fasciata compressicauda* Kennicott and comments on the status of *N. f. taeniata* Cope. Unpubl. MS.
- Kochman, H. I. 1977. Differentiation and hybridization in the *Natrix fasciata* complex (Reptilia:Serpentes): A nonmorphological approach. M.S. Thesis, University of Florida, Gainesville. 105 pp.
- Kochman, H. I., and S. P. Christman. 1979a. Atlantic salt marsh snake. Pages 27-28 in R. W. McDiarmid, ed. Rare and endangered biota of Florida, Vol. 3, amphibians and reptiles. Univ. Presses of Florida, Gainesville.

- . 1979b. Gulf salt marsh snake. Pages 62-63 in R. W. McDiarmid, ed. Rare and endangered biota of Florida, Vol. 3, amphibians and reptiles. Univ. Presses of Florida, Gainesville.
- Neill, W. T. 1958. The occurrence of amphibians and reptiles in saltwater areas, and a bibliography. Bull. Mar. Sci. Gulf and Caribb. 8(1): 1-97.
- Pettus, D. 1956. Ecological barriers to gene exchange in the common water snake (*Natrix sipedon*). Ph. D. Dissert. Univ. of Texas, Austin. 87 pp.
- . 1963. Salinity and subspeciation in *Natrix sipedon*. Copeia 1963(3):499-504.
- Wright, A. H., and A. A. Wright, 1957. Handbook of snakes of the United States and Canada. Vol. 1. Comstock Publishing Associates, Ithaca. 564 pp.

ACCOUNT PREPARED/UPDATED BY:

National Fish and Wildlife Laboratory
412 N.E. 16th Avenue, Room 250
Gainesville, FL 32601

Biological Services Program

FWS/OBS-80/01.25

March 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States-

THE DUSKY SEASIDE SPARROW



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

FWS/OBS-80/01.25
March 1980

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—

THE DUSKY SEASIDE SPARROW

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: BILL LEENHOUTS

DUSKY SEASIDE SPARROW

Ammospiza maritima nigrescens Ridgway

KINGDOM Animalia
 CLASS Aves
 ORDER Passeriformes
 FAMILY Fringillidae
 OTHER COMMON

NAMES black and white shore finch,
 black shore finch.

DATE

Entered into SWIS. To be determined.
 Updates. 10 October 1978.

LEGAL STATUS

Federal: Endangered (32 FR 4001; 11 March 1967).
 States: Endangered: Florida.

REASONS FOR CURRENT STATUS

The dusky seaside sparrow is distributed in an extremely limited area in northern Brevard County, Florida. It is adapted to narrow, unstable zones of vegetation within salt marshes. Diking of the marshes for mosquito control has altered the vegetation and the species has disappeared on northern Merritt Island. Wildfires and marsh drainage for housing, roads and pasture have reduced available habitat in the St. Johns River Basin (Sharp 1968, 1970; Baker 1973, 1976, in press; USDI 1973; DSSRT draft). Aerial spraying in coastal marshes with DDT and other insecticides to control mosquitoes from 1942 to 1953 may have been responsible for a 70% reduction in the population (Trost 1968).

PRIORITY INDEX

Not assigned.

DESCRIPTION

The dusky seaside sparrow is about 15 cm long. Adults have black or blackish brown upper parts, edged with grayish olive, white venter with heavy black streaking, bright yellow on lores and at bend of wing. The wings and tail are fuscous to fuscous black, edged with light yellowish olive. The sexes are similar.

Juvenal plumage is lighter in color with narrower tan streaking, and reduced yellow on lores and wings.

Color plates appear in Howell (1932), Peterson (1947), Sprunt (1954), and Trost (1968). A black and white photograph appears in Eberhart (1968).

RANGE

The dusky seaside sparrow is a sedentary inhabitant of brackish marshes and savannahs in northern Brevard County, Florida. The 1978 survey of singing males documented their presence in the St. Johns River Basin at the following three locations: St. Johns National Wildlife Refuge, approximately 1 km south of the refuge, and between the north and south forks of the Beeline Highway (Baker in press). The subspecies is isolated from other populations of seaside sparrow by 120 km to the north, 200 km to the west, and 400 km to the south (Trost 1968).

Dusky seaside sparrows were formerly abundant in Indian River salt marshes on Merritt Island, from Dummitt Creek south to Banana Creek (Trost 1968). Sharp (1968) determined the mainland distribution to be from Salt Lake south nearly to Florida Highway 520 and between I-95 and the St. Johns River.

RANGE MAP

Critical habitat and 1977 range are indicated on the following page. The dusky seaside sparrow apparently no longer occurs on Merritt Island (J. Baker, personal communication).

STATES/COUNTIES

Florida: Brevard.

HABITAT

The species inhabits salt marshes with highly fluctuating water levels and salinities. It prefers moist zones dominated by cordgrass (*Spartina bakerii*), 3 to 5 m above mean sea level. The St. Johns River marshes present a savannah-like

aspect, being dotted with small ponds, salt pans, cabbage palms (*Sabal palmetto*), and hammocks (Sharp 1968, 1970; Baker 1976; DSSRT draft).

Sharp (1968, 1969a, 1970) believes zones of short and tall interdigitating plants form the preferred microhabitat. The Merritt Island habitat was composed of a heterogeneous mosaic of the tall cordgrass and black rush (*Juncus roemerianus*) with short saltgrass (*Distichlis spicata*), saltwort (*Batis maritima*) and glasswort (*Salicornia perennis*). In the St. Johns River savannahs, fires and varying salinities and water levels produce the tall-short pattern with cordgrass.

Black and white habitat photographs may be found in the following: diked salt marsh—Eberhart (1968); former Merritt Island habitat—Baynard (1914) and Nicholson (1928); St. Johns River savannah—Sharp (1969b).

FOOD AND FORAGING BEHAVIOR

The subspecies is largely insectivorous. Six stomachs contained 37% grasshoppers and crickets and 25% spiders. Other items included miscellaneous insects, seeds, and tubers (Howell 1932). Trost (1968) observed duskies feeding on small snails, a dragonfly larva, a butterfly, and possibly ants.

They forage at or near the ground (Baker (1976, in press). Feeding has been observed on dikes and in tidal zone (Trost 1968).

SHELTER REQUIREMENTS

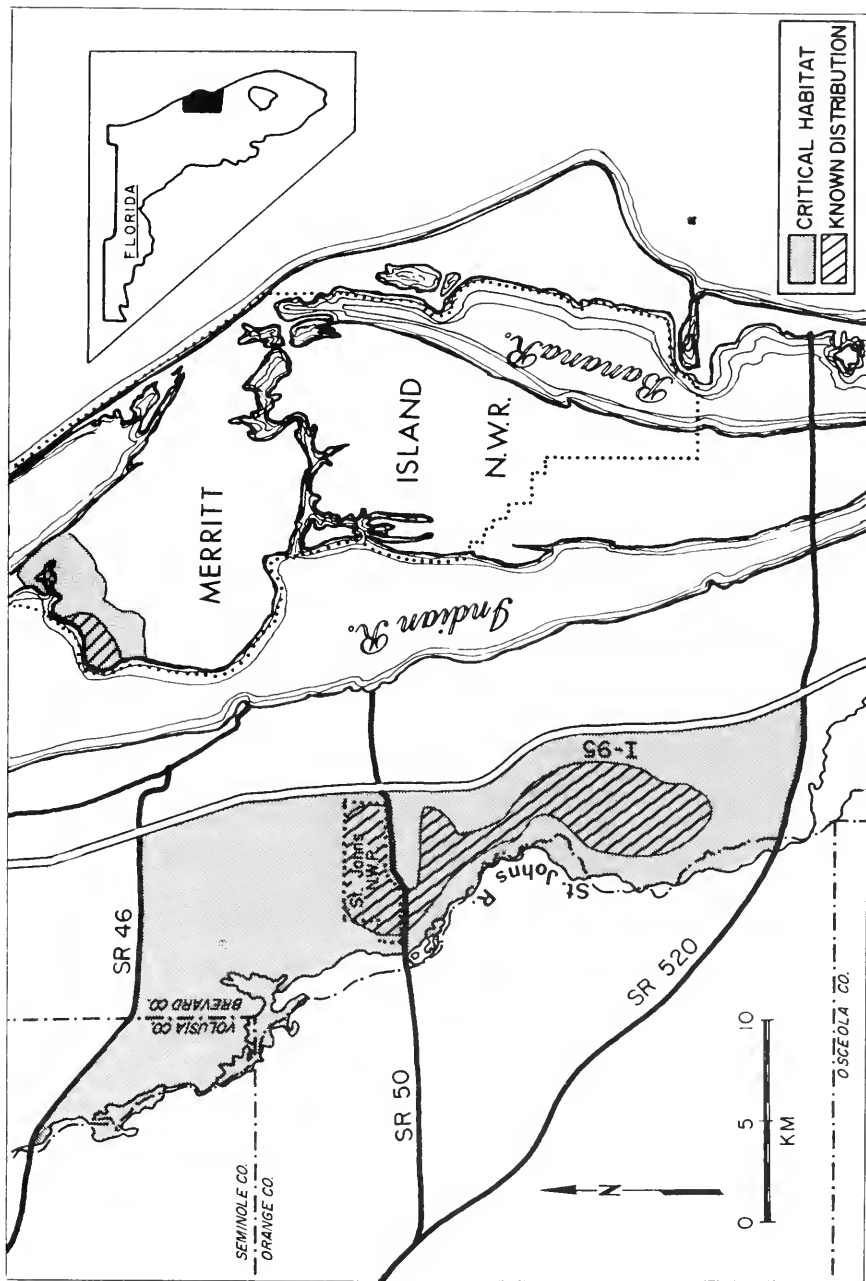
The dusky sparrow remains concealed in dense vegetation during the nonbreeding season (Trost 1968). Glasswort on Merritt Island (Baynard 1914) and cordgrass in the St. Johns floodplain (Sharp 1968, Baker 1973) form the preferred shelter.

NESTING OR BEDDING

The dusky seaside sparrow constructs a cupped nest from grasses. Nests are placed in tussocks 2 to 35 cm above ground and may be covered with arched vegetation (Nicholson 1928).

Nest sites include tussocks of glasswort, black rush, cordgrass, salt grass, and wire grass (*Sporobolus virginicus*) (Baynard 1914; Nicholson 1928, 1929; Trost 1968). Baker (in press) reported a nest in a salt bush (*Bacharis angustifolia*).

Baynard (1914) and Nicholson (1928) present black and white photographs of nests and nest sites on Merritt Island.



Present distribution and critical habitat of the dusky seaside sparrow are indicated on this map.

RITUAL REQUIREMENTS

During the breeding season males sing from prominent perches atop the glasswort, grasses, or rushes. A male occasionally will flutter slowly upward 7 to 12 m and then descend to its perch while singing. Males chase females in low erratic flights over the tops of vegetation (Nicholson 1928, Trost 1968).

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

Nesting is confined to a male's territory, which is defended by song and occasional chasing. Occupied nests were found within 12 m of one another in the 1930's, but territories appear to have increased to 100 m in diameter in recent years, due to thinning of marsh vegetation and reduction in bird densities. Banding has shown that males defend the same territory year after year. Banded juveniles have returned a year later and established territories 300 m from where they were fledged. Birds may fly 200 m or more from nest sites to feeding areas (Trost 1968).

Predation appears to occur mainly on eggs and young mostly by rats (*Oryzomys palustris*, *Sigmodon hispidus*), raccoons (*Procyon lotor*), and many snakes (*Lampropeltis getulus*, *Agkistrodon piscivorus*). Fish crows (*Corvus ossifragus*) and boat-tailed grackles (*Cassidix mexicanus*) may rob nests. Ants may force adults to abandon nests, especially during high water (Nicholson 1928; Trost 1968). Nesting red-winged blackbirds (*Agelaius phoeniceus*) constantly harass duskies which nest nearby (DSSRT draft).

The dusky occupies a median position on the marsh moisture gradient between the 3 and 5 m contour lines. Above this elevation, the drier marsh has woody growth and is vulnerable to wildfire, and the eastern meadowlark (*Sturnella magna*) replaces the dusky. In lower areas with standing water and/or dense cordgrass, least bitterns (*Ixobrychus exilis*), king rails (*Rallus elegans*) and probably black rails (*Laterallus jamaicensis*) occur. The dusky prefers patches of cordgrass with heights of 0.5 to 1.5 m and a density of approximately 1,700 stems/m² (Sharp 1968, 1970).

Natural fires seem to play a beneficial role in maintaining dusky habitat along the St. Johns River. Most lightning fires occur in the rainy season when the marsh is wet and humidity high; they move slowly and burn small, discontinuous areas, removing woody plants and allowing the

tall and short cordgrass savannah required by the duskies to regenerate (Sharp 1968, Baker in press). Birds in the immediate vicinity are displaced, but presumably recolonize afterward.

POPULATION NUMBERS AND TRENDS

Dusky sparrow populations were probably stable until the 1940's, when Nicholson estimated that aerial insecticide spraying from 1942 to 1953 reduced numbers 70% by 1957 (Trost 1968). Decreases may have resulted from reproductive failure and disruption of the food chain. Sharp (1968) estimated that there were 2,000 pairs on Merritt Island prior to spraying, based on his observed densities and the reports of Baynard (1914) and Nicholson (1928). Impoundment of the island marshes in the mid-1950's and resulting changes in salt marsh vegetation reduced populations to four localities having 70 pairs in Trost's 1961-1962 study (Sharp 1968). Sharp (1970) found 33 or 34 males in his 1968 survey. Baker (in press) located two males at the north end of Merritt Island in 1977 and none in the 1978 survey.

Sharp (1970) found 372 singing males in the St. Johns River marshes in the spring of 1968 and estimated the probable total of the mainland population to be 894 pairs. The St. Johns National Wildlife Refuge surveys for 1970 and 1972-1978 documented 143, 110, 54, 37, 47, 11, 12, and 9 singing males, respectively. Winter wildfires apparently caused the most drastic reductions. Singing males in the entire St. Johns Basin numbered 28 in 1977 and 24 in 1978; no females were seen in 1978, although some were seen in 1977 (Baker, in press).

REPRODUCTION

Dusky sparrows breed from March to August, with two egg-laying peaks—one from late April to early May and the other from late June to early July, indicating production of two broods during an average season. Pair formation and copulation have not been observed (Trost 1968). One to five eggs have been found in nests; four is the most frequent clutch size (Baynard 1914, Nicholson 1928). The female incubates the eggs for 12 to 13 days and broods the young for 9 days more. Juveniles stay in the territory about 20 days more, after which the male may drive them away. Both parents feed the young (Trost 1968).

The fledglings start to molt in late August and are almost identical to adults by November. The postnuptial molt of adults begins in August and concludes by October. The light edges of the contour feathers wear off during the winter and produce the dark nuptial plumage (Trost 1968).

The average longevity is unknown, but an adult banded in 1972 was seen twice in 1978 (Baker in press).

A color plate of a fledgling appears in Trost (1968), and black and white photographs of eggs and nestlings, in Baynard (1914) and Nicholson (1928).

MANAGEMENT AND CONSERVATION

The conflict between mosquito control and the dusky's stringent habitat requirements has made conservation extremely difficult. Attempts to recover the dusky on Merritt Island have included lowering impoundment water levels, connecting an impoundment to the Indian River by a culvert, and removal of a 3,000-m dike. The high water levels and consequent vegetation changes, such as shrub encroachment, have prevented these measures from succeeding so far (DSSRT draft, Baker, in press).

Management of the mainland dusky population involves primarily land acquisition and controlled burning. On the St. Johns National Wildlife Refuge, destructive winter wildfires now are checked by firebreaks maintained by refuge personnel. Experiments to control brush encroachment include small prescribed burns, summer burning, and herbicide use. A refuge addition of 1,320 ha in the vicinity of the Beeline Highway is under negotiation (Baker, in press).

In addition, the Recovery Team calls for the determination of habitat requirements, refining of habitat manipulation techniques, population monitoring by annual survey, and restoration of habitat such as that on Merritt Island (DSSRT draft).

The 1978 survey documented 9 singing males on the St. Johns National Wildlife Refuge and 15 in the rest of the river basin. Most of those outside the refuge inhabit the area of a proposed refuge addition between the forks of the Beeline Highway (Baker, in press).

Critical Habitat is designated as the mainland area bounded by I-95, the St. Johns River, and Florida Highways 45, 528, and 529, and as mosquito-control impoundments T-10-J and T-10-K on Merritt Island National Wildlife Refuge (41 FR 53074, 3 December 1976; 42 FR 40685, 11 Au-

gust 1977; 42 FR 47849, 22 September 1977).

AUTHORITIES

J. L. Baker (Recovery Team)
U.S. Fish and Wildlife Service
Merritt Island National Wildlife Refuge
P.O. Box 6504
Titusville, FL 32780

H. W. Kale (Recovery Team)
Ornithological Research Division
Florida Audubon Society
35 1st Court S.W.
Vero Beach FL 32960

B. F. Sharp
U.S. Fish and Wildlife Service
Lloyd 500 Building
500 N.W. Multnomah Street
Portland, OR 97232

P. W. Sykes (Recovery Team)
Fish and Wildlife Service
P.O. Box 2077
Del Ray Beach, FL 33440

L. E. Williams (Recovery Team)
Wildlife Research Office
Florida Game and Fresh Water Fish
Commission
4005 South Main Street
Gainesville, FL 32601

PREPARER'S COMMENTS

The bird was named *Ammodromus maritimus* var. *nigrescens* by Ridgway in 1873. It was designated *Ammospiza nigrescens* by Howell (1932), American Ornithologists' Union (1957), and Trost (1968). It was redesignated as a race of *Ammospiza maritima* (Eisenmann 1973). It is geographically isolated from, but morphologically similar to, other races of seaside sparrow (Trost 1968). It is unique in its extremely limited distribution (Chapman 1912).

LITERATURE CITED/SELECTED REFERENCES

- American Ornithologists' Union. 1957. Check-list of North American birds. 5th ed. Port City Press, Baltimore. 641 pp.
- Baker, J. L. 1973. Preliminary studies of the dusky seaside sparrow on the St. Johns National Wildlife Refuge. Proc. Annu. Conf. Southeast Assoc. Game Fish Comm. 27:207-214.

- . 1979. Dusky seaside sparrow. Pages 16-19 in H. W. Kale, ed. Rare and endangered biota of Florida, Vol. 2, Birds. Univ. Presses of Florida, Gainesville.
- . In press. Status of dusky seaside sparrow. In Rare and Endangered Wildlife Symposium. Georgia Dep. Natur. Resour. and Georgia Chapter Wildl. Soc. Aug. 3-4, 1978. Athens.
- Baynard, O. E. 1914. The dusky seaside sparrow (*Passerherbulus nigrescens*). Oologist 32(7): 130-134.
- Beecher, W. J. 1955. Late-Pleistocene isolation of salt-marsh sparrows. Ecology 36:23-28.
- Chapman, F. M. 1912. Handbook of birds of eastern North America (rev. ed.). D. Appleton and Co., New York.
- DSSRT (Dusky Seaside Sparrow Recovery Team). Dusky seaside sparrow recovery plan. U.S. Fish Wildl. Serv. 15 pp.
- Eberhart, J. 1968. The dwindling dusky. Sci. News. 93:501-501.
- Eisenmann, E. (Chairman). 1973. Thirty-second supplement to the American Ornithologist's Union check-list of North American birds. Auk 40:411-419.
- Howell, A. H. 1932. Florida bird life. Coward-McCann, Inc. New York. 579 pp.
- Maynard, C. J. 1875. A new species of finch from Florida. Am. Sportsman 5:248.
- Nicholson, D. J. 1928. Nesting habits of seaside sparrows in Florida. Wilson Bull. 40:225-237.
- . 1929. Breeding of the dusky seaside sparrow on the mainland of Florida. Auk 46: 391.
- Peterson, R. T. 1947. A field guide to the birds, 2nd ed. Houghton Mifflin Co., Boston. 230 pp.
- Sharp, B. E. 1968. Numbers, distribution, and management of the dusky seaside sparrow. M.S. Thesis. Univ. Wisconsin, Madison. 76 pp.
- . 1969a. Conservation of the dusky seaside sparrow on Merritt Island, Florida. Biol. Conser. 1(2):175-176.
- . 1969b. Let's save the dusky seaside sparrow. Fla. Natur. (April 1969):68-70.
- . 1970. A population estimate of the dusky seaside sparrow. Wilson Bull. 8(2):158-166.
- Sincock, J. L. 1958. Waterfowl ecology of the St. Johns River Valley as related to proposed conservation areas and changes in the hydrology from Lake Harney to Ft. Pierce, Florida. Florida Game Fresh Water Fish Comm, Fed. Aid Project W-19-R.
- Sprunt, A., Jr. 1954. Florida bird life. Coward-McCann, Inc. New York. 527 pp.
- Trost, C. H. 1968. Dusky seaside sparrow. Pages 849-859 in O. L. Austin, Jr., ed. Life histories of North American cardinals, grosbeaks, buntings, towhees, finches, sparrows, and allies. U.S. Natl. Mus. Bull. 237. Part 2.
- USDI (U.S. Department of the Interior). 1973. Threatened wildlife of the United States. Compiled by Office of Endangered Species and International Activities. Bur. Sport Fish Wildl. Resour. Publ. 114. U.S. Gov. Printing Office, Washington, D.C. 289 pp.

ACCOUNT PREPARED/UPDATED BY:

National Fish and Wildlife Laboratory
412 N.E. 16th Avenue, Room 250
Gainesville, FL 32601

Biological Services Program

FWS/OBS-80/01.26

MARCH 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States- **HAWAIIAN GOOSE (NENE)**



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

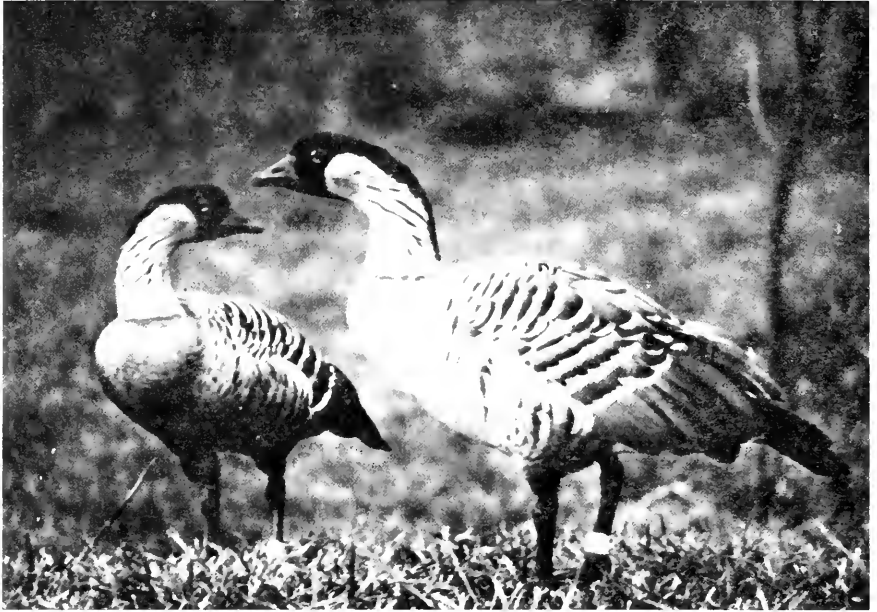
SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—

HAWAIIAN GOOSE (NENE)

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: GLEN SMART

HAWAIIAN GOOSE (*Nene*)

Branta (Nesochen) sandvicensis (Vigors)

KINGDOMAnimalia
 CLASSAves
 ORDER..... Anseriformes
 FAMILY.....Anatidae
 OTHER COMMON
 NAMES..... Nene; Lava Goose (Elder 1958)

DATE

Entered into SWIS.....To be determined
 UpdateTo be determined

LEGAL STATUS

FEDERAL: Endangered (42 FR 36426, 14 July 1977). Listed: Appendix I, 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora.

States: Endangered: Hawaii.

REASONS FOR CURRENT STATUS

This highly specialized goose is adapted to life in an environment that was originally predator-free and waterless in the Hawaiian lava flows. Their weak wings, exceptionally long flightless period during molt, and young that are unable to fly because of their exceptionally long development period made them vulnerable to introduced predators (Elder 1958; Elder and Woodside 1958).

There is evidence that overgrazing by sheep and goats may have adverse effects on the nene range, and the introduced mongoose is definitely a predator on the young. The spread of the mongoose corresponded to the period of nene decline. Mongooses and dogs are probably the most significant predators, and the tameness and curiosity of the nene makes them extremely vulnerable to predation as well as to poaching (Elder 1958; Elder and Woodside 1958). Zimmerman (1974) believes that the information necessary to identify and correct lethal dangers is still lacking.

Hunting is believed to have contributed heavily to their original decline, especially since ignorance of the winter breeding season permitted hunting at the time when geese were either incubating, followed by broods, or molting and flightless (Henshaw 1902 in Elder and Woodside 1958). Hunting of this species was made illegal in 1911 (Ripley 1965).

A gradual increase in the nene population in recent years has resulted from introduction of artificially propagated stock on Hawaii and Maui, the creation of sanctuaries in cooperation with land owners, and control of predators at release and breeding sites (Hawaii Div. Fish and Game 1972). However, it is not known if the present population can maintain itself or increase in the wild without additional introductions. The introduced population on Maui is clearly not maintaining itself. The future of the species in the wild will remain in doubt until it can be shown that reproduction is high enough to offset losses from all sources (King in press).

PRIORITY INDEX

39

DESCRIPTION

The nene is a medium-sized goose, with a bill comparatively long, broad, and high near its base and depressed at the tip. The crown, face, area around eyes, throat, and a wide band on hind neck are deep black; sides of head and sides and front of neck are tawny buff; the feathers of the neck have dark bases forming deep furrows and producing a striped appearance; there is a blackish ring around the base of the neck, broadening on the back; the breast is pale brown; and the rest of the body plumage is grayish brown barred with whitish buff, the feathers having pale borders; the rump is black; coverts are white with gray bases; rectrices and primaries are black. The iris is brown. Bill and legs are black. The tarsus and toes are long and strong, with much reduced webbing. The female is smaller than the male, with shorter neck and slightly duller, darker plumage (Delacour 1954).

Measurements. - male: wing 372 to 378 mm; the tail is 147 to 158 mm; culmen, 40 to 47 mm; tarsus, 81 to 90 mm. In the female: wing 350 to 368 mm; tail 144 to 151 mm; culmen 40 to 42 mm; and tarsus 73 to 78 mm (Delacour 1954).

Reported weights of wild specimens were as follows: Males - summer, 2,074 g; winter (breeding season), 2,370 g. Females - summer 1,762 g, winter, 2,095 g (Kier et al. 1962).

Immatures.- Duller and more mottled.

Downy Chicks.- Grayish brown; forehead, sides of head, throat and center of underparts whitish buff; a dark spot on ear coverts and whitish spots on base of wing.

Eggs.- Creamy white; five to eight in clutch; 80 x 50 mm (Delacour 1954). The clutch size for captive birds at Pohakuloa and those recorded in the wild on Hawaii is three to five eggs.

This species has become highly specialized anatomically for its original environment, with legs and feet best adapted to a strictly terrestrial environment and wings poorly developed for flight compared to other related geese. It is so different morphologically from *Branta* that it should be accorded a separate genus (Miller 1937).

RANGE

The Hawaiian goose or nene is native to and resident on the Island of Hawaii; it has been introduced and is still surviving on Maui, Hawaiian Islands (Delacour 1954). It occurs at several local-

ities on the slopes of Mauna Loa and Hualalai volcanoes, chiefly between the 1,600- and 2,400-m elevations. Its former range was reported to have been much more extensive, even reaching to the seashore, although records of earlier writers are dubious (Baldwin 1945; Elder 1958). Nene bones considered of Pleistocene or early recent age are found on all the main Hawaiian Islands; those of most recent age, probably dating to the Polynesian occupancy, are on Molokai (Storrs Olson pers. comm. 1977).

At present, breeding is recorded primarily in three areas: Keauhou Sanctuary, on the east slope of Mauna Loa; Kahuku Sanctuary, on the southern slope of Mauna Loa; and Keauhou 2 Sanctuary, on the southeast slope of Hualalai (Hawaii Div. Fish & Game 1972).

The only known major seasonal movement of the populations is from the winter breeding areas on the higher mountain slopes to a summering area on the saddle between Mauna Loa and Mauna Kea. The summering flock makes daily flights from their nighttime range in the vicinity of Puu Oo Ranch southeast of Mauna Kea and north of the Saddle Road to the daytime range on lava flows on the slopes of Mauna Loa, at least 15 miles away (Woodside 1956; Ripley 1965; Hawaii Div. Fish & Game 1972).

RANGE MAP

The following map is adapted from Elder and Woodside (1958); National Park Service, Hawaii 17004, 1963; Zimmerman 1975.

STATES/COUNTIES

Hawaii: Hawaii, Maui

HABITAT

Nene are usually seen on mountain slopes between 1525 and 2440 m elevation. Nesting and feeding habitat is supplied by kipukas, or islands of vegetation on lava flows, ranging in size from less than 1 ha to several thousand hectares. Vegetation grows on decomposing lava in various stages of succession from lichens on bare rock to such pioneering plants as ohelo (*Vaccinium* sp.), kukainene (*Coprosma ernodioides*), gosmore (*Hypochaeris radicata*), pukeawe (*Styphelia tameiameia*), and various grasses. Older kipukas with deeper soils are vegetated with aalii (*Dodonaea viscosa*), mamane (*Sophora chrysophylla*), ohia (*Metrosideros collina*), and koa (*Acacia koa*) in

association with other shrubs and grasses. Rainfall is one of the most important factors in decomposition of lava and the progress of ecological succession. Average annual rainfall from 1960 through 1969 in the nene range on Mauna Loa at 2,042 m was 154 cm (Hawaii Div. Fish and Game 1972).

FOOD AND FORAGING BEHAVIOR

Nene are vegetarians. They consume a variety of available foods, but show a marked preference for gosmore (*Hypochaeris radicata*), eating the leaves, buds, and flowers. Ohelo (*Vaccinium* sp.) and kukainene (*Coprosma ernodioides*) are the most important food berries in nene sanctuaries. The geese feed most heavily during morning and late afternoon. Goats and pigs are not numerous enough to be serious competitors to nene, even though they graze on the same plants. In some instances pigs may be beneficial by stimulating growth of gosmore and other succulents. At the present time, food resources are not considered a limiting factor to nene in the wild (Baldwin 1947; Hawaii Div. Fish and Game 1972).

Although nene do eat berries, their preference is for greens, especially the succulent leaves, stems and buds of pualele (*Sonchus oleraceus*) and gosmore (*Hypochaeris radicata*). Also, the nene strips seeds from the heads of grasses and sedges. At more frequented altitudes, 1525 to 2440 m, there is no evidence of food shortage at any season. Grasses and greens are never scarce in that zone of high moisture and infrequent frosts (Elder 1958). In captivity, nene prefer green feed over commercial mixtures (Hawaii Div. Fish & Game 1972).

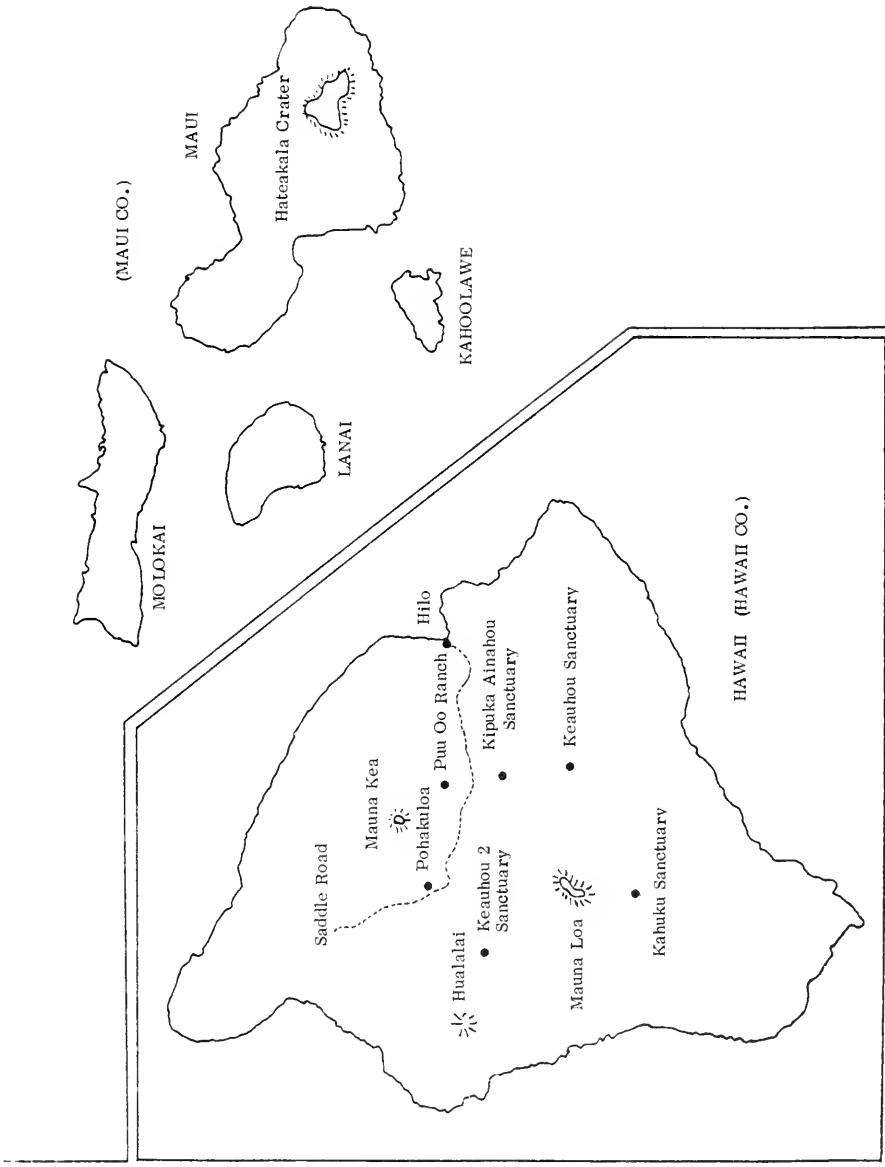
Nene in the wild do not appear to be attracted to water. At waterholes, they seem to be concerned only with succulent green vegetation for food. Drinking water is obtained from fog and dew condensed on vegetation (Elder 1958; Hawaii Div. Fish & Game 1972).

SHELTER REQUIREMENTS

Low bushes for concealing nests are the only known shelter requirements (Hawaii Div. Fish and Game 1972).

NESTING OR BEDDING

Most nests have been found under pukeawe bushes or scrub ohia trees, where the goose scoops out a shallow depression in the litter or duff.



Range of the Hawaiian goose (nene).

Leaves, twigs, and down are used to cover eggs when the incubating bird leaves to forage (Hawaii Div. Fish and Game 1972).

RITUAL REQUIREMENTS

Nene are more jealous and quarrelsome than is common among geese. The gander defends his territory, mate, and brood savagely, but sometimes exhibits the unusual behavior of attacking his own mate (Delacour 1954).

POPULATION NUMBERS AND TRENDS

The wild population may have totaled 25,000 or more in the 18th century. Reduction began between 1778 and 1850, progressed rapidly until 1900, and tapered off slowly between 1900 and 1930. In 1953, the estimated population of wild birds was only 33 (Baldwin 1945). Smith (1952) estimated the total population in the wild at less than 30. Since 1940, coincident with conservation efforts, the population has obviously increased if the earlier estimates were reasonably correct. Counts on the summer roosting area near Puu Oo Ranch north of the Saddle Road on the southeast slope of Mauna Kea have ranged from 42 in 1966 to 114 in 1969. An increase during the 17 years of counting in that area (since 1955) was indicated, although inconsistent. About 90% of birds in the summer roosting area are unbanded and presumed to be wild rather than pen-reared (Hawaii Div. Fish and Game 1972).

The number of individual birds observed with eggs or young in the three nene sanctuaries have been: 1966, 2; 1967, 32; 1968, 36; 1969, 12; 1970, 16; 1971, 12. Of these parent birds, 40% were banded, indicating they were released pen-reared birds; and 60% were unbanded, indicating they were either wild or offspring of released birds. There is no indication of a new population developing from releases on the new sanctuary at Kipuka Ainahou, northeast of Mauna Loa between Access Road and Saddle Road (Hawaii Div. Fish and Game 1972).

Counts of introduced population on Maui recorded 43, with 2 produced in the wild in August 1973; 45 were seen in October 1974, with unbanded birds showing up increasingly. Nests or young were found in 1972 and 1974 (Monthly re-

ports of Hawaii Div. Fish and Game).

The actual number of nene in the wild is unknown. The "educated guess" is at least 600 wild and released birds and their progeny on Hawaii and a third as many more (200) on Maui (Woodside in Zimmerman 1974).

REPRODUCTION

Clutch size has been reported as 5 to 8 eggs (Delacour 1954), although 3 to 5 eggs per clutch were recorded for the wild population on Hawaii and the captive birds at Pohakuloa. The incubation period is 28 to 31 days (Ripley 1965).

The nesting season may run from October through March. February to late May is a flightless period for young and a molting period for adults (Ripley 1965). Wild pigs, dogs, cats and mongooses may threaten nene eggs and goslings and even adult birds during the 4- to 6-week flightless period (N. Santos in Zimmerman 1975). Young grow slowly, requiring 10 to 12 weeks to reach the flying stage; this is nearly twice the time required by Canada geese. Adults are completely grounded for 4 to 6 weeks by the wing molt; thus, part or all of the nene family may be vulnerable to ground predators for 3 months or more each year (Elder and Woodside 1958). Breeding potential is low because they rarely reach sexual maturity or lay fertile eggs in captivity until 3 years of age or more. Six pairs observed in the wild produced an average of only 2 young annually (Elder and Woodside 1958).

In the captive flock at Slimbridge, England, the sex ratio is equal. Sixty-two percent laid eggs at the end of their second year. Ganders between their fourth and eighth years have fertilized the most eggs. Females laid the most fertile eggs in their fourth year. Clutch size at Slimbridge averaged 3.95 eggs, compared to 3.7 at Pohakuloa, Hawaii. In Hawaii, nene lay their first eggs in November; in England, about 9 February. Day length, rather than temperature, is thought to induce breeding. Long days inhibit breeding and induce molting (Kier et al. 1967).

In the captive flock at Pohakuloa, inbreeding of original stock was determined to be the cause of low fertility; infusion of a new wild bird strain and selection of birds for productivity greatly increased fertility. Fertility increased with age of breeders to 75% at 15 years in the Shipman strain and to 100% at 8 years in the wild strain. Dates of

first egg laying at Pohakuloa ranged from 21 September (1969) to 5 December (1953), and was most frequent during the first 2 weeks in November. Time of nesting in the wild is generally similar to that at Pohakuloa. Nene in the wild have nested as early as October and as late as April, depending on weather conditions.

Nest sites are usually located in kipukas, which tends to isolate nesting pairs. Nests are left uncovered until the last egg is laid, then thoroughly covered with down, leaves, and twigs before the female leaves. The male guards the nest from an elevated lookout point a short distance away and gives warning at the approach of danger. The female leaves the nest when approached during the early stages of incubation, but sits tight during late stages. Males have never been found incubating. Most pairs return to the same kipuka each year.

Released birds will pair with wild mates as well as with other released birds, although of 56 pairs in the wild, only a few cases of captive reared birds mated with other released individuals were observed. No evidence has been seen of renesting if the nest is deserted; in contrast, renesting is common in captivity when the first clutch has hatched and young have been removed (Hawaii Div. Fish and Game 1972).

In 1956-57, the breeding area at Keauhou on Mauna Loa had at least 6 adult pairs and 1 "unemployed" bird; 12 young were produced, for an average of 2 young per pair. The one unmated bird indicates either that reproduction was poor the preceding year or that most nonbreeders spend their time elsewhere (Elder and Woodside 1958).

MANAGEMENT AND CONSERVATION

In 1949, IUCN placed the Hawaiian Goose on its list of the 13 most threatened bird species in the world, stimulating the beginning of a restoration program with \$6,000 appropriated by the Territory of Hawaii. Captive rearing was started at a former Civilian Conservation Corps Camp at Pohakuloa, on the saddle between Mauna Loa and Mauna Kea, with 4 birds from Herbert C. Shipman's aviary in Hilo, 1 from the Honolulu Zoo, and 1 wild bird caught by a hunter's dog. In 1950, 2 birds were reared at Pohakuloa. In 1951, 3 were sent from Shipman's aviary to the wild-fowl Trust at Slimbridge, England, to start a rearing project there. In 1958, the U.S. Fish and Wild-

life Service provided a grant of \$15,000 per year, later increased to \$25,000, for a nene restoration project. The nene was officially designated the territorial—now State—bird of Hawaii (Ripley 1965).

In early attempts at propagation, only 1 in 5 eggs hatched at either Pohakuloa or Slimbridge. After about 10 years of frustratingly poor production, inbreeding was identified as the cause, so several wild birds were added to the captive flock. The result was to almost triple the yield of fertile eggs. Careful selection of goslings for quality eliminated a "hairy down" mutant. Old and unproductive adults were also culled from stock (Zimmerman 1975).

Through the 1973-74 breeding season, 1,306 goslings were raised at Pohakuloa and about one-third as many at Slimbridge and other sites in Europe and North America. Most of these birds have been released to the wild—934 on Hawaii and 391 on Maui. The non-Pohakuloa reared birds were released on Maui, all before 1971. Since 1971, only Pohakuloa-reared birds have been released on both islands. Production at Pohakuloa has been between 100 and 150 goslings per year at an average cost of \$250.00 per gosling (D. Woodside *in* Zimmerman 1975).

Birds are released into the wild in a flightless stage, mostly as young between 2 and 4 months old, but some as molting adults, into predator-proof enclosures of habitat having natural food available in addition to artificial food and water. From there, birds fly over the fence into the wild after their flight feathers grow. This is known as the "gentle release" method (Hawaii Div. Fish and Game 1972). The "nene park" method, proposed by Peter Scott, where young are hatched under incubating nene in large pens in natural habitat, was tried, but the Hawaii Div. of Fish and Game considered it too costly to build large enclosures and assure predator-proof conditions. Nene park methods would seem to avoid the possibility of imprinting goslings to unnatural conditions of artificial brooders and pens, and has other possible advantages (Pratt 1972). No adequate testing to show the relative merits of the two methods has been done (Zimmerman 1975).

Propagated stock has been liberated on the island of Hawaii in three areas known to be frequented by nene, starting on 17 March 1960. These areas were established as "sanctuaries" by cooperative agreement with the land owners.

They are: Keauhou Sanctuary-1,278 ha on the eastern flank of Mauna Loa; Keauhou 2 Sanctuary-514 ha on southeastern slope of Hualalai in North Kona; and Kahuku Sanctuary, on the southern flank of Mauna Loa. A nene park has been built in Hawaii Volcanoes National Park on the Island of Hawaii with Pohakuloa stock. All released birds are marked with bright, color-coded plastic leg bands that identify where and when liberated (Hawaii Div. Fish and Game 1972). Roughly half of the 100 geese released each year survive their first year, and at least 25% survive at least 7 years. Data are still too sparse to construct complete life tables (D. Woodside *in* Zimmerman 1975). Older birds, when liberated, appear to leave flocks of younger birds and range over a wider area. Data are insufficient to determine if age at the time of release affects adaptability or survival. Some released birds disperse to unknown areas, then reappear after 4 or 5 years (Hawaii Div. Fish and Game 1972).

A total of 391 birds have been released in Haleakala Crater on Maui within National Park boundaries, some every year from 1962 through 1970 except 1967. The first nests were found there in 1968. A total of 38 nests have been found and 11 young are known to have hatched. Five dead goslings were attributed to heavy rains. Mature young were found with parents in May 1971. In January 1972, nene produced the previous year were observed paired with Slimbridge-reared birds. The tendency of Maui nene is to return to the same locality for nesting and sometimes, to the same site. An exceptional case of dispersal was the one bird that flew back to Hawaii and appeared at Pohokuloa (Hawaii Div. of Fish and Game 1972). No thorough study of the Maui population has ever been conducted (Berger 1972).

Predator control has involved the use of poison, injected into chunks of meat scattered in crevasses frequented by predators. This bait was placed throughout the sanctuaries for control of dogs, cats, pigs, and mongooses. Additional bait was placed in the vicinity of nene nests. Poisoning is believed to have been effective, at least against rats and dogs. Bait was placed so as to prevent its being eaten by Hawaiian hawks, which species was observed to harass nene on two occasions, but is not believed to be a serious predator because of its small number. Since the inception of the predator control program on sanctuaries, only

two known incidents of predation have been observed: a partly consumed carcass of a gosling, presumed to have been the work of a rat, and 3 adult nene killed by dogs (Hawaii Div. Fish and Game 1972).

Among measures proposed for the management of nene are: preservation of the natural environment, including the establishment of permanent refuges; control of predators and feral grazing and browsing animals in breeding areas; continuation of the captive and "nene park" propagation program, if necessary to reinforce propagation or extend the population to new range; conduct of field studies to follow up on the fate of released captive-reared birds and appraise total populations (U.S. Fish and Wildlife Service 1973; King *in press*); expansion of education program. More specific recommendations of the Hawaii Dept. of Land and Natural Resources (1976) were to continue the propagation project in 1976 to furnish nene for release in South Kona; reduce propagation effort to 24 breeders and produce only 1 brood per pair; continue use of same propagation methods; discontinue plucking primaries because deformed primaries can result when this is done; expand the information and education program. At least five nene have been illegally killed within the last 2 years. In only one instance was the killing believed to be malicious; the remainder appeared to have been through ignorance.

In addition to 3 nene sanctuaries cooperatively managed on private lands, the Division of Fish and Game announced the establishment of a State sanctuary, Kipuka Ainahou Nene Sanctuary consisting of 15,540 ha on the northeast slope of Mauna Loa between the Mauna Loa access road and Saddle Road, approved 13 March 1974.

AUTHORITIES

David H. Woodside
Hawaii Division of Fish and Game
1151 Punchbowl Street
Honolulu, Hawaii 96813

Eugene Kridler
U.S. Fish and Wildlife Service
835 Akumu Street
Kailua, Hawaii 96734

Paul H. Baldwin
Department of Zoology
Colorado State University
Fort Collins, Colorado 80521

William Elder
108 Stephens Hall
Columbia, Missouri 65201
Ernest Kosaka
Division of Fish and Game
1179 Punchbowl Street
Honolulu, Hawaii 96813

PREPARER'S COMMENTS

Of the 2 to 36 individual nene observed in Hawaii sanctuaries with eggs or young each year from 1966 to 1971, 40% were banded, indicating they were released pen-reared birds, and 60% were unbanded, indicating they were either wild or the offspring of released birds. Since 90% of the birds observed on the summering grounds were unbanded, it appears that this group draws from a wider breeding population than that recorded in the sanctuaries, where only 60% were unbanded. On the other hand, in 2 years with high counts in the breeding area (32 in 1967 and 36 in 1968), 46 and 45 appeared in the summering area in 1967 and 1968, respectively, showing only a small difference in the two annual counts. This would seem to indicate that most of the breeding population of the three sanctuaries moves to the Puu Oo summer area. On the other hand, with over 100 birds observed in the summering area in 2 different years, it would appear that probably less than half of the total population is observed in either the breeding season or the summer counts in most years. In any case, with data so far presented for Hawaii and Maui, the "educated guess" of 600 for the two islands (Zimmerman 1974) appears far too optimistic and points up the need to establish much more detailed investigation of the population as a primary objective of the nene restoration project in the future.

It is hoped that a census technique, using transects and census blocks, will be developed by 1980. If this approach proves valid in the sanctuaries, a method for censusing the entire nene range will be devised.

LITERATURE CITED/SELECTED REFERENCES

Baldwin, P. H. 1945. The Hawaiian Goose, its distribution and reduction in numbers. *Condor* 47:27-37.

- Baldwin, P. H. 1947. Food of the Hawaiian Goose. *Condor* 49:108-120.
- Berger, A. 1972. Hawaiian birdlife. Honolulu, Univ. of Hawaii Press. p. 75.
- Berger, A. 1972a. Hawaiian Birds. 1972. *Wilson Bull.* 84:212-222.
- Delacour, J. 1954. The waterfowl of the world. Vol. 1. London, Country Life Limited.
- Elder, W. H. 1958. Nene in Hawaii. Preliminary report on the Nene in Hawaii. Wildfowl Trust. Ninth Annual report. 112-117.
- Elder, W. and D. Woodside. 1958. Biology and management of the Hawaiian Goose. *Trans. 23rd N. Amer. Wildlife Conf.* p. 206.
- Hawaii Department of Land and Natural Resources (contributed by Ronald L. Walker). 1976. Nene restoration project, 1 July 1972-30 June 1975. *Elepaio* 36(9):104-108.
- Hawaii Division of Fish and Game. 1972. A report of the nene restoration program. Unpublished administrative report of Hawaii Div. Fish and Game.
- Kier, J. 1975. Returning the Hawaiian Goose to the wild, pp. 115-123, in *Breeding endangered species in captivity*, R. D. Martin ed. London, New York, San Francisco, Academic Press.
- Kier, J., H. S. Roberts and R. Warren. 1967. The Hawaiian Goose in Captivity. unpub. ms.
- King, W. In press. (Revised) Red data book Vol. 2 - Aves. International Union for the Conservation of Nature and Natural Resources, Survival Service, Morges, Switzerland.
- Miller, A. H. 1937. Structural modifications in the Hawaiian Goose (*Nesochen sandvicensis*). A study in adaptive evolution. *Univ. California Press* 42:1-80.
- Pratt, J. 1972. Research study proposal for investigation of behavior of the Hawaiian Goose under the "Nene park" plan. *Elepaio* 33:33-34.
- Ripley, S. D. 1965. Saving the Nene, World's rarest goose. *Nat. Geog. Nov.* 1965:745-754.
- Schwartz, C. W. and E. Schwartz. 1948. An ecological survey of the game birds in the Hawaiian Islands with recommendations for management. Board of Commissioners of

- Agric. and Forestry, Territory of Hawaii. pp. 273-275.
- Scott, P. A. 1962. A project for a Nene park in Hawaii. *Elepaio* 22:80-81.
- Smith, J. D. 1952. The Hawaiian Goose (Nene) restoration program. *J. Wildl. Mgmt.* 16:1-9.
- State of Hawaii Department of Game and Natural Resources. 1976. Nene restoration project. 1 July 1972-30 Jan. 1975. *Elepaio* 36:104-108.
- U.S. Fish and Wildlife Service. 1973. Threatened Wildlife of the United States. Resource Publication 114, U.S. Department of Interior, G.P.O.
- Woodside, D. H. 1956. Wild Nene on Hawaii. *Elepaio* 16:67-68.
- Zimmerman, D. R. 1974. Return of the nene. *Animal Kingdom*. May, June, July 1974.
- Zimmerman, D. R. 1975. To save a bird in peril, Chap. 5. New York Coward, McCann & Geoghegan.

Biological Services Program

FWS/OBS-80/01.27

March 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States-

COLUMBIAN WHITE-TAILED DEER



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

FWS/OBS-80/01.27
March 1980

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES
COLUMBIAN WHITE-TAILED DEER

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



COLUMBIAN WHITE-TAILED DEER

Odocoileus virginianus leucurus [Douglas]

REASONS FOR CURRENT STATUS

The Columbian white-tailed deer was once abundant in the low and moist prairie habitat of the Willamette River Valley of Oregon and northward across the Columbia River into the river valleys of southern Washington (Cowan 1936, Gavin 1979). Suppression of burning by Indians and conversion of land for agricultural uses have eliminated the native grass-herb association upon which the deer depended. Drainage of beaver ponds and their accompanying microenvironment may also have eliminated essential habitat (Gavin 1978). These deer were also shot for food and sport until early in this century, by which time they were extirpated from most of their former range.

KINGDOMAnimalia
CLASSMammalia
ORDER.....Artiodactyla
FAMILY.....Cervidae

OTHER COMMON NAMES..... Pacific white-tailed deer, tideland deer, cotton-tail deer

DATE
 Entered into SWIS.....To be determined
 Updates..... 8 Nov. 1978

LEGAL STATUS
 Federal ...Endangered (32 FR 4001, 11 March 1967).
 States Endangered: Oregon, Washington.

PRIORITY INDEX
 Not assigned.

DESCRIPTION

This subspecies is a small-sized white-tailed deer, with a greyish-brown tail distinguishing it from the race of yellow-tailed deer (*O. v. ochrourus*) of eastern Washington (Cowan 1936). The skull is smaller in all measurements, and there is little possibility of confusion with neighboring subspecies when adult specimens are compared (Cowan 1936). The posterior margin of the palate is even with or extending little farther (2 mm) than the posterior end of the third upper molar. Antlers are exceptionally small for northern races of the white-tailed deer.

RANGE

It occurs in three widely separated groups of relict populations. The first is found primarily within the boundaries of the Columbian White-Tailed Deer National Wildlife Refuge, which consists of several islands and the adjacent mainland near the mouth of the Columbia River. These deer are also found on private land in the lower Columbia River area: Puget Island, Washington, Wallace Island, Oregon, and near Westport, Oregon.

A search conducted by the Washington Department of Game did not locate any Columbian white-tailed deer between these populations and Portland, Oregon, to the east. Recently, Columbian white-tailed deer were found at a second Columbia River area near Camas and Washougal, Clark County, Washington (T. A. Gavin, pers. comm.). A third group of populations occur in the foothills near Roseburg, Oregon, some 320 km (200 mi) to the south.

RANGE MAP

Location of known populations is indicated on the accompanying map (after Gavin in press).

STATES/COUNTIES

Washington . . . Wahkiakum, Clark
Oregon Clatsop, Columbia, Douglas,
Multnomah

HABITAT

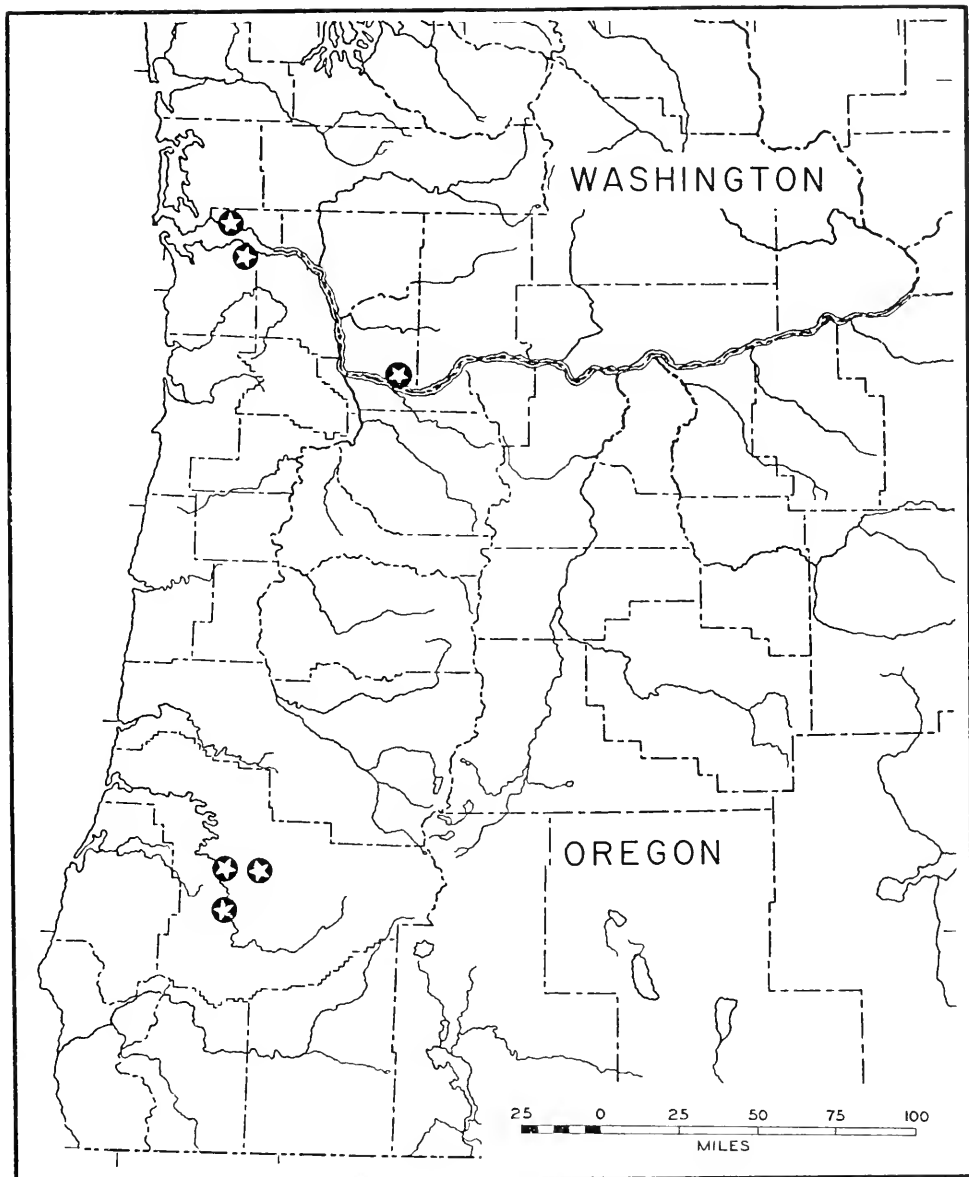
The Columbia River herd prefers low-lying islands and bottomlands. Much habitat has been converted to pasture and is enclosed within dikes

or levees. Native trees and shrubs, occurring in patches, are composed mostly of Sitka spruce (*Picea sitchensis*), dogwood (*Cornus stolonifera*), cottonwood (*Populus trichocarpa*), red alder (*Alnus rubra*), and willow (*Salix*) (Gavin 1979). Common pasture grasses and forbs include *Festuca*, *Dactylus*, *Trifolium*, *Ranunculus*, and *Lolium*. *Carex* and *Juncus* are found in wet areas. Common shrubs are *Rubus*, *Rosa*, *Sambucus*, and *Symphoricarpos* (Gavin 1979). Forest cover in the refuge areas has been reduced from 70% in 1939 to 17% in 1972 and the pasture lands are heavily used by the Columbian white-tailed deer (Suring 1974). The deer are less abundant on islands (e.g., Price and Hunting Islands) that are primarily brushy and heavily wooded (Gavin 1978).

The Roseburg herd is found from river bottoms into rolling hills covered by oak woodland. Major plants include *Quercus garryana*, *Arbutus menziesii*, *Acer macrophyllum*, *Fraxinus latifolia*, and the shrubs *Rosa* and *Symphoricarpos*. Annual grasses are interspersed among trees (Gavin in press). Much habitat is privately owned and used for sheep ranching.

FOOD AND FORAGING BEHAVIOR

The Columbian white-tailed deer is unusual in its tendency to feed almost exclusively on herbaceous vegetation (grasses and forbs). Scheffer (1940) reported finding only grass in a sample of four stomachs, and Gavin (in press) found only herbaceous material in the contents of 33 stomachs. Food plants include *Ranunculus*, *Trifolium*, *Alopecurus*, and *Phalaris*. There is some browsing in the spring on twigs of *Cornus*, *Rubus*, *Sambucus*, *Lonicera*, *Symphoricarpos*, and *Fraxinus*. Of all the feeding deer observed by Suring (1974) 99% were grazing. These deer appear to prefer feeding on pasture where grasses and forbs are kept short and in a palatable stage of growth by cattle grazing (Gavin in press). However, they avoid such areas when cattle are actually present (Suring 1974). Suring (1974) suggests there is more feeding during the night than during daylight hours, and that the percentage of time spent feeding varies seasonally, with the greatest percentage of active time (90%) in summer devoted to feeding.



The locations of known populations of Columbian white-tailed deer.

The University of Washington is conducting a detailed study of the food habits of this deer, including food availability and plant community characteristics on the refuge.

SHELTER REQUIREMENTS

Resting deer seek cover in woodlands or brushy areas adjacent to feeding pastures (Suring 1974). The physiognomy of cover seems more important than the particular species composition.

NESTING OR BEDDING

Scheffer (1940) reports that these deer are seen to emerge from willow thickets about day-break to begin feeding activities. They are also reported to bed down in mint or hay fields (Scheffer 1940). Fawns are sometimes discovered resting in high grass of unmowed pastures in mid-summer (U.S. Fish and Wildlife Service 1977).

RITUAL REQUIREMENTS

A relatively solitary animal, the average group size is two to three individuals (Suring 1974). The largest aggregations seen by Suring (1974) occurred in winter and usually did not exceed 10 animals. Intraspecific interactions are relatively infrequent in this deer, and then they are of low intensity (only 17% of all male-male conflicts result in physical contact, as opposed to 42% in Michigan whitetails) (Suring 1974). Most of the high-intensity threat actions observed were during the rut.

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

Juxtaposition of grazing and cover areas seems to be critical for this deer. Large expanses of grazing land, providing ample forage, are unused unless there is cover nearby. Tenasillahee Island supports a low density of whitetails, primarily because the available cover is concentrated around the perimeter of the island (Gavin in press). Diking of Columbia River islands is essential to prevent mass mortality, especially to fawns, during high water (Scheffer 1940, Gavin 1978) and to provide grazing habitat.

POPULATION NUMBERS AND TRENDS

The entire lower Columbia River population was estimated to number 300 to 400 individuals, with the refuge population exhibiting a very stable trend from 1972 to 1977 (Gavin 1979). The refuge mainland population ranged from a total of 164 to 215 deer during those years, or 3.67 to 4.82 deer per ha (Gavin 1979). Densities on adjacent islands, both refuge-owned and private, were much lower (e.g., about 1 deer per 100 ha on Puget Island, a private island). The sex ratio of yearling and adult deer on the refuge was quite stable from 1972 to 1977 at about three females per male (Suring 1974, Gavin 1979). Mean home range size was 103.6 ha (N=18) and 108.6 ha (N=7) for adult females and adult males, respectively (Gavin 1979).

All sources agreed that this population has probably been at carrying capacity for some time. Stability of population size has been enforced by low fawn recruitment and moderate adult mortality. Fawn mortality is very high (69% to 80%) during the summer, and adult mortality is often associated with bacterial infections and parasites (Gavin 1979).

Population density varies greatly among parts of the refuge, with some refuge islands notably underpopulated (e.g., Tenasillahee Island). Small populations of whitetails are in danger of extinction by chance catastrophic events, such as flooding of the Columbia River. Little information is available for the Roseburg herd, since most of the habitat is on private land and research was only recently begun on these deer. Rough estimates indicated there might be 1,900 whitetails in Douglas County (Gavin in press). There is no indication that recent hunting has been detrimental to the deer. On the other hand, sheep ranchers' clearing of brushy cover used by deer is continuing at a high rate, and this could be very damaging.

REPRODUCTION

Rutting begins during the first week of November and reaches its peak later in the month (U.S. Fish and Wildlife Service 1977). Circumstantial evidence indicates that some deer are reproductively active through March (U.S. Fish and Wildlife Service 1977). No specific information is

available on gestation period, but researchers have assumed it is similar to that of the eastern white-tail (210 days). In November of 1972, 1974, and 1975, the fawn/doe ratio was 35, 60, and 37 per 100, respectively. Many does are observed without fawns, and there are few reports of twins, both of which further indicate a low survival rate for fawns in the Columbia River herd, presumably due to poor conditions of individuals in a population at or near carrying capacity (Suring 1974). Most births occur around the second week of June. Female fawns are not known to breed their first year. There is no information available on the population dynamics of the Roseburg herd.

MANAGEMENT AND CONSERVATION

Habitat within the Columbian White-Tailed Deer National Wildlife Refuge is currently protected, and efforts should be directed toward its improvement. Originally an animal of wet prairies, riparian habitat, and river bottoms, the deer on the refuge feed on grazed and mowed pasture. Maintaining pasture land in favorable condition for deer is a primary task of refuge personnel. Habitat management on Tenasillahee Island to produce more dispersed cover would increase the carrying capacity of this part of the refuge (Gavin in press). Reducing the time spent by cattle in favorable areas might increase their utilization by deer (Suring 1974). But Gavin (pers. comm.) and Suring and Vohs (1979) pointed out that cattle grazing is a benefit in maintaining herbaceous vegetation on the pastures in a short, actively growing state. Timing of mowing should be tied to the reproductive cycle, so as to avoid fawn mortality (U.S. Fish and Wildlife Service 1977). Although the present density of deer appears to have no adverse effect on the habitat (T. A. Gavin pers. comm.), as Suring (1974) concludes, 'a healthy population (one able to weather times of stress) is to be desired, not one of maximum density.' Surplus animals should be used to reestablish the species in other areas of its former range that can be identified as favorable habitat (U.S. Fish and Wildlife Service 1977).

These deer are responsible for some agricultural damage (Scheffer 1940, U.S. Fish and Wildlife Service 1977). Their current protected status engenders reluctance on the part of local management and agricultural agencies to establish satellite herds, due to the difficulty in controlling

damage to crops and orchards (U.S. Fish and Wildlife Service 1977). The policy concerning management of surplus animals should be reevaluated for species demonstrated to have a high intrinsic rate of increase. Loss of habitat, rather than mortality, seems to be the primary reason for the decline of such species. For example, it has been demonstrated that reestablished herds of Tule elk can grow rapidly (McCullough 1969). Since conservation of the Columbian white-tailed deer required maintenance of a minimum of five viable subpopulations (U.S. Fish and Wildlife Service 1977), that goal should not be subverted by resistance stemming from technical restrictions placed on control of new populations.

The Roseburg herd poses special management problems, initially because so few data are available on its population size and dynamics. Studies are urgently needed to determine these data prior to developing a management program. Habitat preservation is needed for this herd. Urbanization and clearing are ongoing problems. The primary range of this herd is closed to hunting. Deer damage to ornamentals and gardens is an increasingly serious problem.

There have been repeated allegations that the white-tailed deer of the Roseburg herd interbreed occasionally with the sympatric black-tailed deer (Gavin in press, U.S. Fish and Wildlife Service 1977). But in this area deer can usually be easily assigned to one species or the other by field observations (Gavin, personal communication). Evidence indicates that hybridization between these two species is possible in captive animals (Gavin in press) and probably occurs in the wild.

The Washington Department of Game is conducting a study of the Columbia River islands as potential release sites for this species. A recovery team has been established and has drafted a recovery plan.

AUTHORITIES

Thomas A. Gavin
Department of Ecology, Fisheries and Wildlife
Oklahoma State University
Stillwater, Oklahoma 74074

E. Charles Meslow
Oregon Cooperative Research Unit
Oregon State University
Corvallis, Oregon 97331

Winston Smith
Department of Fisheries and Wildlife
Oregon State University
Corvallis, Oregon 97331

Fred Martinsen
Columbia White-Tailed Deer Recovery
Team (Leader)
Washington Department of Game
600 North Capitol Way
Olympia, Washington 98501

PREPARER'S COMMENTS

Most of our information about this deer is from studies made on the Columbia River herd. Since the Roseburg herd occupies different habitat, generalization about the biology and management of this deer should be extrapolated to the Roseburg herd with caution.

LITERATURE CITED/SELECTED REFERENCES

- Bailey, V. 1936. The mammals and life zones of Oregon. North Am. Fauna 55:1-416.
- Columbia White-Tailed Deer Recovery Team. 1977. Columbian white-tailed deer recovery plan. Draft Rep.
- Cowen, I. McTaggart. 1936. Distribution and variation in deer (genus *Odocoileus*) of the Pacific coastal region of North America. Calif. Fish and Game 22:155-246.
- Dalquist, W. W. 1948. Mammals of Washington. Univ. Kans. Publs. Mus. Nat. Hist. 2:1-444.

Gavin, T. A. 1978. Status of Columbian white-tailed deer (*Odocoileus Virginianus leucurus*): some quantitative uses of biogeographic data. pp. 185-202 in Threatened Deer. IUCN, Morges, Switzerland. 434 pp.

———. 1979. Population ecology of the Columbian white-tailed deer. Ph.D. dissertation. Oregon State Univ. Corvallis, Oregon 149 pp.

———. In press. The Columbian white-tailed deer. in Halls, L. K. (ed). The Ecology and Management of White-Tailed Deer. The Stackpole Co., Harrisburg, Pa.

McCullough, D. R. 1969. The tule elk. Its history, behavior, and ecology. Univ Calif. Publ. Zool. 88:1-209.

Scheffer, V. B. 1940. A newly located herd of Pacific white-tailed deer. J. Mamm. 21: 271-282.

Suring, L. H. 1974. Habitat use and activity patterns of the Columbian white-tailed deer along the lower Columbia River. Unpubl. M. S. thesis, Oregon State Univ.

Suring, L. H. and P. A. Vohs, Jr. 1979. Habitat use by Columbian white-tailed deer. J. Wildl. Manage. 43:610-619.

ACCOUNT PREPARED/UPDATED BY

National Fish and Wildlife Laboratory
1300 Blue Spruce Drive
Fort Collins, Colorado 80524

Biological Services Program

FWS/OBS-80/01.28

March 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States- **SALT MARSH HARVEST MOUSE**



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

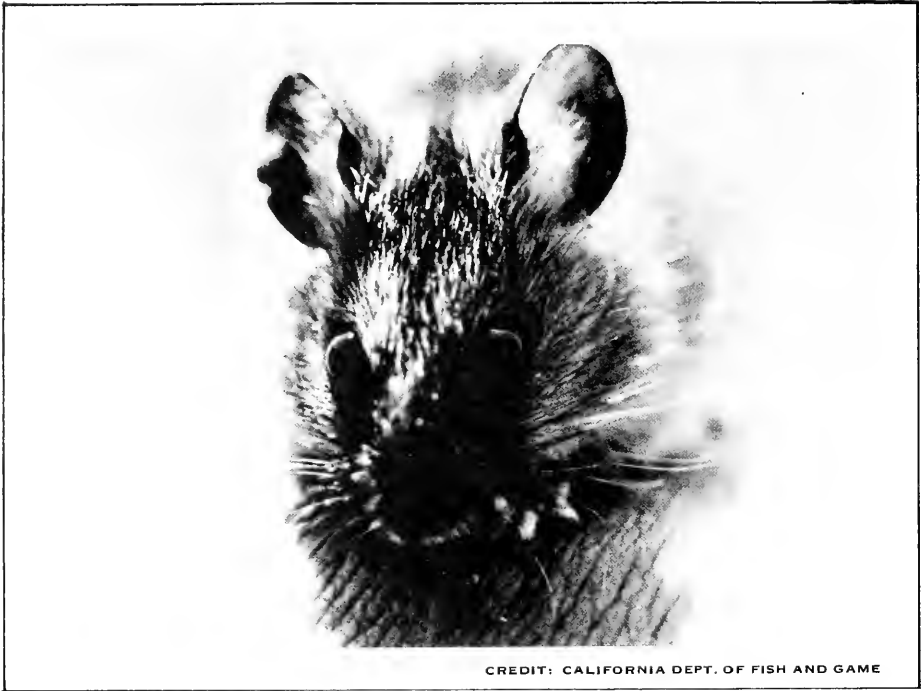
FWS/OBS-80/01.28
March 1980

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—
SALT MARSH HARVEST MOUSE

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: CALIFORNIA DEPT. OF FISH AND GAME

SALT MARSH HARVEST MOUSE

Reithrodontomys raviventris Dixon

KINGDOMAnimalia
 CLASSMammalia
 ORDER..... Rodentia
 FAMILY.....Cricetidae
 OTHER COMMON
 NAMES.....Red-bellied harvest mouse,
 Petaluma marsh harvest mouse

DATE

Entered into SWIS..... To be determined.

LEGAL STATUS

Federal Endangered (35 FR 16047, 13 Oct 1970).
 States Endangered: California

REASONS FOR CURRENT STATUS

Distribution of the salt-marsh harvest mouse is limited to native salt marsh habitat bordering bays, estuaries, and rivers of the San Francisco Bay region. Destruction of salt marsh habitat by land filling and diking has greatly reduced and fragmented the habitat of this species (Leach 1976, Shellhammer 1977).

PRIORITY INDEX

Not assigned.

DESCRIPTION

This species is distinguished from the western harvest mouse (*Reithrodontomys megalotis*) by darker coloration on the back (especially in the southern subspecies), many hairs being tipped with black, especially mid-dorsally. Underparts are white to fulvous; hairs at the anterior base of

the ear often form an ochraceous tuft. Hind feet and tail are usually very dark. The tip of the tail is blunt as opposed to pointed in *R. megalotis*, and the thickness of the tail is greater (2.1 mm) 20 mm distal from the base (Fisler 1965:14). The skull is longer than in *R. megalotis* (Dixon 1908, 1909; Howell 1914; Hall and Kelson 1959).

RANGE

R. raviventris is restricted to salt and brackish marshes bordering south San Francisco, San Pablo, and Suisun Bays. It is found on both sides of the Golden Gate and the Sacramento River. Two subspecies have been described, which differ in some aspects of morphology, coloration, and behavior (Fisler 1965). The easternmost occurrence of the species is in the vicinity of Antioch, eastern Contra Costa County, and the extreme western occurrence is in Sacramento County. A marginal record from Grand Island, 2 miles north of Knight's Landing, Solano County (Hall and Kelson 1959) is actually a capture of *R. megalotis* (Fisler 1965).

RANGE MAP

Distribution is shown on the accompanying map (Fisler 1965, Shellhammer, 1977). To make the locations of populations visible on the map, the width of the coastal strip occupied by the mice has been exaggerated. Often the distribution is limited to a linear strip of marsh within a few hundred feet of the coast.

STATES/COUNTIES

California	Sonoma, Solano, Marin, Contra Costa, San Mateo, Alameda, Santa Clara, Sacramento, Napa.
------------	---

HABITAT

This mouse is restricted to salt and brackish marshes where plants provide a dense mat of cover, ideally 0.2 to 1.0 m high, and a network of spaces on the ground (Hooper 1944, Wondolleck et al. 1976). Pickleweed (*Salicornia*) is the most important indicator species; other plants typical of *R. raviventris* habitat are *Atriplex semibaccata*, *A. patula*, *Grindelia cunifolia*, *Spartina*, and *Distichlis*.

FOOD AND FORAGING BEHAVIOR

The salt marsh harvest mouse's diet is dominated by green vegetation. It can eat salt grass (*Distichlis*) and pickleweed (*Salicornia*), as well as some seeds. Seasonal shifts in diet are influenced by available food plants: much more green vegetation is eaten in winter (Fisler 1965).

SHELTER REQUIREMENTS

It is restricted to areas with considerable cover, mostly in the form of halophytic vegetation, and does not venture into open areas, even a few feet from vegetation (Fisler 1965, Zetterquist 1977). Since most of its habitat is within the range of the extreme high winter tides, high ground from which to escape the rising water is a necessity. The lower high tides of summer are avoided by climbing into the higher vegetation of the marsh or by swimming to floating objects (Fisler 1965). Fills and habitat alteration along the upper edge of marshes that have no cover are unsuitable as refugia.

NESTING OR BEDDING

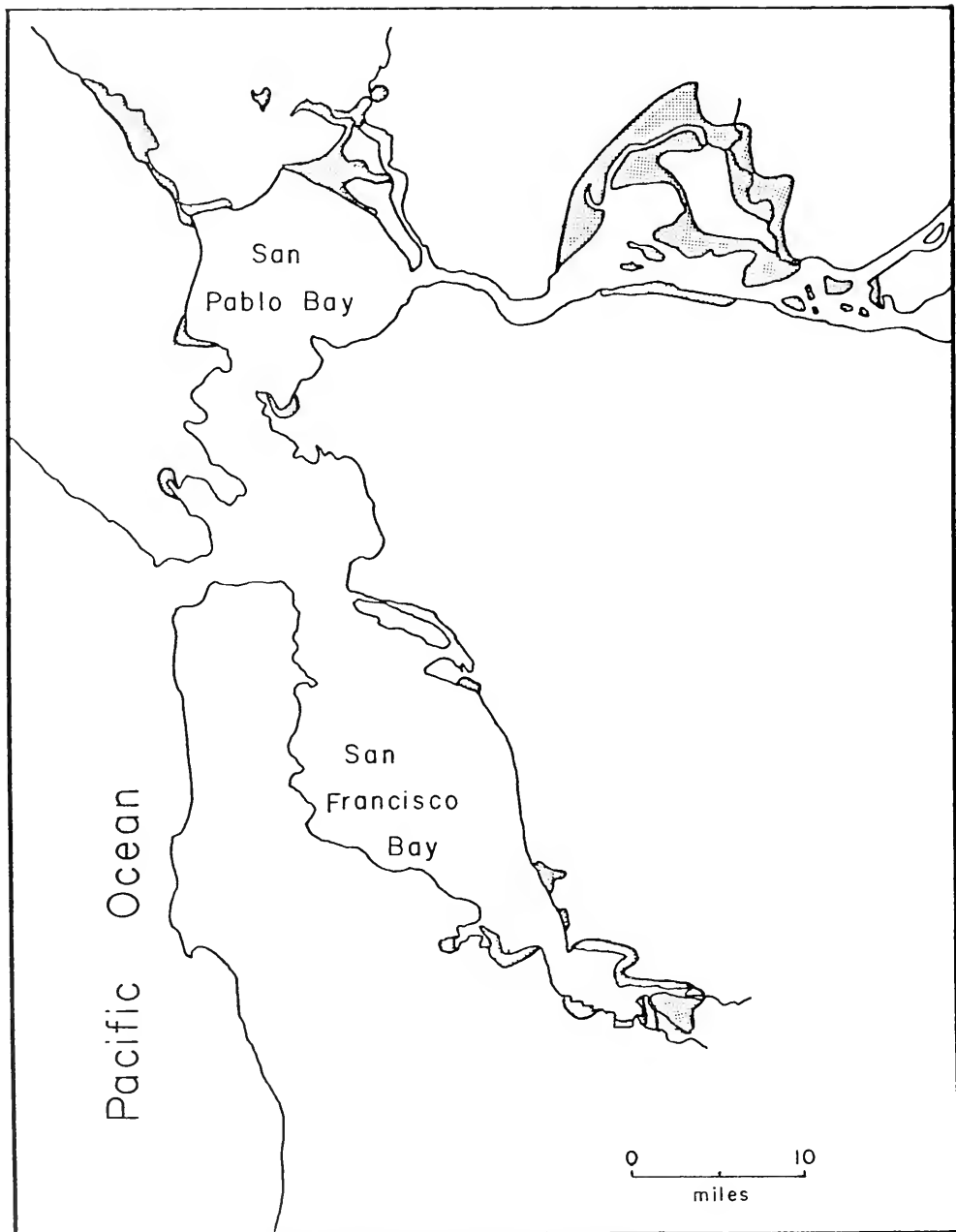
The subspecies *R. r. halicoetes* builds a nest of dry grasses or sedges, usually located on the ground or in a hummock of vegetation. Nests are often used by several individuals, and are abandoned when fouled (Fisler 1965). *Reithrodontomys r. raviventris* is not known to build nests, but merely huddles in an accumulation of vegetation or nesting material (Fisler 1965). It is also reported to use abandoned nests of other species as temporary shelters, including those of song sparrows (Johnston 1956).

RITUAL REQUIREMENTS

Not known. Its secretive habits render field observation difficult.

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

Fisler (1965) stressed the behavioral adaptations in *R. raviventris* that restrict it to areas of high cover: a placid temperament and loss of the frenetic escape behavior typical of *R. megalotis*. *R. raviventris* is strongly dependent on the presence of densely vegetated salt marsh habitat for survival.



Range of the salt marsh harvest mouse.

POPULATION NUMBERS AND TRENDS

It occurs throughout the salt marshes of the San Francisco Bay area, except for very small marshes and those extensively modified by human activity (Fisler 1968). The southern subspecies (*R. r. raviventris*) seems the most immediately threatened, for its range includes marshes surrounded by heavily populated areas. It has already been eliminated from the Corte Madera marshes in Marin County (Fisler, 1965).

Density estimates are unavailable for this species, partly because of the rapidly changing pattern of marsh occupation by harvest mouse populations. The few remaining large marshes support moderately high populations (Schaub 1971), especially in San Pablo and Suisun Bays. The rate of population turnover is high; few mice reach the age of 12 months, and most survive less than 6 months (Fisler 1971, Wondolleck et al. 1976).

The main influence on the decreasing numbers of these mice is habitat destruction rather than any direct removal or direct mortality resulting from human activities. Seasonal changes in population distribution occur in these mice. During the winter months there is a movement toward the upper edge of the marsh to escape the highest tides, whereas the population spreads throughout the marsh during the summer. In some high tides, the populations move to higher ground.

REPRODUCTION

Some males are reproductively active during most of the year, with the low point in the winter months. The season for pregnancy and lactation in females is March through November (Fisler 1965). Females may produce only one litter per year in the field (Fisler 1965). Average litter size is 3.7 in *R. r. raviventris* and 4.2 in *R. r. halicoetes* (Fisler 1965).

MANAGEMENT AND CONSERVATION

This small, secretive mouse is little noticed by humans. It poses no economic problems. Habitat protection is the critical factor in its management. The dense cover available in the preferred salt marsh habitat would seem to effectively protect the species from predation by human commensals during most of the yearly cycle. Occasionally,

mice forced onto levees during high tides may be captured by feral cats and birds of prey. Increasing pressure for land in the San Francisco Bay area has resulted in outright destruction of much of the original range of this species. Its continued survival depends directly on the persistence of the remaining salt-marsh habitat.

AUTHORITIES

George F. Fisler
Department of Biology
California State University, Northridge
Northridge, California 91330

Howard S. Shellhammer
Department of Biological Sciences
San Jose State University
San Jose, California 95192

PREPARER'S COMMENTS

The two subspecies of this mouse appear to have evolved different physiological and genetic traits and they may be considered incipient species (Fisler 1965, Shellhammer 1967, 1977). While some populations of the northern subspecies (*R. r. halicoetes*) appear to occupy secure habitat, others are restricted to small areas. The remaining populations of the southern subspecies are all restricted to small refugia of native salt marsh and need careful management.

Habitat occupied by the salt marsh harvest mouse is much diminished and fragmented from its original condition. Remaining populations are isolated genetically, living on natural islands in a sea of human-altered land. Under such circumstances, populations can be predicted to become extinct (McArthur and Wilson 1967). Since these mice avoid areas without cover, a single levee or wide space may effectively isolate two adjoining marshes, reducing the effective genetic pool. Attention should be given to the maintenance of larger refugia of continuous salt-marsh habitat, rather than equal areas of habitat dissected by access roads, walkways, or barren ground.

LITERATURE CITED/SELECTED REFERENCES

- Dixon, J. 1908. A new harvest mouse from the salt marshes of San Francisco Bay, California. *Proc. Biol. Soc. Washington* 21:197-198.

- . 1909. A new harvest mouse from Petaluma, California. Univ. Calif. Publ. Zool. 5:271-273.
- Fisler, G. F. 1963. Effects of salt water on food and water consumption and weight of harvest mice. Ecology 44:604-606.
- . 1965. Adaptations and speciation in harvest mice of the marshes of San Francisco Bay. Univ. Calif. Publ. Zool. 77:1-108.
- . 1968. Adaptations in movement patterns of two species of salt-marsh rodents. Bull. So. Calif. Acad. Sci. 67:96-103.
- . 1969. Mammalian organizational systems. Contrib. Sci., Los Angeles County Mus. 167: 1-32.
- . 1971. Age structure and sex ratio in populations of *Reithrodontomys*. J. Mammal. 52: 653-662.
- Grinnell, J. 1933. Review of the recent mammal fauna of California. Univ. Calif. Publ. Zool. 40:71-234.
- Hadaway, H. C., and J. R. Newman. 1971. Differential responses of five species of salt marsh mammals to inundation. J. Mammal. 52: 818-820.
- Haines, H. 1964. Salt tolerance and water requirements in the salt-marsh harvest mouse. Physiol. Zool. 37:266-272,
- Hall, E. R., and K. R. Kelson. 1959. The mammals of North America. 2 vols. Ronald Press Co., New York. 1,083 pp.
- Hooper, E. T. 1944. San Francisco Bay as a factor influencing speciation in rodents. Misc. Publ. Mus. Zool., Univ. Michigan 59:1-89.
- Howell, A. H. 1914. Revision of the American harvest mice (Genus *Reithrodontomys*). No. Am. Fauna 36:1-97.
- Leach, H. R. 1976. Salt marsh harvest mouse (*Reithrodontomys raviventris*). Pages 4-5 in At the crossroads: a report on California's endangered and rare fish and wildlife. Calif. Dep. Fish Game Biannual Rep. 103 pp.
- Johnston, R. F. 1956. Population structure in salt marsh song sparrows. Part I. Environment and annual cycle. Condor 58:24-44.
- . 1957. Adaptation of salt marsh mammals to high tides. J. Mammal. 38:529-531.
- MacArthur, R. H., and E. O. Wilson. 1967. The theory of island biogeography. Princeton Univ. Press, Princeton. 203 pp.
- Rice, V. C. 1974. The population ecology of the salt marsh harvest mouse at Triangular Marsh. M.A. Thesis, San Jose State Univ., San Jose, Calif. 128 pp.
- Schaub, D. B. 1971. Salt marsh harvest mouse survey, 1971. Calif. Dep. Fish Game, Spec. Wildl. Invest. Final Rep. 11 pp.
- Shellhammer, H. S. 1967. Cytotaxonomic studies of the harvest mice of the San Francisco Bay region. J. Mammal. 48:549-556.
- Wondolleck, J. T., W. Zolan, and G. L. Stevens. 1976. A population study of the harvest mice (*Reithrodontomys raviventris* Dixon) in the Palo Alto Baylands salt marsh. Wasmann J. Biol. 34:52-64.
- Zetterquist, D. K. 1977. The salt marsh harvest mouse (*Reithrodontomys reviventris*) in marginal habitats. Wasmann J. Biol. 35:68-76.

PREPARED/UPDATED BY

National Fish and Wildlife Laboratory
1300 Blue Spruce Drive
Fort Collins, Colorado 80524

Biological Services Program

FWS/OBS-80/01.29

March 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States- **PUERTO RICAN PARROT**



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

FWS/OBS-80/01.29
March 1980

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—

PUERTO RICAN PARROT

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: LUTHER C. GOLDMAN

PUERTO RICAN PARROT
Amazona vittata (Boddaert)

KINGDOMAnimalia
 CLASSAves
 ORDERPsittaciformes
 FAMILYPsittacidae
 OTHER COMMON

NAMES....Puerto Rican Amazon (Forshaw
 1973); Cotorra de Puerto Rico (Leopold
 1963); Cotorra Puertorriquena (Rules and

regulations concerning wildlife and hunt-
 ing in Commonwealth of Puerto Rico).

DATE

Entered into SWIS.....To be determined
 UpdateTo be determined

LEGAL STATUS

Federal: Endangered (42 FR 36426, 14 July
 1977). Listed Appendix 1, Convention
 on International Trade in Endangered
 Species of Wild Fauna and Flora (42
 FR 10478, 22 February 1977).

States: Protected against hunting, killing, or capture permanently by Rules and Regulations concerning the Wildlife and Hunting in the Commonwealth of Puerto Rico, 1972, Article 8a.

REASONS FOR CURRENT STATUS

Deforestation, widespread hunting, and taking of parrots for pets almost certainly brought about the original decline of this species. Now that the population is so small, all adverse pressures are very serious. Severe hurricanes in 1928 and 1932 decimated the population, probably by destruction of fruit (Noel Snyder pers. comm.). Interactions between parrots and red-tailed hawks, broad-winged hawks, and sharp-shinned hawks have been seen (Cameron Kepler in Forshaw 1973). The pearly-eyed thrasher (*Margarops fuscata*), which competes with parrots for nesting sites and also preys on eggs and chicks, has become much more abundant and widespread in recent years (Nathan Leopold 1968 pers. comm.; Cameron Kepler in Forshaw 1973). Pearly-eyed thrashers and red-tailed hawks are believed to be the most serious predators; rats and screech owls are not considered serious (Noel Snyder pers. comm.).

A critical shortage of nesting holes in hollow trees combined with fierce competition from the exploding population of pearly-eyed thrashers continue to threaten parrots. Illegal hunting and nest robberies by humans are still threats (Noel Snyder pers. comm.).

PRIORITY INDEX

65³

DESCRIPTION

The adult parrot is about 29 cm long, with predominantly green plumage, paler and more yellowish on underparts; feathers are edged with dusky black, particularly on head and neck; lores and frontal band are red; there is a distinct white eye ring; under tail coverts are yellowish-green; feathers of abdomen are sometimes slightly tinged with dull red; primary-coverts and primaries are dark blue; outer webs of outermost secondaries are blue narrowly edged with dull green; under wing-coverts are green; undersides of flight feathers are bluish-green; tail is green narrowly tipped

with yellowish-green, bases of lateral feathers are marked with red on inner webs and outermost feathers are edged with blue; bill is yellowish horn; iris is brown; legs are yellowish brown. Immatures are similar to adults (Forshaw 1973).

The extinct subspecies *A. v. gracilipes* of nearby Culebra Island was very similar, but smaller and with smaller, more slender feet (Forshaw 1973).

Measurements. *A. v. vittata*: (8 males) wing 182-193 mm (av. 188.5 mm); tail 90-103 (96.9); exposed culmen 27-30 (28.5); tarsus 21-24 (22.1); (5 females) wing 178-196 (av. 185.6 mm); tail 93-104 (98.2); exposed culmen 27-28 (27.2); tarsus 22-24 (23.0). *A. v. gracilipes*: (2 males) wing 169-173 (av. 171.0 mm); tail 93-95 (94.0); exposed culmen 26 (26.0); tarsus 20-21 (20.5); (1 female) wing 175 mm; tail 100; exposed culmen 23; tarsus 20 (Forshaw 1973).

RANGE

The present range is confined to Puerto Rico; it formerly included nearby Culebra, Vieques and Mona Islands. This parrot was last recorded on Culebra Island in 1899; it disappeared from other offshore islands of Puerto Rico earlier.

It has not been recorded from the mangrove swamp at the mouth of the Mameyes River since Wetmore (1927) found it there. It was known to be in Guanajataca Forest at medium altitudes up to 1910, in Rio Abaja Forest also at medium elevations up to 1920's, and in Carite Forest at high elevations up until the 1930's. It is now virtually confined to Luguillo National Forest, which comprises 11,200 ha of relatively high-elevation tropical rainforest in extreme eastern Puerto Rico (Noel Snyder pers. comm.).

RANGE MAP

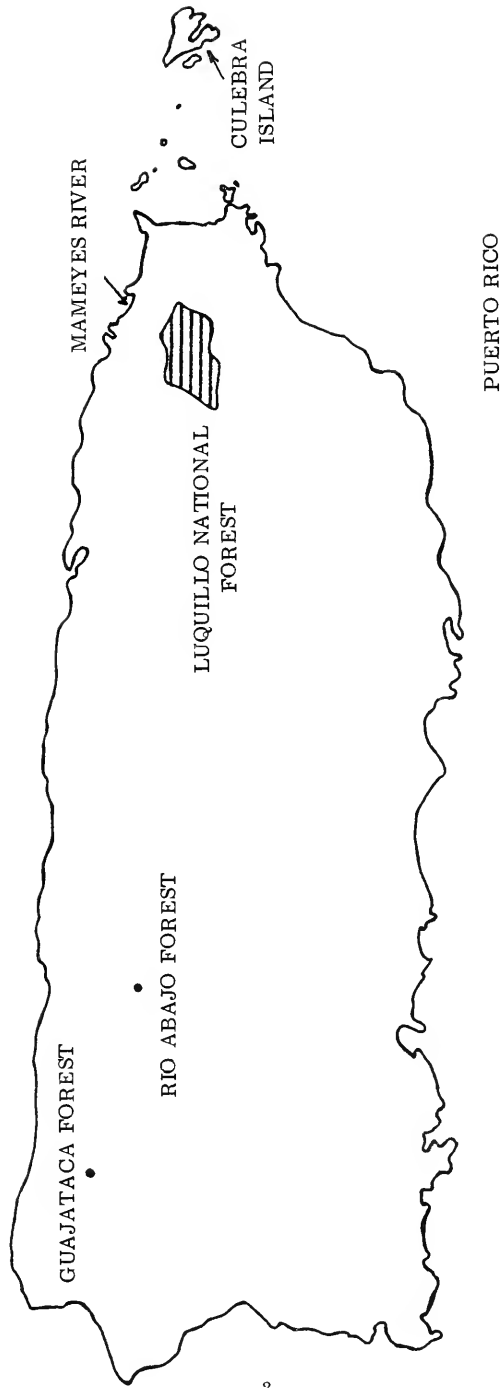
The range of the parrot has included most areas of Luguillo Forest above 400 m elevation.

STATES/COUNTIES

Commonwealth of Puerto Rico.

HABITAT

Mature wet forests with high rainfall between about 400 and 800 m elevation are required by this species. It is now confined in breeding areas having the largest number of old colorado trees,



Range of the Puerto Rican Parrot

which supply nesting cavities. It formerly frequented more diversified habitat, particularly at lower elevations (Noel Snyder pers. comm.). Dwarf forest at higher elevations and second growth lowland forest are not used by parrots (Cameron Kepler in lit. 8 Feb. 1971).

Parrots occupy the Tabonuco, Sierra Palm, and Colorado forest types of Wadsworth (1952).

FOOD AND FORAGING BEHAVIOR

Rodriguez-Vidal (1959) lists more than 50 species of fruiting plants used by parrots. Most commonly used was sierra palm (*Prestoea montana* [*Euterpe geobosa*]) with a long fruiting period from November to June (chiefly Feb. through March). Other important food plants were bejuco de rana vine (*Marcgravia sintenisii*), camasey de paloma (*Miconia sintenisii*), tabonuco (*Dacryodes excelsa*), cabeilo (*Casearia guianensis*), guara (*Cupania triquetra*) and hueso blanco (*Mayepea domingensis*) trees. Kepler (1970) has seen parrots extracting nectar from fleshy bracts below flower clusters on marcgravia vines and noted that, in some areas parrots feed more heavily on *Clusia krugiana* than any other tree.

Rodriguez-Vidal (1959) also stressed the importance of the tabonuco tree in providing fruit during August to November because parrot food is scarce during that period of heavy rains. However the largest flocks he counted (200) were feeding on sierra palm, bejuco de rana and camasey de paloma (with no mention of tabonuco); on 8 November 1953 and 31 October 1954, both at Valle Hicaco on El Yunque. He never observed parrots feeding on the ground. They fed chiefly on pericarps of wild fruits but also on flowers and tender shoots. If fruit is in clusters, parrots cut off the entire small supporting branch, held it in one foot, and picked off ripe fruit, letting unripe fruit fall to ground. They fed in groups and if frightened while eating would fly off, some carrying one piece or clusters of fruit in their bills. He did not see any parrots fighting over food. Parrots move about widely to feed especially between September and December when tabonuco is in fruit. They are highly regular in their daily flights of from 1 to 5 km to and from food sources and night roosts (Kepler 1973). Kepler (1970) points out the possibility that an adequate supply of their essential foods is not found within the

Forest Reserve, accounting for reported flights from the forest during the summer months. They forage in semi-social groups. The normal foraging range of a nesting pair is about 1.6 km, but sometimes 8 km or farther. There is no evidence of a shortage of food. With failure of the sierra palm crop in 1974, parrots shifted to other foods (Noel Snyder pers. comm.).

SHELTER REQUIREMENTS

Cavities for nesting are the only shelter required.

NESTING OR BEDDING

The nest is a hollow in a tree. In Luquillo Forest Reserve nearly all nests found have been in cavities in large colorado trees (*Cyrilla racemiflora*) formed by rotting of wood of trunk after branches have been lost to wind or other accidents. Parrots prepare nests by clearing out the interior of the cavity, but do not add lining material. Most sites chosen have been more than 5 m from the ground. Cavities have been random in compass orientation, with minimum observed entrance diameters of 10 cm and minimum observed internal diameters of about 23 cm. Cavity depths have ranged to 240 cm with the deepest cavities apparently preferred. All recent nests have been about 500 m elevation.

Historically, parrots nested in holes in cliffs as well as hollow trees, but recently located nests have all been in rotted out cavities in large colorado trees. Most such cavities are unsuitable for nesting because they are too wet or too small. Suitable nest sites are scarce and limiting to breeding of parrots in their traditional areas, which they seem to be reluctant to leave for other areas where suitable nest sites exist (Noel Snyder pers. comm.).

RITUAL REQUIREMENTS

Kepler (1973) says there are distinct take-off calls, flight calls, and series of contact calls, including duetting between pair members. The latter probably serve as "station identification" (Helen Snyder pers. papers 9 May 1975).

Calls are pair specific. Pairs are very territorial and aggressively defend their territory. There is evidence that pairs identify one another by calls,

and don't pay much attention to nonterritorial pairs (Noel Snyder pers. comm.).

OTHER CRITICAL REQUIREMENTS

Not known.

POPULATION NUMBERS AND TRENDS

Wetmore (1927) points out that in 1836, Moritz reported great flocks of parrots in Puerto Rico, and in 1864 Taylor found them to be common. It seems that until the turn of the century they were plentiful, particularly in the interior, but in 1911-12, Wetmore located populations only in the karst of western Puerto Rico, in the lowlands near the mouth of the Mameyes River, and in the Luquillo Forest of eastern Puerto Rico (Forshaw 1973). Counts in Luquillo National Forest Reserve from August 1953 to March 1956 never exceeded approximately 200 individuals (Rodriguez-Vidal 1959). By December 1966, the highest count achieved by Victor Marquez in a several month effort was 70 individuals (pers. comm.), and by 1968 the highest count achieved by Kepler was only 24. The wild population dropped to a low point of only 13 or 14 in 1974, but has been showing some signs of recovery since that time. By summer 1979, there were 26 to 28 birds in the wild, including 4 breeding pairs.

REPRODUCTION

With but one exception—a 1974 cavity in a laurel sabino (*Magnolia splendens*)—all recent nests of the parrots have been in cavities in palo colorados. The predominant use of palo colorados is probably a reflection of the greater abundance of natural cavities in this species. Nevertheless, good nesting cavities are not abundant in general. Systematic climbing and checking of over 1200 trees within the parrot nesting areas from 1973-1976 revealed a dearth of good cavities, and several pairs of recent years have failed to lay eggs because of apparent failures to locate good sites, a problem that has been alleviated in the last 4 years by provision of artificial nest sites (Snyder and Wiley pers. comm.).

Incubation is approximately 26 days; clutch size 2 to 4 (average 3), and nestling period 8 to 11 weeks (average 9 weeks). Only females incubate and males provide all food to females during the incubation period. Both adults provide food for

young. Sexual maturity is reached at 3 to 4 years of age.

Before 1973, when intensive nest management efforts were begun, nesting success for all nests found at the egg stage was between 11% and 26%. Since 1973, success has increased to 71%, primarily due to efforts to alleviate nest predation by pearly-eyed thrashers and to maintain the quality of nest sites. Sources of nesting failure in addition to nest-site disintegration and predation by thrashers have been parasitism of nestlings by bot flies and predation on adults and nestlings by red-tailed hawks (*Buteo jamaicensis*), but neither of these factors appears to have been a major cause of the historical decline of the species. Nest-robbing by man accounted for a large fraction of the nestlings that survived other pressures up until the late 1960's, but has not been a major problem since that time.

Numbers of young fledged in the wild in recent years have run: 1973,3; 1974,3; 1975,6; 1976,8; 1977,3; 1978,9; and numbers of egg-laying pairs have run: 1973,3; 1974,2; 1975,5; 1976,4; 1977,3; 1978,4.

MANAGEMENT AND CONSERVATION

A program of study conducted by the Fishery and Wildlife Section of the Puerto Rico Dept. of Agriculture and Commerce financed by the Pitman-Robertson Federal Aid to Wildlife Program from 18 August 1953 to 30 June 1956, with Jose A. Rodriguez-Vidal as chief investigator, was followed by a project developed in 1968 by the U.S. Fish and Wildlife Service, U.S. Forest Service, World Wildlife Fund, and the Commonwealth of Puerto Rico. The latter project is still continuing with primary funding from the U.S. Forest Service and the U.S. Fish and Wildlife Service. Studies from 1968 to 1971 were under the direction of Cameron Kepler; from 1972 to 1976 were under the direction of Noel Snyder; and from 1977 to the present are under James Wiley.

Management efforts began in 1956 with rat-poisoning with warfarin in the parrot nesting areas. Rat control has been continued in most years of study since that date. However, recent evidence strongly suggests that rats are only a secondary threat to nests (Snyder pers. comm.), and in recent years management emphasis has shifted from rat control to efforts to reduce the impacts of thrashers and to provide and enhance the quality of nest sites.

In the years just prior to 1973, thrashers were apparently responsible for the majority of parrot nest failures, although this species was not present in Luquillo Forest in any abundance before 1950 and thus was not involved in the early decline of the parrots there. Starting in 1973, intensive guarding of parrot nests has prevented any further cases of nest failure from this cause. In 1973, 1974, and 1975, thrashers were eliminated by shooting whenever they threatened parrot nests, and in addition some nests were protected by artificial incubation of eggs and later replacement of young into nests. Parrots were maintained in these nests by dummy eggs made from plaster. At least 2, very likely 4, and possibly as many as 6 parrot nests were saved from thrasher predation during these years by these efforts.

Studies of nest-site preferences of thrashers conducted in 1974, 1975, and 1976 demonstrated a reluctance of this species to enter deep structures with bottoms not visible from entrances. Parrots, in contrast, appear to prefer such structures, and in 1976 efforts to convert parrot nests into such structures were begun. All parrot nests were deepened and provided with baffles - changes which the parrots accepted without obvious difficulties. Thrashers have been provided with alternative nest sites close to each parrot nest and once established in these alternative sites, have greatly reduced the frequency with which thrashers have attempted to enter parrot nests by their intraspecific territorial behavior. Since 1977 there have been no significant thrasher threats to any parrot nests, and it has not been necessary to eliminate any thrashers.

The provision of artificially created nest sites has also met with considerable success, and all currently active parrot pairs are using such sites.

As a hedge against loss of the wild population and to provide a source of birds for future release into the wild, a number of parrots have been taken into captivity in recent years, primarily as eggs. The current (1979) captive population stands at 15 individuals. As yet, no successful reproduction has taken place in the captive flock, although several females have laid infertile eggs and one pair laid fertile eggs that did not hatch in 1978. By chance, the captives taken consist largely of females so their number of potential egg-laying pairs has remained low. Success in breeding the closely related Hispaniolan Parrot (*Amazona*

ventralis) at Patuxent and at other facilities provides optimism that the captive program may soon begin to produce young.

Other management efforts of recent years have been directed at reducing the impact of bot fly parasitism of young parrots. Experiments are currently underway with methods of preventing this parasitism. Nestlings of the past few years have been closely monitored for parasitism and treated when such parasitism has occurred.

AUTHORITIES

- James Wiley
Box 21
Palmer, Puerto Rico 00721
- Noel Snyder
Patuxent Wildlife Research Center
Laurel, MD 20810
- Cameron Kepler
RR Maalaea Road
Kula, Hawaii 96790
- Frank H. Wadsworth
Institute of Tropical Forestry
University of Puerto Rico
Box AQ
Rio Piedras, Puerto Rico 00928

PREPARER'S COMMENTS

It appears that we now have the technology for ensuring satisfactory reproduction of Puerto Rican Parrots in the wild by appropriate effort in nest site enhancement, brood care, and pearly-eyed thrasher management. Future parrot management should concentrate on providing and maintaining suitable nest sites combined with continued routine censusing of the species.

LITERATURE CITED/SELECTED REFERENCES

- Danforth, S. J. 1935. Supplementary account of the birds of the Virgin Islands, including Culebra and adjacent islands, pertaining to Puerto Rico, with notes on their food habits. *J. Agric. Univ. Puerto Rico* 19(4):430-472.
- Forshaw, J. M. 1973. *Parrots of the World*. New York, Doubleday & Company. p. 522.
- Kepler, C. B. 1970. The Puerto Rican Parrot in Chapter E-14: Preliminary comparison of bird species diversity and density in Luquillo and

Guanica Forests, H. J. Odum ed. *A Tropical Rain Forest*, Oak Ridge, Tenn. U.S. Atomic Energy Commission Div. of Tech. Info.

Leopold, N. J. 1963. Checklist of birds of Puerto Rico and the Virgin Islands. Bull. 168, University of Puerto Rico Agric. Exp. Sta. 119 pp.

Rodriguez-Vidal, J. A. 1959. Puerto Rican Parrot (*Amazona vitata vitata*) study. Monog. Dept. Agric. and Commerce, Puerto Rico, No. 1:1-15.

Wadsworth, F. H. 1952. Forest Management in the Luquillo Mountains. Caribbean Forests, Ann. Rep. Vol. 14 (1&2) p. 40.

Wetmore, A. 1916. The birds of Vieques Island, Puerto Rico. *Auk* 33:403-419.

Wetmore, A. 1927. The birds of Puerto Rico and the Virgin Island-Psittaciformes to Passeriformes. *Scient. Surv. Puerto Rico and Virgin Islands*, New York Acad. Sci. 9(4):409-598.

Biological Services Program

FWS/OBS-80/01.30
March 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States-

KEMP'S (ATLANTIC) RIDLEY SEA TURTLE



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

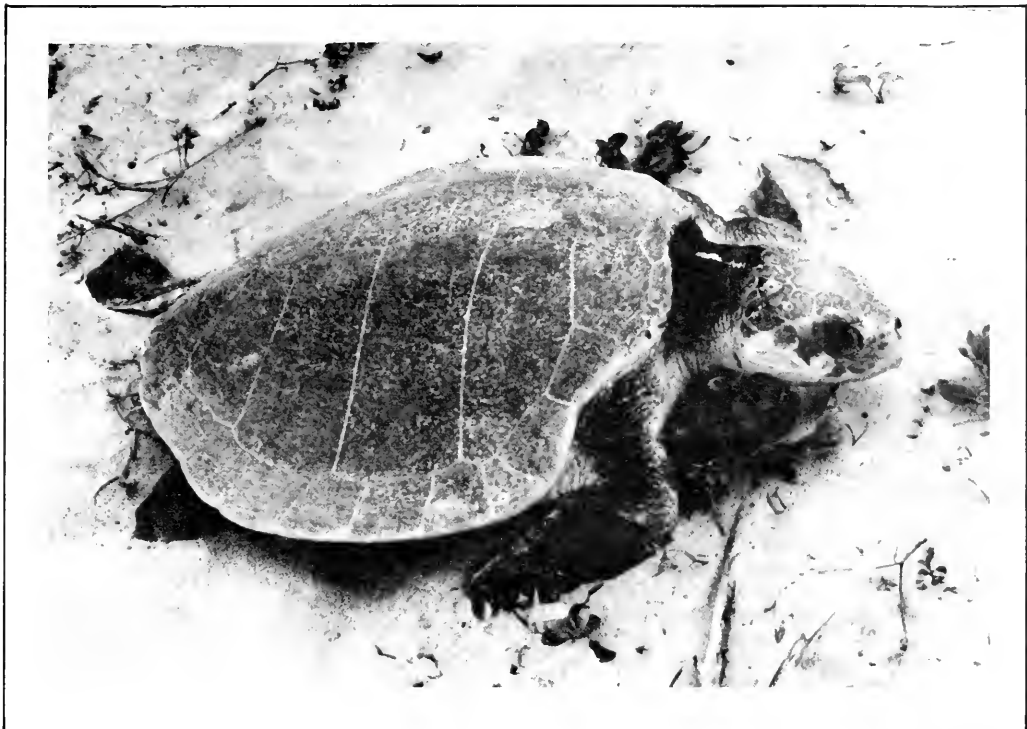
FWS/OBS-80/01.30
March 1980

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—
KEMP'S (ATLANTIC) RIDLEY SEA TURTLE

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: P. C. H. PRITCHARD

KEMP'S (ATLANTIC) RIDLEY SEA TURTLE

Lepidochelys kempii Garman

Protected: Alabama, North Carolina.

KINGDOM Animalia
CLASS Reptilia
ORDER Testudinata
FAMILY Cheloniidae
OTHER COMMON NAMES Mexican ridley, Atlantic ridley, Tortuga lora.

DATE
 Entered into SWIS. to be determined.
 Updates. .22 September 1976, 25 February 1977.

LEGAL STATUS
Federal: Endangered (35 FR 18310, 2 December 1970)
States: Endangered: Florida, Georgia, Maryland, New Jersey, South Carolina, Texas.

REASONS FOR CURRENT STATUS

Overuse by man is the primary factor responsible for the present small numbers of sea turtles. Diurnal nesting on a single beach in Mexico makes this turtle particularly susceptible to predation by man and wild animals. Commercial harvesting of eggs and skin has played a significant role in the decline (IUCN 1968). Harvesting has recently (1966) been prohibited by the Mexican government, but no upward trend in population numbers has been observed (Pritchard and Marquez M. 1973). Predation by wild animals is acute, especially on hatchlings. Crabs, fish, reptiles, birds, and mammals are predators; adult predation is limited to sharks (Rebel 1974).

Because of aggregate nesting on a single beach, Rancho Nuevo in Tamaulipas State, Mexico, any habitat modification there could result in loss of the entire breeding population.

Sea turtles are caught incidental to commercial fishing activities. Some turtles drown in

trawls, some are eaten by fishermen, sold in local markets, or mutilated as a result of entanglement in the trawls (U.S. Department of Commerce 1976). According to Pritchard (1976), ridleys are caught north and south of the Rio Grande off the States of Florida, Louisiana, and Texas, as well as in Tabasco, Veracruz, and off the Campeche Bank in Mexico.

PRIORITY INDEX

Not assigned.

DESCRIPTION

The ridley is a small sea turtle with an unusually broad (compared with other sea turtles), heart-shaped, keeled carapace that is serrated behind the bridge. It has a triangular head and a somewhat hooked beak with large crushing surfaces. The plastron has several small pores on each side, leading to Rathke's glands (secretory structures).

Hatchlings are black on both sides. As the turtle matures, the bridge and hingeless plastron change to white, then yellow; and the carapace changes to gray and then olive green. The head and paddle-like limbs are gray.

Adults weigh between 35 and 42 kg, and have a carapace length of 56 to 70 cm.

Close examination of the carapace reveals five pairs of pleural shields with the nuchal shield touching the first costals. There are 12 to 14 marginals on each side of the carapace and pores in the four bridge shields.

Black-and-white photographs appear in Carr (1952, 1967), Ernst and Barbour (1972), Bustard (1973), Rebel (1974) and Pritchard (1976).

RANGE

Adults are restricted to the Gulf of Mexico. Immatures may be observed along the Atlantic coast as far north as Massachusetts and are sighted infrequently along European shores.

The former range was probably equivalent to the present range (IUCN 1968, Witham 1976).

RANGE MAP

On the following pages distribution is shown by shading, and U.S. nesting sites by dots.

STATES/COUNTIES

Alabama: Baldwin, Mobile.

Delaware: Sussex;

Florida: Bay, Brevard, Broward, Charlotte, Citrus, Collier, Dade, Dixie, Duval, Flagler, Franklin, Gulf, Hernando, Hillsborough, Indian River, Jefferson, Lee, Levy, Manatee, Martin, Monroe, Nassau, Okaloosa, Palm Beach, Pasco, Pinellas, St. Johns, St. Lucie, Santa Rosa, Sarasota, Volusia, Wakulla, Walton.

Georgia: Bryan, Camden, Chatham, Glynn, Liberty, McIntosh.

Louisiana: Cameron, Iberia, Jefferson, Lafourche, (parishes) Plaquemines, St. Bernard, St. Mary, Terrebonne, Vermilion.

Maryland: Worcester.

Massachusetts: Barnstable, Dukes, Essex, Middlesex, Nantucket, Norfolk, Plymouth.

Mississippi: Hancock, Harrison, Jackson.

New Jersey: Atlantic, Cape May, Monmouth, Ocean.

New York: Nassau, Suffolk.

North

Carolina: Brunswick, Carteret, Currituck, Dare, Hyde, New Hanover, Onslow, Pender.

Rhode

Island: Newport, Washington.

South

Carolina: Beaufort, Charleston, Colleton, Georgetown, Horry.

Texas: Aransas, Brazoria, Calhoun, Cameron, Chambers, Galveston, Jefferson, Kenedy, Kleberg, Matagorda, Nueces, Willacy.

Virginia: Accomack, Northampton.

HABITAT

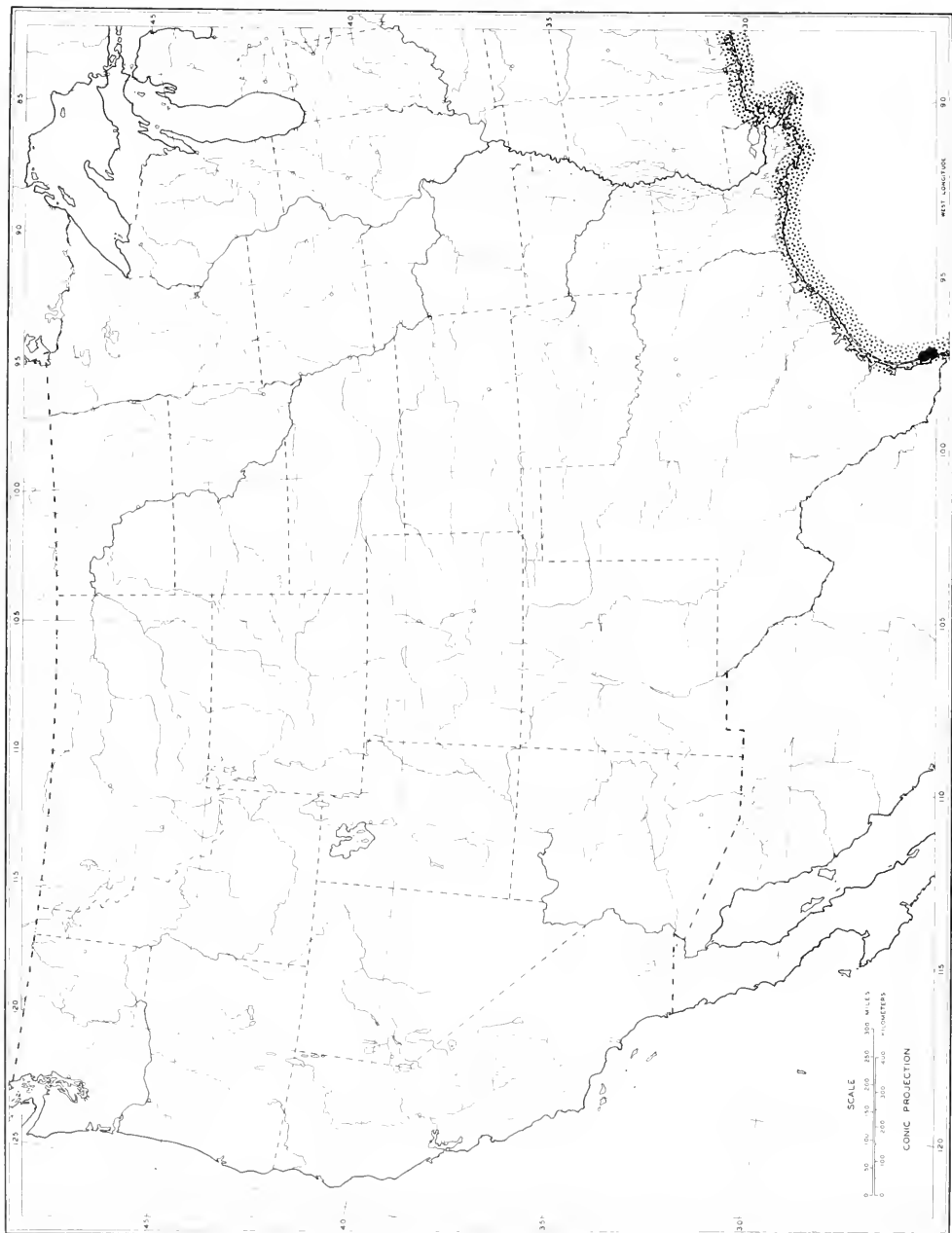
The ridley inhabits shallow coastal and estuarine waters; it is often associated with subtropical shorelines of red mangrove (*Rhizophora mangle*) (Witham 1976).

FOOD AND FORAGING BEHAVIOR

The ridley's diet consists primarily of invertebrates, mostly crabs (*Arenaeus*, *Calappa*, *Callinectes*, and *Hepatus*), but also shrimp, snails, sea urchins, sea stars, fish, and, occasionally, marine plants (Ernst and Barbour 1972, Pritchard and Marquez M. 1973, R. Marquez M. personal communication).



Distribution of Kemp's ridley sea turtle in the eastern United States.



Distribution (shading) and nesting sites (dots) of the Kemp's ridley sea turtle in the western United States.

SHELTER REQUIREMENTS

Not known.

NESTING OR BEDDING

With the exception of occasional females known to nest on Padre Island, Texas (Werler 1951), the entire population nests on about 24 km of beach between Barra del Tordo and Ostional in State of Tamaulipas, Mexico. They prefer sections of beach backed up by extensive swamps or large bodies of open water having seasonal, narrow ocean connections (Pritchard and Marquez M. 1973).

A well-defined and elevated dune area is necessary for successful nesting. Pritchard and Marquez M. (1973) suggest that this provides a landmark for the turtle to dig a nest that will be above mean high tide.

RITUAL REQUIREMENTS

Not Known.

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

Females land in large numbers only when strong or moderate north winds blow. Pritchard (1976) suggests that this may cover the turtle's tracks and/or dissipate nesting smell.

POPULATION NUMBERS AND TRENDS

In 1947, a Mexican, Sr. Herreva, filmed nesting. Estimates based on this film put the breeding population at 40,000 at that time. Despite the protection of the nesting beach since 1966, the breeding population now is reported to be between 1,500 and 3,000 adults, with only about 500 females nesting during the 1978 season (Anon. 1978).

The 1947 film shows what is believed to be the entire breeding population swarming ashore at once. Such a massive landing is called an 'arribada.' R. Marquez M. (personal communication) has observed nesting since 1966 and reports that the number within arribadas is declining. In 1976, the largest was made up of approximately 150 females, and there are usually between five and seven arribadas per season.

Failure to rebuild population numbers in spite of beach protection may result from low survivorship (Pritchard 1976).

REPRODUCTION

Ridley's nest from April to June, during which time turtles appear off Tamaulipas. After strong winds, females swarm ashore to nest in daylight hours. A female nests a maximum of three times a season with an interesting interval of 10 to 28 days. Individuals often nest annually with an average clutch size of 110 eggs (Pritchard 1969a, Lund 1976).

Copulation takes place offshore near the nesting beach, and some pairs remain embraced for hours. Black-and-white photographs of courtship and mating activities appear in Bustard (1973).

MANAGEMENT AND CONSERVATION

Since 1966, the Mexican government has conducted a tagging program for adults at Rancho Nuevo and has protected the beach with military personnel. About 330 clutches of eggs have been relocated annually to fenced compounds (R. Marquez M. personal communication).

Pritchard (1976) argued for the perfection and deployment of a modified trawl net to prevent the incidental catch of sea turtles, and work on this project is well underway by the U.S. National Marine Fisheries Service.

Lund (1974) reported on a private effort to stock Texas waters with eggs taken from the Rancho Nuevo beach in Mexico. In 1978, a multi-agency effort was initiated by the U.S. Fish and Wildlife Service, National Park Service, National Marine Fisheries Service, and Texas Parks and Wildlife Department in coordination with the Mexican government (Anon. 1978). This program incorporates a wide variety of techniques, including more intensive protection for the Rancho Nuevo beach, an attempt to establish a breeding population at Padre Island National Seashore by transplanting 2,000 eggs annually, and head-starting of 2,000 hatchlings from the Rancho Nuevo beach and the hatchlings from Padre Island at the NMFS laboratory in Galveston, Texas (Anon. 1978, Wauer 1978).

Marquez M. (1976b) recommends formation of seven natural reserves for Mexican coasts, which include Playa de Rancho Nuevo, Tamaulipas, the Kemp's ridley's nesting beach.

AUTHORITIES

Archie Carr
Department of Zoology
University of Florida
Gainesville, FL 32611

Henry Hildebrand
Department of Zoology
Texas A&M University
Kingsville, TX 78363

Frank Lund
P.O. Box 541
Jupiter Island, FL 33458

Rene Marquez M.
Apdo Postal 79-052
Col. Doctares
Mexico 7. D.F.

Peter Pritchard
Florida Audubon Society
P.O. Drawer 7
Maitland, FL 32751

PREPARER'S COMMENTS

None.

LITERATURE CITED/SELECTED REFERENCES

- Adams, D. E. 1966 More about the ridley operation: Padre Island egg transporting. *Int. Turt. and Tort. Soc. J.* 1(1):18-20, 40-43, 45.
- Anon. 1978. U.S.-Mexico restoration efforts may be only hope for Kemp's ridley. *End. Sp. Tech. Bull. U.S. Fish Wildl. Serv.* 3(10):6-8.
- Brongersma, L. D. 1968. Miscellaneous note on turtles. I. *Kon. Ned. Akad. Wetensch. Proc. Serv. C. Biol. Med. Sci.* 71:439-442.
- Bustard, R. 1973. Sea turtles: natural history and conservation. Taplinger Publ. Co., New York. 220 pp.
- Carr, A. F. 1952. Handbook of turtles. Turtles of the United States, Canada, and Baja California. Comstock Publ. Assoc., Cornell Univ. Press, Ithaca, N.Y. 542 pp.
- . 1955. The riddle of the ridley. *Anim. Kingd.* 58(5): 146-156.
- . 1956. The windward road. Alfred Knopf, Inc., New York. 258 pp.
- . 1961. The ridley mystery today. *Anim. Kingd.* 64:7-12.
- . 1967. So excellent a fish. The Natural History Press, Garden City, N. Y. 248 pp.
- Chavez, H. 1969. Tagging and recapture of the lora turtle (*Lepidochelys kempii*). *Int. Turt. and Tort. Soc. J.* 3(4):14-19, 32-36.
- Chavez, H., M. Contreras G., and T. P. E. Hernandez D. 1968. On the coast of Tamaulipas, Parts I and II. *Int. Turt. Soc. J.* 2(4):20-29, 37 and 2(5):19, 27-34.
- Ernst, C. H., and R. W. Barbour. 1972. Turtles of the United States. Univ. of Kentucky Press, Lexington. 347 pp.
- IUCN. 1968. Red data book. Vol. 3, Amphibia and reptilia. Compiled by R. E. Honegger. IUCN, Morges, Switzerland.
- Lund, F. 1974. A survey of marine turtle nesting in the United States. Unpubl. 39 pp.
- . 1979. Atlantic ridley. Pages 25-26 in R. W. McDairmid ed. Rare and endangered biota of Florida, Vol. 3, Amphibians and reptiles. Univ. Presses of Florida, Gainesville.
- Marquez M., R. 1973. Instructivo para la proteccion de las tortugas marina. *Serie Dioulgacion. INP/SD* 2:1-34.
- . 1976a. Estado actual de la pesquina de tortugas marina en Mexico, 1974. *INP/SI* 1-27.
- . 1976b. Reservas naturales para la conservacion de las tortugas marinas en Mexico. *INP/Sii* 83:1-22.
- Marquez M., R., A. Villanueva O., and C. Penaflores S. 1976. Sinopsis de datos biologicos sobre la tortuga golfina. *Lepidochelys olivacea* (Eschscholtz, 1829). *INP Sinop. Pesca* 2: 1-61.
- Montoya, A. E. 1969. Programas de investigacion y conservacion de las tortugas marinas en Mexico. Pages 34-53 in Marine turtles. IUCN. New Publ. Ser. Suppl. Paper. 20.
- Pritchard, P. C. H. 1969a. Studies of the systematics and reproductive cycles of the genus *Lepidochelys*. Ph. D. Dissert. Univ. of Florida, Gainesville. 226 pp.
- . 1969b. Summary of world sea turtle survival situation. *IUCN Bull.* 2(1):90-91.
- . 1969c. The survival status of ridley sea turtles in American waters. *Biol. Cons.* 2(1): 13-17.
- . 1976. Endangered species: Kemp's ridley turtle. *Florida Nat.* 49(3):15-19.
- Pritchard, P. C. H., and R. Marquez M. 1973. Kemp's ridley turtle or Atlantic ridley *Lepidochelys kempii*. IUCN Monogr. 2. Marine turtle series. Morges, Switzerland.
- Rebel, t. P. 1974. Sea turtles and the turtle indus-

try of the West Indies, Florida, and the Gulf of Mexico. Rev. ed. Univ. of Miami Press, Coral Gables. 250 pp.

Sweat, D. E. 1968. Capture of a tagged ridley turtle. Q. J. Florida Acad. Sci. 31(1):47-48.

U.S. Department of Commerce. 1976. Proposed listing of the green sea turtle (*Chelonia mydas*), loggerhead (*Caretta caretta*), and pacific ridley sea turtle (*Lepidochelys olivacea*) as threatened species under the Endangered Species Act of 1973. Natl. Oceanic Atm. Admin., Natl. Marine Fish. Serv., Washington, D.C.

Walker, W. F. 1971. Swimming in sea turtles of the family Cheloniidae. Copeia 1971(2):229-233.

Wauer, R. 1978. Headstart for endangered turtles. Natl. Parks Conserv. Mag. 52(11):16-20.

Werler, J. E. 1951. Miscellaneous notes on the eggs and young of Texas and Mexican reptiles. Zoologica 36(3):37-48.

Witham, R. 1976. *Lepidochelys kempii* account. In H. O. Hillestad, D. B. Means, and W. W. Baker, eds. Endangered and threatened vertebrates of the southeastern United States. Tall Timbers Res. Stn. Misc. Publ. 4.

Zim, H. S., and H. M. Smith. 1953. Reptiles and amphibians. A guide to familiar American species. Simon and Schuster, New York. 147 pp.

GATEKEEPER

To be designated by the Office of Endangered Species.

ACCOUNT PREPARED/UPDATED BY:

National Fish and Wildlife Laboratory
412 N.E. 16th Avenue, Room 250
Gainesville, FL 32601

Biological Services Program

FWS/OBS-80/01.31

March 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States-

BACHMAN'S WARBLER



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—

BACHMAN'S WARBLER

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



DWG. BY WALTER DAWN

BACHMAN'S WARBLER

Vermivora bachmanii Audubon

KINGDOMAnimalia
 CLASS Aves
 ORDER Passeriformes
 FAMILY Parulidae
 OTHER COMMON NAMES None

DATE

Entered into SWIS. To be determined.
 Updates. 5 April 1978; 10 October 1978.

LEGAL STATUS

Federal: Endangered: 32 FR 4001; 11 March 1967.

States: Endangered: Florida, Georgia, Mississippi, North Carolina, South Carolina, Texas.

REASONS FOR CURRENT STATUS

Stevenson (1938), USDI (1973), Shuler (1977b, 1977c, personal communication) and Arthur Wayne's (approximately 1910) unpublished statement, "I never expect to see another specimen as the great swamp in which I found it breeding has been deforested by a lumbering company," all suggest that the clearing of the southern swamp forests contributed to the decline of the Bachman's warbler. On the other hand, Stevenson (1972) and personal communications from P. Hamel, R. Hooper, and D. Urbston insist that the reasons for the current status of this species are unknown.

Other suggestions for the species' current status have included: (1) competition with other species on the breeding grounds (Hamel 1977a); (2) excessive collecting along migration route in Florida (USDI 1973); (3) climatic catastrophe such as storms (R. Hooper personal communica-

tions); and (4) "genetic or evolutionary problems" (Hamel 1977a: R. Hooper personal communications).

PRIORITY INDEX

Not assigned.

DESCRIPTION

The Bachman's warbler is 10 to 11 cm long, with a small, sharp-pointed bill. Their color pattern is somewhat variable. Males usually have a bright yellow shoulder patch, forehead, eye ring, chin, and belly and a black throat patch with some black on crown. Crown is otherwise gray and black olive. Wings and tail are dusky with subterminal white patches on tail. Females usually lack black on throat (although some may be present); the breast is shaded with gray; white markings on tail are reduced, and underparts are often much less yellowish.

Distinguishing field marks are the yellow underparts and the black crown and throat. Color illustrations appear in Howell (1932), the December 1977 cover of *Birding*, and the inside back cover of *South Carolina Wildlife* 23(2), 1976.

RANGE

Bachman's warblers are known to have nested in Alabama, Kentucky, Missouri, and South Carolina (Hooper and Hamel 1977). The last nest known in Alabama was discovered in 1937 (Stevenson 1938).

Their present range is unknown; the species may be extinct (Hamel 1977b). Shuler (1977a) reported sightings of individual males in South Carolina's I'On Swamp (Francis Marion National Forest) in 1974, 1975, and 1976, one in each year. Shuler et al. (1978) reported sightings of a male and a female in I'On Swamp in 1977, including reported verification by subsequent sightings by different individuals. Other recent reported sightings include Berkeley County, S. C. (1967), Louisiana (1973), Long County, Georgia (1975), Kentucky (1977), Maryland (1977), and Cameron Parish, Louisiana (1977). Hamel (1977b) considers all of these sightings as unconfirmed and D. Urbston (personal communication) considers them all 'questionable.'

The last sighting accepted by Hamel (1977b) as valid was in Charleston County, S. C. in 1962.

If the Bachman's warbler still exists, most authorities agree that it is most likely in the I'On Swamp area in Charleston and Berkeley Counties, South Carolina.

RANGE MAP

Not provided.

STATES/COUNTIES

South Carolina: Berkeley(?), Charleston (?).

HABITAT

Nested in bottomland hardwood swamps.

FOOD AND FORAGING BEHAVIOR

Five stomach samples contained caterpillars and Hymenoptera (Meanley and Mitchell 1958).

SHELTER REQUIREMENTS

Dense understory of shrubs and vines within hardwood swamps.

NESTING OR BEDDING

They nest in low bushes or vines, 0.7 to 1 m off the ground (Wayne 1907), in nests constructed of dried weed and grass stalks and dead leaves, lined with black threads of pendent lichens (*Ramalina* sp.) (Widmann 1897).

RITUAL REQUIREMENTS

Not known.

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

Not known.

POPULATION NUMBERS AND TRENDS

Formerly locally abundant (Widmann 1897; Embody 1907). Formerly abundant during migration along the Suwannee River, Florida (Brewster 1891).

Present population, if any, unknown.

REPRODUCTION

Eggs are laid March through June with three to five eggs per set (Wayne 1907).

MANAGEMENT AND CONSERVATION

Shuler (1977b, 1977c, personal communication) suggests discontinuing of harvesting of bottomland hardwoods in the I'On Swamp, Francis Marion National Forest, South Carolina. R. Hooper (personal communication) suggests increased cutting to open up the canopy and thus allow secondary growth of shrubs and vines.

Extensive studies by U.S. Forest Service biologists Urbston and Hooper and Clemson University zoologist Hamel are underway to better define the status and requirements of the Bachman's warbler.

AUTHORITIES

Paul B. Hamel
Department of Zoology
Clemson University
Clemson, SC 29631

Robert G. Hooper
U. S. Forest Service
Southeastern Forest Experiment Station
Forestry Sciences Laboratory
2730 Savannah Highway
Charleston, SC 29407

Jay Shuler
P.O. Box 288
McClellanville, SC 29458

David F. Urbston
USDA Forest Service
Ouachita National Forest
Hot Springs, AR 71901

PREPARER'S COMMENTS

None.

LITERATURE CITED/SELECTED REFERENCES

- Barnes, I. R. 1954. A new look at Bachman's warblers. *Atlantic Nat.* 10:18-30.
- Bent, A. C. 1953. Life histories of North American wood warblers. *U.S. Natl. Mus. Bull.* 203. 734 pp.
- Brewster, W. 1891. Notes on Bachman's warbler (*Helminthophila bachmanii*). *Auk* 8:149-157.
- Chamberlain, G. B. 1958. Bachman's warbler in South Carolina. *Chat* 22:73-74, 77.
- Embury, G. C. 1907. Bachman's warbler breeding in Logan County, Kentucky. *Auk* 24:41-42.
- Evenden, F., D. Marshall, and W. Zeedgk. 1977. Revised final report of the Bachman's warbler Panel. 30 pp.
- Hamel, P. B. 1977a. Problem analysis for research to determine the status of Bachman's warbler, and the evolutionary, ecological, and historical factors associated with its decline. *U.S. For. Serv. Southeast. For. Exper. Stn., Charleston, SC. Contract* 18-409. 25 pp.
- . 1977b. Progress report, research to determine the status of Bachman's warbler, the ecological, evolutionary, and historical factors responsible for its decline. *U.S. For. Serv. Southeast. For. Exper. Stn., Charleston, SC. Contract* 18-409. 24 pp.
- Hamel, P. B., and R. G. Hooper. In press. The status of Bachman's warbler, a progress report. *Proc. Endangered Species Symp., Athens, Ga.*
- Hamel, P. B., R. G. Hooper, D. Urbston, and A. McDonald. 1977. Bachman's warbler breeding habitat: A hypothesis. Presented before 95th Annu. Mtg. Am. Ornithol. Union, Berkeley, Ca., 25 August 1977.
- Hamel, P. B., R. G. Hooper, and L. M. Wright. 1976. Where is the Reverend Bachman's warbler? *S.C. Wildl.*, March-April 1976: 9-13.
- Holt, G. G. 1920. Bachman's warbler breeding in Alabama. *Auk* 37:103-104.
- Hooper, R. G., and P. B. Hamel. 1977. Nesting habitat of Bachman's warbler: A review. *Wilson Bull.* 89(3):373-379.
- Howell, A. H. 1910. Notes on the birds of the sunken lands of southeastern Missouri. *Auk* 27:381-384.
- Howell, A. H. 1932. Florida bird life. Coward-McCann, Inc., New York. 597 pp.
- Meanley, B. and R. T. Mitchell. 1958. Food habits of Bachman's warbler. *Atlantic Nat.* 236-238.
- Shuler, T. 1977a. Three recent sight records of Bachman's warbler. *Chat* 41(1):11-12.
- . 1977b. Bachman's phantom warbler. *Birding* 9(6): 245-250.

- . 1977c. Bachman's warbler habitat. Chat 41(2):19-23.
- Shuler, T., P. Nugent, J. Trochet, and J. Vanos. 1978. Bachman's warbler observations continue in the l'On Swamp. Chat 42(2):23-24.
- Stevenson, H. M. 1938. Bachman's warbler in Alabama. Wilson Bull. 50:36-41.
- . 1972. A recent history of Bachman's warbler. Wilson Bull. 84:344-347.
- U. S. Department of the Interior. 1973. Threatened Wildlife of the United States. Compiled by Office of Endangered Species and International Activities, Bur. Sport Fish. Wildl., Resour. Publ. 114. U.S. Gov. Printing Office, Washington, D.C. 289 pp.
- Wayne, A. T. 1907. The nest and eggs of Bachman's warbler, *Helminthophila bachmanii* (Aud.), taken near Charleston, South Carolina. Auk 24:43-48.
- Widman, O. 1897. The summer home of Bachman's warbler no longer unknown. Auk 14: 305-309.

Biological Services Program

FWS/OBS-80/01.32
March 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States-

THE FLORIDA EVERGLADE KITE



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

FWS/OBS-80/01.32
March 1980

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—

THE FLORIDA EVERGLADE KITE

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: PAUL. W. SYKES, JR.

FLORIDA EVERGLADE KITE

Rostrhamus sociabilis plumbeus Ridgway

KINGDOM Animalia
 CLASS Aves
 ORDER Falconiformes
 FAMILY Accipitridae
 OTHER COMMON

NAMES Everglade kite, snail kite, Florida
 snail kite, snail hawk.

DATE

Entered into SWIS to be determined
 Updates 15 October 1976, 13 April 1977

LEGAL STATUS

Federal: Endangered (32 FR 4001, 11 March
 1967).

States: Endangered: Florida.

REASONS FOR CURRENT STATUS

Reduction of suitable habitat due to drainage of marshes is the primary reason for the kite's endangered status. By 1967, only 3,981 km² of the original 7,112 km² of Everglades remained undrained (Stieglitz and Thompson 1967, U.S. Department of the Interior 1973, Sykes 1979). Droughts and water management have also affected kite habitat by reducing populations of apple snails (*Pomacea paludosa*), the kite's only food source (U.S. Department of the Interior 1973).

The introduced water hyacinth (*Eichornia crassipes*) now covers the water surface in many areas, making it impossible for kites to locate apple snails (Sykes 1979).

Excessive human disturbance and malicious killings have also contributed to population declines (Stieglitz and Thompson 1967, Sykes 1979).

Potential factors of unknown importance include parasites transmitted by snails, weather pattern changes, and inbreeding due to reduced population size (Stieglitz and Thompson 1967).

Pesticide concentrations in snails, kites, and kite eggs are very low and probably do not present a threat (Stieglitz and Thompson 1967).

PRIORITY INDEX

Not assigned.

DESCRIPTION

The kite is a medium-sized hawk, 41 to 46 cm long, with a wingspan of 114 cm. Its beak is slender and strongly hooked. Adult males are slate gray with black head and wing tips, and a white patch at the base of the tail. Legs are orange-red. Females and immatures are buffy, heavily streaked with dark lines, with a white rump and yellow legs.

RANGE

The species ranges widely in the Neotropics, with three recognized subspecies. The Florida race is restricted to peninsular Florida and Cuba.

It formerly ranged over much of Florida, wherever suitable habitat occurred, including the following counties: Brevard, Broward, Collier, Dade, Flagler, Glades, Hendry, Highlands, Indian River, Jefferson, Lake, Monroe, Okeechobee, Orange, Osceola, Palm Beach, St. Lucie, Seminole, Sumter, Volusia, and Wakulla (Sykes 1979).

It is now restricted to the headwaters of the St. Johns River, the southwest side of Lake Okeechobee, a portion of Everglades National Park, a portion of the Loxahatchee National Wildlife Refuge, and small areas in Broward, Dade, and Palm Beach Counties (Sykes 1979).

RANGE MAP

Present distribution is adapted from Sykes (1979).

STATES/COUNTIES

Florida Broward, Dade, Glades, Indian River, Palm Beach, St. Lucie.

HABITAT

The species is typically found in freshwater marshes with a distant horizon. Favorable areas consist of shallow open water vegetated with sawgrass (*Cladium jamaicensis*) and spike-rushes (*Eleocharis* sp.). Flats, often interspersed with tree islands or small groups of shrubs and trees including dahoon holly (*Ilex cassine*), coastal plain willow (*Salix caroliniana*), wax myrtle (*Myrica cerifera*), and buttonbush (*Cephalanthus occidentalis*). Other common aquatics include waterlily (*Nymphaea odorata*), big floating heart (*Nymphoides aquatica*), maidencane (*Panicum hemitomon*), bulltongue (*Sagittaria lancifolia*), pickerelweed (*Pontederia lanceolata*), cattail (*Typha domingensis*), waterlettuce (*Pistia stratiotes*), and water hyacinth (Stieglitz and Thompson 1979).

Water levels may fluctuate so long as the surface does not completely dry (Sykes 1979). Habitat photographs appear in Stieglitz and Thompson (1967), Snyder and Snyder (1969), and Sykes (1979).

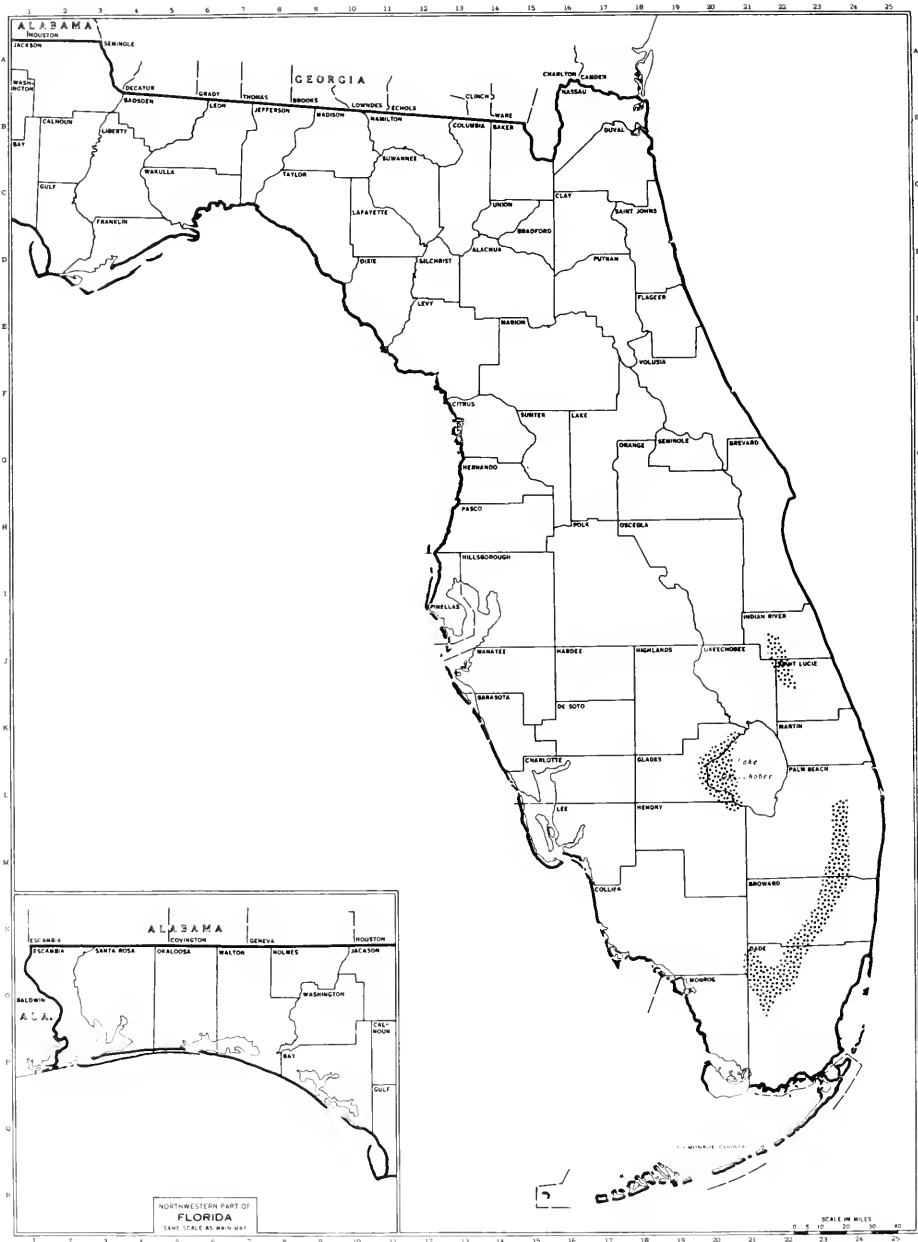
FOOD AND FORAGING BEHAVIOR

Snail kites feed only on the freshwater apple snail. They fly 1.5 to 9 m above the surface, descending when a snail is sighted. Snails are grasped with a single talon and are usually transferred to the beak in flight. They also sometimes hunt from perches. Snails are extracted and the shells discarded.

Captives will survive on horse meat and will take other species of snails. Their dependence upon apple snails in nature probably results from this snail's occurrence near the water's surface, unlike other large snails (Snyder and Snyder 1969).

SHELTER REQUIREMENTS

Not known.



The present distribution of the Everglades kite in Florida is depicted by shading.

NESTING OR BEDDING

Kites normally nest in loose aggregations, with 150 m or less between nests (Howell 1932, Bent 1937, Stieglitz and Thompson 1967). They often nest among or near other colonial nesters such as herons and egrets (Ardeidae) and Anhingas (*Anhinga anhinga*).

Nests are usually 1 to 3 m above the water in low trees or shrubs, although occasionally sawgrass or cattails are used for support (Howell 1932, Stieglitz and Thompson 1967, Sykes 1976). In the Loxahatchee marshes, nests are built in small cypress trees (*Taxodium* sp.) 2 to 3 m above the surface.

The nest is loose and bulky, 30 to 38 cm in diameter, and 20 to 30 cm deep. It is built of twigs and Spanish moss (*Tillandsia usneoides*) and lined with green grasses and vines (Bent 1937).

RITUAL REQUIREMENTS

An important part of the courtship display consists of the male carrying a small twig in his beak while flying and making a series of swooping dives with the wings folded (Stieglitz and Thompson 1967).

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

Adequate water levels are essential, as snail populations are drastically reduced when the marsh dries.

POPULATION NUMBERS AND TRENDS

Snail kite numbers have dropped drastically. Bent (1937) stated that kites were common in 1909, but that population levels had declined sharply by 1937, due to the draining of the Everglades. Estimates for 1973 were slightly over 100 individuals (Sykes 1979).

The total population of Florida Everglade kites has probably averaged close to 100 birds for the past 4 to 5 years, with 80% of the reproduction occurring on the southwest side of Lake Okeechobee (T. Martin personal communication). Seventeen young were fledged from 7 of 9 nests in 1968 (U.S. Department of the Interior 1973).

REPRODUCTION

The breeding season is variable and probably correlated with snail availability, rainfall, and/or temperature; generally, from February to June

(Howell 1932, Bent 1937). Average clutch size is two to four. Eggs are oval or elliptical and smooth, colored dull white with brown mottling (Bent 1937); average size is 44.2 by 36.2 mm (Bent 1937).

The male builds the nest, and both sexes incubate eggs and assist in rearing young (Bent 1937).

Courtship displays consist of soaring about 150 m above the marsh, folding the wings for sudden short dips, stretching the legs while diving as if to grapple, somersaulting while diving, and stick-carrying (Stieglitz and Thompson 1967).

MANAGEMENT AND CONSERVATION

In a 2-year habitat management study by Martin and Doebel (1973), water levels were raised on a 142-ha site in the Loxahatchee National Wildlife Refuge; plant density was controlled and snails were stocked. The first two techniques were successful, but stocking of snails had little effect on population level. Other methods will be implemented in a projected second experiment. Artificial nesting platforms have been successfully used to support nests that would otherwise be subject to damage from high winds or heavy rains (Sykes and Chandler 1974).

Kite response to management efforts was rapid and extremely favorable. Martin and Doebel (1973) concluded that continued research into life history of both snail and kite is critical to management success. They believe the kite can remain a part of our natural fauna only through sound management practices and maintenance of natural habitats. The American Ornithologists' Union (1975) states that the only solution for saving the kite is a very expensive land-acquisition program. Sykes (1979) makes several recommendations for preservation of the Everglade kite. These include purchasing and managing suitable kite habitat, providing protection during the hunting season, establishing a 0.4 km buffer zone closed to entry around nesting areas, maintaining adequate surface water in the kite areas, and researching both kite and apple snail biology.

Critical habitat has been designated (42 FR 47841, 22 September 1977) as parts of Dade, Broward, and Palm Beach counties and the western shore of Lake Okeechobee in Glades County.

AUTHORITIES

Thomas Martin
Loxahatchee National Wildlife Refuge
Route 1, Box 278
Delray Beach, FL 33444

Alexander Sprunt, IV
Natl. Audubon Society
115 Indian Mound Trail
Tavernier, FL 33070
Paul W. Sykes, Jr.
U.S. Fish and Wildlife Service
P.O. Box 2077
Delray Beach, FL 33444

Sykes, P. W., Jr., and R. Chandler. 1974. Use of artificial nest structures by Everglade kites. *Wilson Bull.* 86:282-284.

U.S. Department of the Interior. 1973. Threatened wildlife of the United States. Compiled by Office of Endangered Species and International Activities, Bur. Sport Fish. Wildl. Resour. Publ. 114. U.S. Govt. Printing Office, Washington, D.C. 289 pp.

PREPARER'S COMMENTS

None.

LITERATURE CITED/SELECTED REFERENCES

Amadon, D. 1975. Variation in the Everglade kite. *Auk* 92:380-382.

American Ornithologists' Union. 1975. Report of the committee on conservation. *Auk* 92 (4, Suppl.):1B-16B.

Bent, A. C. 1937. Life histories of North American birds of prey. Part I. U.S. Natl. Mus. Bull. 267. 409 pp.

Howell, A. H. 1932. Florida bird life. Coward-McCann, Inc. New York. 527 pp.

Martin, T. W., and J. H. Doebel. 1973. Management techniques for the Everglade Kite, preliminary report. Proc. S.E. Assoc. Game Fish Comm. Annu. Conf. 27:225-236.

Peterson, R. T. 1947. A field guide to the birds. Houghton Mifflin, Boston. 230 pp.

Snyder, N. F. R., and H. R. Snyder. 1969. A comparative study of mollusk predation by limpkins, Everglade kites, and boat-tailed grackles. *Living Bird* 8:177-223.

Sprunt, A., Jr. 1945. The phantom of the marshes. *Audubon Mag.* 47:15-72.

———. 1954. Florida bird life. Coward-McCann, Inc., and Natl. Audubon Soc., New York. 527 pp.

Stieglitz, W. O., and R. L. Thompson. 1967. Status and life history of the Everglade kite in the United States. Bur. Sport Fish. Wildl. Spec. Sci. Rep. Wildl. 198. 21 pp.

Sykes, P. W., Jr. 1979. Florida Everglade kite. Pages 4-7 in H. W. Kale ed. Rare and endangered biota of Florida, Vol. 2, Birds. Univ. Presses of Florida, Gainesville.

ACCOUNT PREPARED/UPDATED BY:

National Fish and Wildlife Laboratory
412 N.E. 16th Avenue, Room 250
Gainesville, FL 32601

Biological Services Program

FWS/OBS-80/01.33
March 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States- **PUERTO RICAN WHIP-POOR-WILL**



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—
PUERTO RICAN WHIP-POOR-WILL

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: C. B. KEPLER

PUERTO RICAN WHIP-POOR-WILL
Caprimulgus noctitherus (Wetmore)

KINGDOM Animalia
ORDER Caprimulgiformes
FAMILY Caprimulgidae
OTHER COMMON

NAMES Pajaro Bobo (Reynard 1962);
Guabairo Pequeno de Puerto Rico (Biaggi
1979 and Leopold 1963); Guabairo Chico
and Guaraiba (Bond 1936 and Wetmore
1916); Puerto Rican Nightjar (Leopold
1963).

DATE

Entered into SWIS. To be determined
Updates To be determined

LEGAL STATUS

Federal: Endangered (42 FR 36428, 14 July
1977). Protected by Migratory Bird
Treaty Act of July 2, 1918 (40
Stat. 755; 16 U.S.C. 703-711) as

amended Dec. 3, 1969. Public Law
91-135.

Puerto Rico: Listed as "very endangered."
Commonwealth "Wildlife Law"
protects all nongame bird species
including Puerto Rican Whip-poor-
Will.

REASONS FOR CURRENT STATUS

Wetmore (1927), Wadsworth (1949), and
Wolcott (1953) assumed that the exotic mongoose
(*Herpestes jarvanicus*), introduced in 1877, had
stripped the whip-poor-will population from
much its former more extensive range. Some of
this former range still has habitat that appears
suitable for whip-poor-wills, but also has rainfall
and standing water sufficient to support mon-
gooses.

At present, lowland semiarid scrubby forest
habitat is being reduced by expanding human
population and developing industries. A rapidly
expanding petrochemical industry is adjacent to
the Guayanilla whip-poor-will population, only 8

km east of the Guanica Forest which harbors the largest number of the remaining birds. The Commonwealth Forest system is not immune to industrial pressure and over 400 hectares were destroyed between 1968 and 1973 (Kepler and Kepler 1973).

PRIORITY INDEX

33

DESCRIPTION

The Puerto Rican whip-poor-will is a small ground-inhabiting nocturnal bird with fluffy, mottled brown, black, and gray plumage, a very short bill, and very wide mouth with long bristles. There is a white band across the throat and white spots at the ends of the tail feathers. It is similar to the North American whip-poor-will (*Caprimulgus vociferus*) but smaller, with much shorter wings, and plumage tending more toward brown and less toward gray throughout. Buff breast spots are more prominent; posterior underparts are deep cinnamon buff rather than pale buff. White or buff tips on three outer tail feathers are greatly restricted. The type specimen has the following measurements: wing 135 mm; tail 112 mm; bill 11 mm; tarsus 16.3 mm; middle toe without claw 16 mm (Wetmore 1919 and Wetmore in Reynard 1962; J. W. Aldrich personal observations 1977). Downy young are entirely reddish buff or cinnamon. Toes and legs are flesh gray. The iris is dark brown. Eyes open on the day of hatching (Kepler and Kepler 1973).

Authorities differ as to whether *noctitherus* is a distinct species or a subspecies of the North American whip-poor-will (*C. v. vociferus*). Wetmore (1919, 1922, 1927), Vincent (1966), Mayr and Short (1920), Fish and Wildlife (1973), Kepler and Kepler (1973), and Storrs Olson (pers. comm. 1977) prefer to consider it a distinct species, whereas Peters (1940), Bond (1945), and Greenway (1958) consider it a subspecies of *C. v. vociferous*. Vocalizations of *noctitherus*, described by Reynard (1962), are completely different in structure from *vociferous* and may serve to maintain reproductive isolation between two closely related species (Kepler and Kepler 1973). Storrs Olson (pers. comm. 1977) is impressed by the much smaller bones of *noctitherus*. The question of correct classification has no completely satis-

factory answer, but the preponderance of current thinking seems to favor classification as two distinct species.

RANGE

This species is confined to the island of Puerto Rico. It was formerly found in the moist limestone forest of the northwest coast. Specimens were taken in Bayamon in 1888 (Cory 1889, Wetmore in Reynard 1962, Peters 1940). Bones found in cave deposits near Morovis are estimated to be less than 2,000 years old (Wetmore 1919, 1922, 1927). A bird presumed to be this species was sighted at Rio Piedras (Wetmore 1916, 1919, 1927). All three of those localities were in the moist northwestern section of the island. More recent records are all from the dry limestone forest of the southwest coast, including two populations at Guanica and the hills above Guayanilla and one in Susua Commonwealth Forest. It probably once ranged over most of the coastal plain on both sides of the island, but now is probably confined to an area of about 3,200 hectares, or approximately 3% of its probable former range, the limestone regions, and only 0.7% of the total land surface of the island (Kepler and Kepler 1973).

Distribution of the Puerto Rican whip-poor-will has remained stable since 1969 (American Ornithologists' Union 1976).

MAP

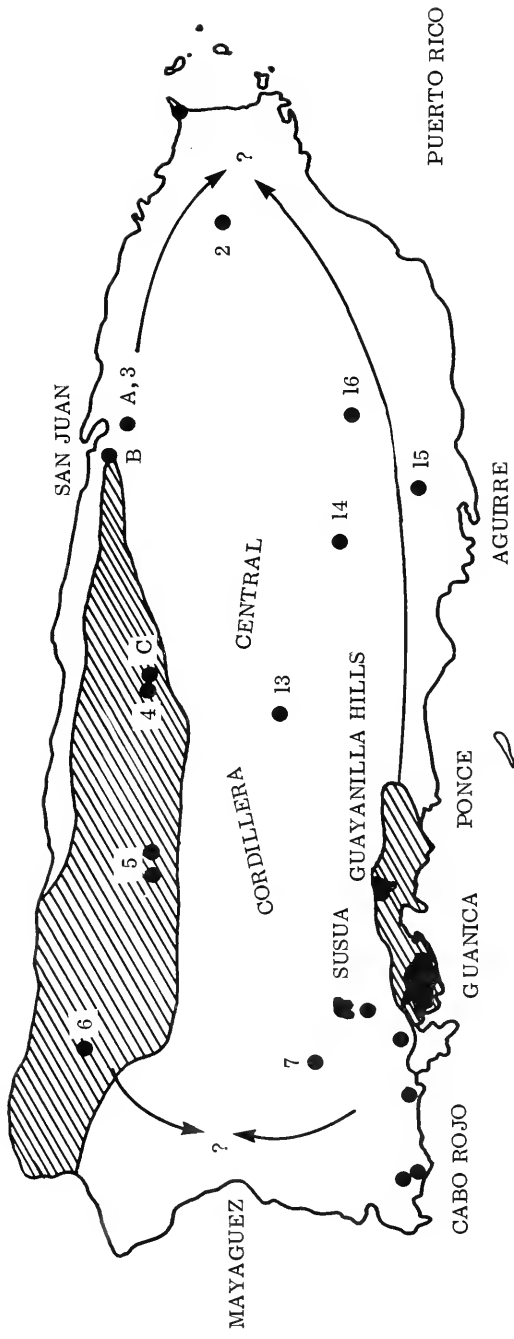
Past and present distribution (after Kepler and Kepler 1973) is shown on the following page.

STATES/COUNTIES

Commonwealth of Puerto Rico:

HABITAT

Habitat formerly included the moist limestone forest that covered most of the northwestern third of the island north of the Cordillera Central described by Little and Wardsworth (1964) and Kepler and Kepler (1973). Probably once occupied the dry limestone forest on southwestern part of the island as well, since they have been heard by residents there at least since 1900 (Reynard 1962). At present, they are known to occur only in the dry limestone forests of the southwestern area.



Past and Present Distribution

▨ Possible former range

● Present known distribution

A, B, and C - Locations of previous records

Numbers - Areas searched unsuccessfully

Range of the Puerto Rican whip-poor-will (from Kepler and Kepler, 1973).

The species frequents the drier, more open sections of the Susua Forest and has not been found in the riparian forests or the denser scrub at elevations above 350 m (Kepler and Kepler 1973). The Guanica forest, where whip-poor-wills occur most commonly, has an annual rainfall of 750 mm, contrasting with an annual water loss through evaporation and plant transpiration of 2,000 mm. The porous limestone permits no standing or running fresh water anywhere. Elevations range from sea level to 230 m. Semideciduous vegetation consists of hardwood trees on top of limestone hills, normally above 75 m. Below this, particularly on the southern slopes, forest changes to mixed cactus and semideciduous growth. The canopy is 4 or 5 m high, with some trees 6-7 m. Important species include *Pisonia alba*, *Swietenia mahogoni*, *Acacia farnesiana* and *Bursera simaruba*. There is no well-marked stratification or epiphytic flora. Whip-poor-will population centered on higher slopes of central hills coincident with semideciduous forest. They are largely absent from south-facing slopes below 75 m dominated by cactus, open patches of grassland and scrub, and thickets of *Agave* (Kepler and Kepler 1973).

Susua Commonwealth Forest is xeric scrub on steep rounded hills of decomposed serpentine soils. It receives 1500 mm of rain per year. The elevation is 100 to 430 m. Two permanent streams support a lush riparian plant life less than 100 m in width. Scrub 4-5 m high predominates 50 or more meters from streams and extends to hill tops, where it becomes much denser. The Puerto Rican whip-poor-will occurs here in small numbers but not in riparian habitat. Greatest numbers occur in open scrub forest with horizontal visibility from 5 to 7 m. None are found in denser sections where visibility dropped to 3 m. Susua Forest is considered suboptimal habitat for whip-poor-wills based on only one pair in 14.1 hectares as compared with one pair in no more than 6.9 hectares in Guanica Forest (Kepler and Kepler 1973).

FOOD AND FORAGING

The whip-poor-will captures flying insect prey by flying from perches well above the ground. It has favorite perches used regularly for feeding in the evening and ventures from forest canopy protection after dark to more

isolated trees for feeding perches (reported by Cotte in Kepler and Kepler 1973).

SHELTER REQUIREMENTS

It requires the shelter of low scrubby forest and undergrowth for daytime concealment and nesting (Kepler and Kepler 1973).

NESTING AND BEDDING

The species nests on leaf litter of the forest floor without additional nest material.

It roosts on the ground or on branches of trees beneath cover of leafy canopy (Kepler and Kepler 1973).

RITUAL REQUIREMENTS

Vocalizations are thought to proclaim territory possession and determine spacing of breeding pairs (Kepler and Kepler 1973).

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

Predation by introduced mongoose and domestic cats and dogs should be controlled; also overbrowsing of habitat by domestic livestock, particularly goats, should be prevented.

POPULATION NUMBERS AND TRENDS

Subfossil bones were found in a cave near Morovis (Wetmore 1919, 1922; Storrs Olson pers. comm. 1977). Cory (1889) reported receipt of a specimen later used as the type specimen. Wetmore (1919, 1922, 1927; Wetmore in Reynard 1962) during 10 months field work in Puerto Rico in 1911 and 1912 saw only one bird that he thought might belong to this species. It was thought to be extinct (Bond 1940; Greenway 1958) until rediscovered in 1961 near Guanica by Reynard (1962) who collected one male and heard six others nearby. Leopold (1963) estimated the Guanica population as about 25 pairs. Bond (1962) reported "numerous individuals heard on semi-arid hills near the coast." J. B. McCandless estimated that as many as 100 birds remained within the Guanica Forest (Kepler and Kepler 1973). During the period 1969-1971, total Guanica population was estimated at about 400 breeding pairs, based on a density of one pair per 6.9 hectares to one pair per 4.9 hectares (Kepler and Kepler

1973). Comparison with estimated densities of the European whip-poor-will suggests that the Guanica birds may be at maximum possible densities within their limited range.

In the Susua Commonwealth Forest 10 km to north of Guanica, and the hills behind Guayanilla 8 km to the east, the total population is estimated at about 80 pairs or one pair per 14.1 hectares, more than twice the area needed in Guanica Forest, indicating that Susua forest is suboptimal for whip-poor-wills (Kepler and Kepler 1973).

The total of all known populations is estimated at 450 to 500 breeding pairs, over 80% of which are in Guanica Commonwealth Forest.

The Puerto Rican whip-poor-will population has remained stable since 1969 when the first accurate data were obtained (American Ornithologists' Union 1976).

REPRODUCTION

Calling is at its peak in February in Guanica Forest, suggesting that territorial encounters are frequent and vigorous at that time, with possible emigration of young or subordinate birds from the central population (Kepler and Kepler 1973).

In a nest found 18 June 1969, 2 chicks were estimated to be 14 or 15 days old. A nest with 2 eggs 1 May 1971, hatched on 4 and 5 May. A nest with 1 egg, 1 July and 2 eggs 3 July, took 19 days for incubation (McCandless report to Kepler and Kepler 1973). Nesting occurs mid-April through early July. May and June probably are peak nesting months, but calling is maintained from February to May with low numbers calling in July in Guanica Forest. There may be two broods per year, although this has not been verified.

No nests are built; eggs are laid directly on leaf litter under scrub vegetation with canopy 4 to 6 m high (never in open areas).

Young wander a short distance (20 cm) from the nest on the third day after hatching and irregularly farther thereafter. They are able to fly on the 14th day.

Based on 3 nests, the clutch size is 2 eggs laid on successive days. Eggs are buffy brown with numerous brownish purple spots over the entire surface, and are only moderately cryptic against the substrate (Kepler and Kepler 1973) of dry leaf litter. Protective coloration of the incubating bird provides safety from predators. The incubating bird remains on eggs even when closely

approached. When driven from nest or chicks, adults engage in distraction display by flapping wings, spreading tail and opening mouth while on the ground (Kepler and Kepler 1973).

MANAGEMENT AND CONSERVATION

Although Susua and Guanica Commonwealth Forests are nominally protected, the tremendous industrial expansion to the east and possibly real estate development to the west threatens them both. These forests must be given additional recognition and protection from human use and domestic predatory and herbivorous animals, particularly goats, to assure the continued existence of the Puerto Rican whip-poor-will (Fish and Wildlife Service 1973; Kepler and Kepler 1973).

A recent favorable action has been the ruling by the Environmental Quality Board that any new industrial growth east of Guanica cannot be accompanied by increased air pollution. Emissions from existing oil refineries would have to decrease to accommodate new growth. Also, an attempt to use Guanica as a sanitary landfill site has been temporarily shelved.

The most recent serious threat is a proposed condominium complex on Punta Ballena, a privately owned tract 3.2 km south of the center of Guanica Forest. Several thousand people would be housed within easy walking distance of the whip-poor-wills, necessitating road and commercial development with the expected onslaught of people, cats, rats, and mongooses and the danger of fire (American Ornithologists' Union 1976).

The proposed sanitary landfill at Guanica Forest and highway development along its southern boundary remain threats (H. Rafael pers. comm. 1977).

AUTHORITIES

Cameron B. Kepler and Angela K. Kepler
R. R. Maalaea Rd.
Kula, Hawaii 96709

Ricardo Cottee
U.S. Fish and Wildlife Service
Atlanta, Georgia

Warren King
Smithsonian Institution
Washington, D.C.

Dr. James B. McCandless
P.O. Box 1060
Mayaguez, P.R. 00709

George B. Reynard
105 Midway
Riverton, N.J. 08077

James Wiley
Box 21
Palmer, Puerto Rico 00721

Noel Snyder
Patuxent Wildlife Research Center
Laurel, Md. 20810

PREPARER'S COMMENT

Obviously, the preservation of habitat is the key to survival of the Puerto Rican whip-poor-will. Vigorous action to preserve the approximately 3,200 hectares of occupied habitat, and particularly the 2,300 hectares of optimal habitat in Guanica Forest, and prevention of human interference there is the only way to save the species from extinction.

LITERATURE CITED/ SELECTED REFERENCES

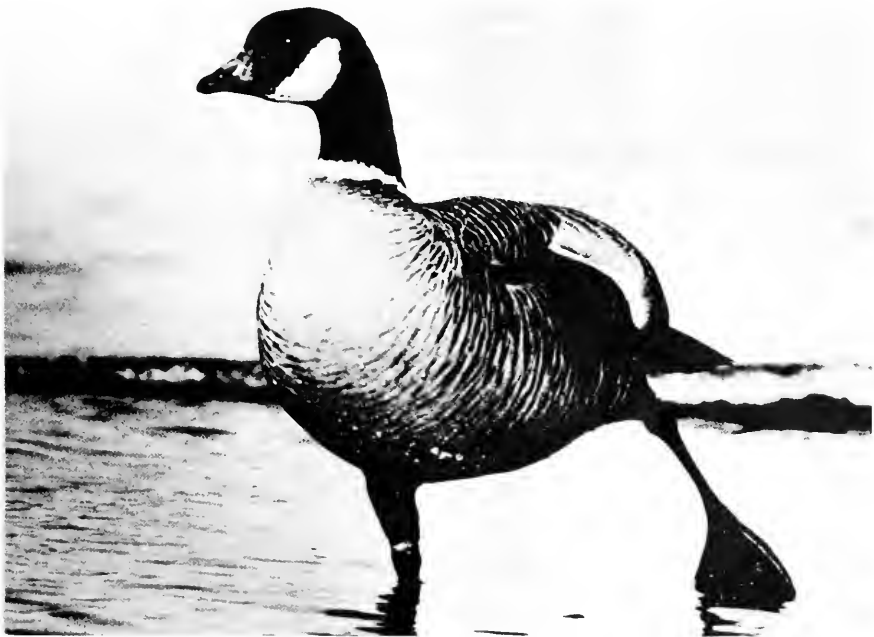
- American Ornithologists' Union. 1976. Report of the Committee on Conservation. *Auk* 93(4th Suppl.): 1DD-19DD.
- Biaggi, V. 1970. Las aves de Puerto Rico. Editorial Universitaria. Universidad de Puerto Rico. pp. 230-231.
- Bond, J. 1936. Birds of the West Indies. Acad. Nat. Sci. Philadelphia.
- Bond, J. 1940, 1945, 1962. Checklist of birds of the West Indies. Acad. Nat. Sci. Philadelphia.
- Cory, C. B. 1889. *Anrostomus vociferus* in Puerto Rico. *Auk* 6:276.
- Fish and Wildlife Service. 1973. Threatened Wildlife of the United States, 1973 Ed. U.S. Gov't. Print. Off.
- Greenway, J. C., Jr. 1958. Extinct and vanishing birds of the world. Amer. Comm. Internat'l. Wildlife Prot. Spec. Publ. 13, New York.
- Kepler, C. B. and A. K. Kepler. 1973. The distribution and ecology of the Puerto Rican whip-poor-will, an endangered species. *Living Bird*, Eleventh Annual Report Cornell Lab. Ornith.
- Leopold, N. F. 1963. Checklist of birds of Puerto Rico and the Virgin Islands. Bull. 168 Univ. Puerto Rico Agric. Exp. Sta., Rio Piedras.
- Little, E. L. and F. H. Wadsworth. 1964. Common trees of Puerto Rico and the Virgin Islands. U.S. Dept. of Agric. Handbook 249: 1-548.
- Mayr, E. and L. Short. 1970. Species taxa of North American birds, a contribution to comparative systematics. Publ. Nuttall Ornith. Club 9.
- McCandless, J. B. 1958. A field guide to the birds of Puerto Rico. Inter-American University Press, San German, Puerto Rico.
- Peters, J. 1940. Check-list of the birds of the world. Vol. 4:200. Harvard Univ. Press, Cambridge.
- Reynard, G. B. 1962. The rediscovery of the Puerto Rican Whip-poor-will. *Living Bird*, 1: 51-60.
- Vincent, J. 1966. Puerto Rico Whip-poor-will. *In*: Red data book. Vol. 2:Aves I.U.C.N. Survival Service Comm., Morges, Switzerland.
- Wadsworth, F. H. 1949. The development of the forest land resources of the Luquillo Mountains, Puerto Rico. Ph.D. Thesis University of Michigan.
- Wetmore, A. 1916. Birds of Puerto Rico. Bull. U.S. Dept. Agr. 326.
- Wetmore, A. 1919. Description of a Whip-poor-will from Puerto Rico. *Proc. Biol. Soc. Wash.* 32:235-237.
- Wetmore, A. 1922. Bird Remains from the caves of Puerto Rico. *Amer. Mus. Nat. Hist. Bull.* 46:297-333.
- Wetmore, A. 1927. The birds of Puerto Rico and the Virgin Islands. *New York Acad. Sci.* Vol. 9, pt. 4.
- Wolcott, G. N. 1953. The food of the mongoose (*Herpestes javanicus auropunctatus* Hodgson) in St. Croix and Puerto Rico. *Journl. Agric. Univ. Puerto Rico* 36:241-247.

Biological Services Program

FWS/OBS-80/01.34

MARCH 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States- **ALEUTIAN CANADA GOOSE**



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

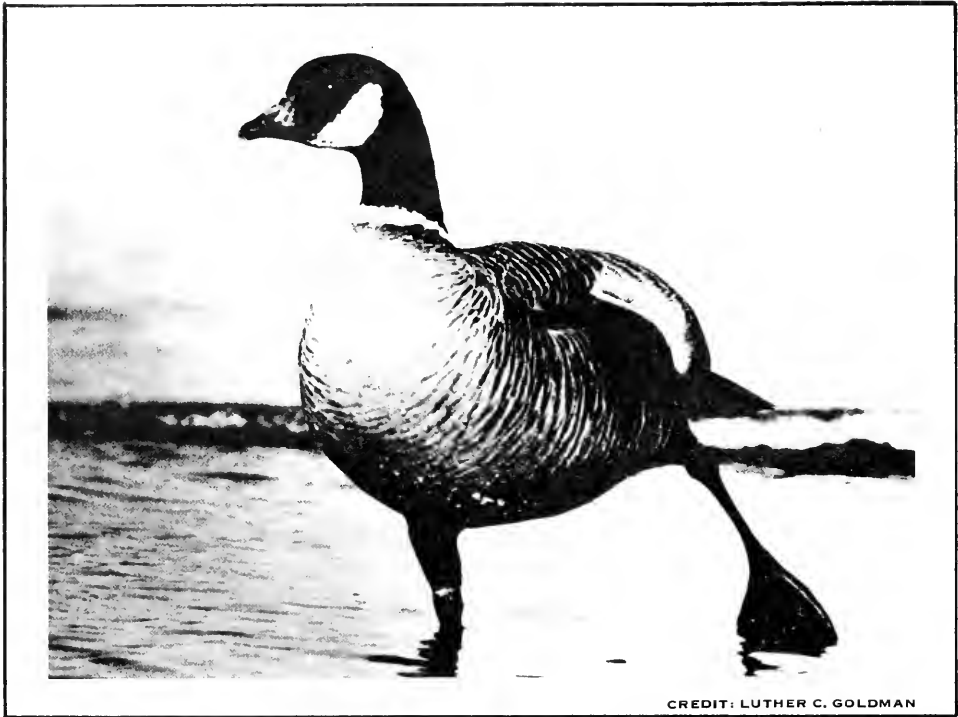
SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—

ALEUTIAN CANADA GOOSE

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: LUTHER C. GOLDMAN

ALEUTIAN CANADA GOOSE
Branta canadensis leucopareia (Brandt)

703-711) as amended Dec. 3, 1969.
 Public Law 91-135.

States: Endangered: Alaska.

KINGDOM Animalia
 ORDER Anseriformes
 FAMILY Anatidae
 OTHER COMMON

REASONS FOR CURRENT STATUS

The rapid population decline during the last 50 years and reduction of known breeding range to one small island is due primarily to introduction of arctic or blue foxes (*Alopex lagopus*) on the Aleutian Islands, although excessive hunting along the migration route and wintering grounds has probably contributed to the decline (Grinnell et al. 1918, Murie 1959, Jones 1963). Blue foxes have been introduced on almost every island in the Aleutian chain from Yunaska westward, excluding Attu which had an ancestral population of foxes (Jones 1963), primarily in the 1920's when fox fur commanded high prices. Large fox populations were produced rapidly and maintained. Buldir Island, the most isolated and inaccessible of the

NAMES. Hutchins' Goose; Turner 1886; Cackling Goose; Lesser Canada Goose; Legch; Luch or lugach or Lagix; land goose; Shjukara gan.

DATE
 Entered into SWIS. To be determined
 Update To be determined

LEGAL STATUS
 Federal: Endangered: (42 FR 36427, 14 July 1977). Migratory Bird Treaty Act of July 3, 1918 (40 Stat. 755; 16 U.S.C.

chain, is one of the few where foxes were not introduced and the only one known to have breeding Canada geese at present (Jones 1963, Springer et al. 1978). Possibly islands of the northern Kuril group where geese formerly bred may also be fox-free (Snow 1897).

Recovery of bands from Buldir Island geese (Springer et al. 1978) shows that hunting pressure in the interior valleys of California is a considerable mortality factor. Avian cholera present in the San Joaquin Valley produced some Aleutian Canada goose mortality (D. W. Woolington et al. unpubl. ms.).

PRIORITY INDEX

24

DESCRIPTION

The Aleutian Canada goose is a small goose, slightly larger than the mallard, with grayish brown body and black tail, neck, bill, feet and legs; white cheeks; a ring at the base of the black neck; and black belly, rump, and tail coverts. It is smaller and paler than *B. c. occidentalis* and about the same size and color as *B. c. taverneri*, except that adults almost always have a relatively wide white collar which *taverneri* usually lacks, and the bill is more tapered and pointed at the tip when viewed from above. Legs are relatively long. It is slightly larger than *B. c. minima*, with longer legs and a more tapered or pointed bill. The white collar is usually absent in *minima* (Delacour 1951, 1954; J. W. Aldrich ms.; Palmer 1976). Nelson (1883) commented on the conspicuous wide white collars of Aleutian Island Canada geese.

Size.- Male: wing 356 to 425 mm (av. 386.4 mm); tail 110 to 137 mm (av. 125.8 mm); exposed culmen 31 to 38 mm (av. 34.4 mm); tarsus 67 to 88 mm (av. 80.5 mm); middle toe without claw 58 to 69 mm (av. 63.2 mm).

Size.- Female: wing 358 to 390 mm (av. 372.6 mm); tail 110 to 130 mm (av. 122.8 mm); exposed culmen 30 to 35 mm (av. 32.7 mm); tarsus 69 to 80 mm (av. 74.2 mm); middle toe without claw 53 to 66 mm (av. 59.4 mm) (J. W. Aldrich ms.).

Shape of bill.- The more tapered bill of *B. c. leucopareia* is shown by the ratio of width of bill at base to width at tip (base of nail). Based on

averages of those measurements, bills of *leucopareia* are 7% more tapered than *taverneri* and 9% more tapered than *minima*. The more pointed appearance of *leucopareia* bills is due to greater length of the nail in proportion to its width. Based on ratio of nail length to width *leucopareia* bills are 8% more pointed than *taverneri* and 16% more pointed than *minima* (J. W. Aldrich ms.).

Weight.- A female specimen from Amchitka Island, 10 May 1959, 1927 g (Kenyon 1961); a female specimen from Amchitka Island, 10 June 1952, 1954 g (Krog 1953). Avg. (Johnson et al.): males - 1946 g (Buldir I.), 2110 g (California); females - 1703 g (Buldir I.), 1863 g (California).

Juvenile plumage is somewhat paler ventrally, with more blended overall coloring. The white neck ring is indistinct or absent (J. W. Aldrich ms., Palmer 1976, D. H. Johnson et al. unpubl. ms.). Downy young are brownish olive above, whitish yellow below.

RANGE

B. c. leucoparei formerly bred in the Commander and northern Kuril Islands, U.S.S.R., and the western Aleutian Islands from Attu east to Atka and Islands of Four Mountains (Nelson 1883, Turner 1886, Stejneger 1885 and 1887, Snow 1897, Clark 1910, Bent 1925, Jochelson 1933, Murie 1959, Delacour 1954, Johansen 1961); possibly also in Pribilof Islands (Delacour 1954), but not according to Nelson (1883). It now breeds only on Buldir Island in Aleutian Islands, as far as is known (Jones 1963, Murie 1959, Springer et al. 1978). The last breeding record for other Aleutian Islands was on Agattu in 1937 (Murie 1959). The species has apparently been extirpated on the Commander Island since 1914 (Johansen 1961).

This species formerly wintered in Japan (Austin and Kuroda 1953), and is reported also to have wintered from British Columbia south to California (Delacour 1951) and northwestern Mexico (Hansen and Nelson 1964). The population in Japan was reduced to one bird in the fall of 1978 (Y. Yokota pers. comm.). At present, it winters chiefly in the Sacramento and San Joaquin Valleys, Morro Bay, on the southeast Farallon Island of California, in the lower Colorado River Valley of Arizona and Mexico (Wollington et al. unpubl. ms.); and in northwestern Mexico near Obregon, Sonora (J. W. Aldrich ms.). There are

no definite winter records north of California (Springer et al. 1978).

In fall migration, the geese leave the Aleutian Islands breeding area as early as late August (Woolington and D. R. Yparraguirre unpubl. ms.) and early September (Byrd and Springer 1976), and move eastward along the Aleutian chain to possible staging areas on Unimak Island. They arrive on the northwestern California coast and in the Sacramento Valley between October and early November. They are not found north of there, suggesting that they fly directly overwater from the western Aleutians to the coast of northwestern California. From there, they move southward through the interior valleys of California to their wintering grounds (Springer et al. 1978, D. W. Woolington et al. unpubl. ms.).

The migrants move from their San Joaquin Valley wintering area to a staging area near Crescent City in northwestern California between middle of February and early March. They leave that staging area for the Aleutian Islands breeding grounds during the latter part of April, presumably flying directly northwestward over the Pacific Ocean, although several reports of unbanded specimens presumed to be Aleutian Canada geese have been received from the mouth of the Columbia River (Byrd and Springer 1976, Springer et al. 1978).

Confusion in taxonomy of Aleutian and Commander Islands populations of *Branta canadensis* has led to misconceptions, including the reported nesting of three subspecies, *hutchinsii*, *minima*, and *asiatica* in those islands (Bent 1912, 1925; Murie 1959; J. W. Aldrich 1946). Actually, only one subspecies, *leucopareia*, nests in the Aleutian Islands (Delacour 1954), and *B. c. asiatica* of the Commander Islands is now thought to be the same as *leucopareia* (J. W. Aldrich ms.; Austin and Kuroda 1953; Palmer 1976).

RANGE MAP

Past and present breeding areas and present wintering area from Byrd and Springer (1976) and Springer et al. (1978) are shown on the following range map.

STATES/COUNTIES

Alaska (localities): Attu I., Agattu I., Semichi Ids., Buldir I., Kiska I., Amchitka I., Tanaga I.,

Kanaga I., Adak I., Atka I., probably *taverneri* on underlined areas, Unimak I. and possibly on Izembek Bay, head of Morzhovoi Bay, Nelson Lagoon, Port Moller.

California (counties): Del Norte, Humboldt, Mendocino, Glenn, Colusa, Sutter, Yolo, Solano, Sacramento, Contra Costa, San Joaquin, Stanislaus, Merced, San Luis Obispo, Imperial, and San Francisco (southeast Farallon Island).

Arizona: Mohave.

Mexico: Sonora.

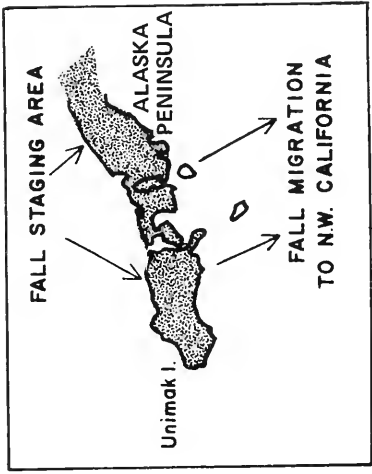
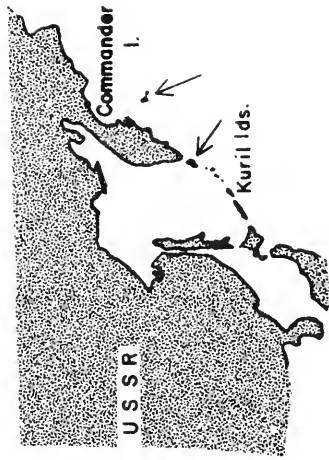
Japan: Hokkaido and Honshu I.

HABITAT

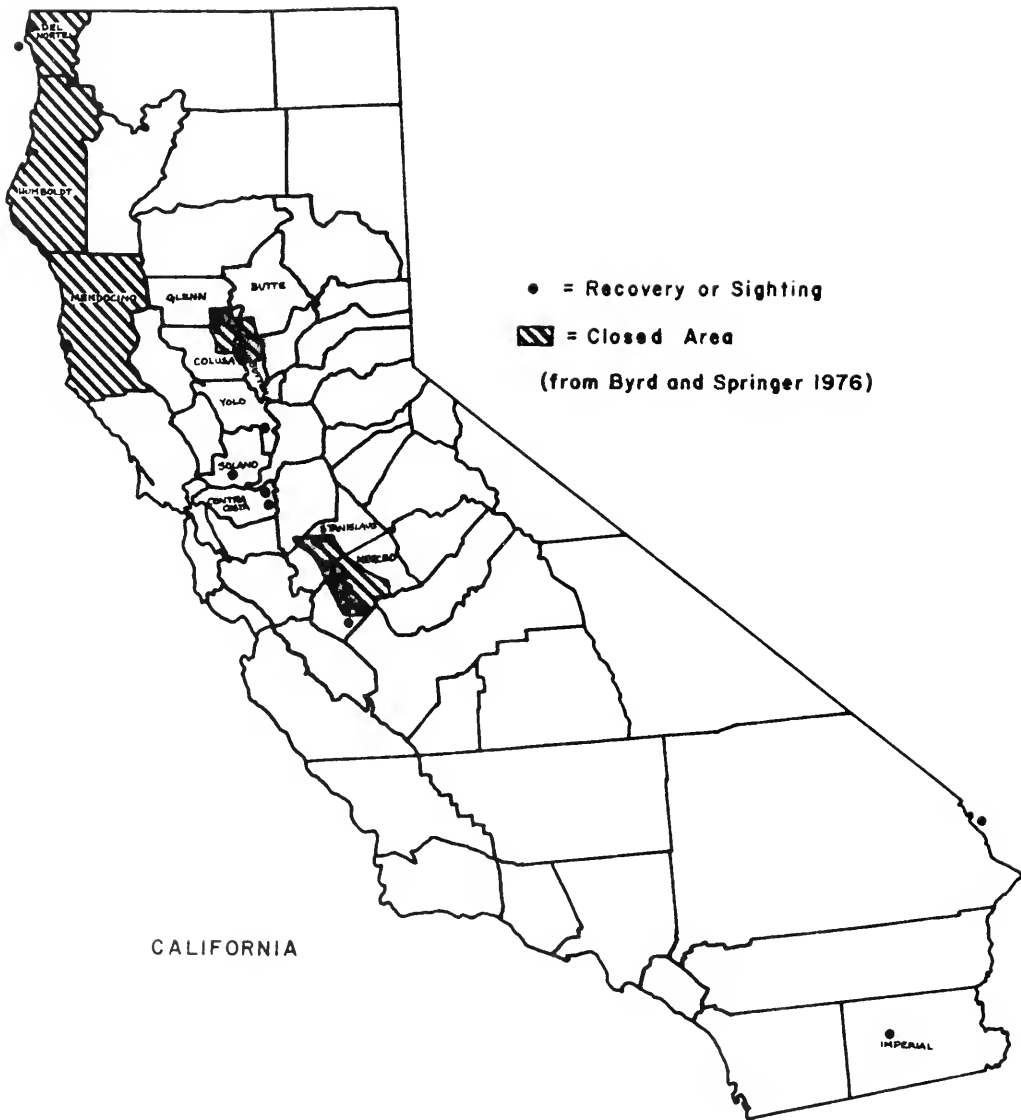
Nesting habitat was reported along the banks of small streams that enter the sea through gaps in high bluffs and on grassy hillsides on Agattu (Clark 1910), and in marshes and lagoons with rank aquatic vegetation on the Semichi Islands (Turner 1886). Nesting on rugged sea cliffs cut by watercourses where grasses and sedges grow in rank profusion was reported (not interior flatlands with ponds) on Buldir (Murie 1959, Jones 1963, G. V. Byrd and D. W. Woolington unpubl. ms.). Nesting habitat in the Aleutian Islands is characterized by polar maritime climate with high humidity, fog, rain, and small diurnal annual range of temperature (Jones 1963). Molting habitat is in the uplands. Night roosting habitat is shallow pools on mountainsides on Attu (Turner 1886); islands, ponds, and flooded fields in migration and wintering areas (D. W. Woolington et al. unpubl. ms.). Fall, winter, and spring habitats in California are fields from which lima bean, black-eyed bean, rice and corn have been harvested; green barley and wheat fields; and flood-irrigated and nonirrigated land (D. W. Woolington et al. and Springer 1977 unpubl. ms.).

FOOD AND FORAGING

The birds fatten in the fall on *Vaccinium* berries on Attu (Turner 1886) and on crowberries (*Empetrum migrum*) at Buldir (G. V. Byrd and



Present and former range and fall staging area of the Aleutian Canada goose



Wintering areas of the Aleutian Canada goose.

D. W. Woolington unpubl. ms.). The main food during the breeding season on Buldir Island is sedge (*Carex* sp.) and red fescue (*Festuca rubra*) (Byrd and Springer 1976).

At the northwestern California spring migration staging area, geese feed on fescue (*Festuca dertonensis*), velvet grass (*Holcus* sp.), plantain (*Plantago major*) and other plants (Byrd and Springer 1976).

SHELTER REQUIREMENTS

Flightless young and molting birds are hidden by over 1-m-tall rye grass (*Elymus arenarius*) and umbelliferous plants (*Heracleum lanatum* and *Angelica lucida*) on Buldir Island (Byrd and Springer 1976).

NESTING AND BEDDING

On Agattu, nests were composed of dead grass and a few feathers carelessly arranged (Turner 1886), plus large masses of light drab or dark gray down mixed with whitish down, numerous breast feathers and bits of straw (Bent 1925). On Buldir Island, the geese place nests on steep slopes under tall vegetation, mostly ryegrass (Byrd and Springer 1976, G. V. Byrd and D. W. Woolington unpubl. ms.).

RITUAL REQUIREMENTS

None Recorded.

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

None known other than protection from predation by introduced Arctic Foxes on breeding grounds and excessive hunting and disease on migration and wintering areas.

POPULATION NUMBERS AND TRENDS

Aleutian Canada geese formerly reared young in considerable numbers on the western Aleutian Islands and were domesticated by the natives (Nelson 1883; Turner 1886). They were the most abundant birds on Agattu, breeding by the thousands (Clark 1910); they were also common migrants throughout the Aleutian Islands area, nesting on many of the islands. Populations appeared greatly reduced by the 1936, 1937, and 1938 observations, as the species had disappeared from most of the islands and only a few pairs remained

anywhere (Murie 1959). On Amchitka, the 7 seen on 27 June and 2 on 5 July 1961 were the last observed on any Aleutian Island prior to their re-discovery on Buldir (Jones 1963). The last birds were recorded on the Commander Islands in 1914 (Johansen 1961).

In 1977 an estimated 170 breeding pairs (340 birds) and an undetermined number of non-breeders were located on Buldir Island (G. V. Byrd and D. W. Woolington unpubl. ms.).

A flock believed to be almost all Aleutian Canada geese at Crescent City in northwestern California peaked at 790 in mid-April 1975, at about 900 in late March 1976, and at 1150 in the spring of 1977 (Byrd and Springer 1976, Springer et al. 1978). This indicates a total population more than double the number of breeding birds on Buldir. It also indicates an increase from 1976 to 1977. The fall population in 1977 was 1600 (D. W. Woolington et al. unpubl. ms.).

REPRODUCTION

Turner (1886) said clutches of eggs of Aleutian Island geese vary from 7 to 13; Byrd and Springer (1976) noted that Buldir Island geese averaged about six eggs, laid in late May or early June. Incubation was 27-28 days, with over 80% of the nests hatching young. Glaucous-winged gulls eat some eggs and bald eagles take a few birds, but predation apparently is not severe (Byrd and Springer 1976). Turner (1886) noted that parent birds complete their molt by 20 August, at which time young are able to fly. G. V. Byrd and D. W. Woolington (unpubl. ms.) made similar observations on Buldir. Turner (1886) noted that a heavy snowfall in the latter part of June on Agattu and Semichi covered the ground to 3 ft (0.91 m), and incubating geese were found dead after the snow melted.

MANAGEMENT AND CONSERVATION

The Recovery Team prepared a plan with 4 objectives: 1) prepare habitat for goose reintroduction by removing fox; 2) produce adequate release stock of geese in captivity; 3) acclimatize and release birds and monitor results; 4) study and protect the wild birds (Byrd and Springer 1976).

Control of foxes, begun by Robert D. Jones, Jr. in the late 1940's, resulted in their complete elimination from Amchitka. To safeguard reintroduced geese, 3 areas were selected for fox removal,

widely separated to reduce the danger of local disasters such as earthquakes and tidal waves; these are Agattu (22,000 ha) with nearby Nizki/Alaid Islands (1300 ha), Amchitka Island (30,000 ha) and Kanaga Island (37,000 ha), all of which formerly had goose populations. Originally, foxes were eliminated by poison, but poisoning is now banned by law. Fifty-four foxes were taken on Agattu and 130 on Nizki/Alaid in 1974 and 1975. It was estimated that one or more foxes were left on Agattu in 1978 (D. W. Woolington and D. R. Yparraguirre unpubl. ms.) and none on Nizki/Alaid in 1976 (Springer et al. 1978). Fox control on Kanaga Island in 1977 removed 142 animals, leaving an estimated 700 plus (J. L. Martin pers. comm.).

Captive propagation began in 1963 with capture of 18 goslings on Buldir Island for transfer to breeding pens at Patuxent Wildlife Research Center, Laurel, Md., in 1966. Additional goslings were taken for that project in 1972 (21) and 1975 (20). Altogether over 451 goslings have been produced from 1966 through 1978 (R. C. Erickson pers. comm.).

To facilitate acclimatization and develop a tradition for homing to Aleutian Islands, a facility was developed on Amchitka Island in 1976 where goslings will be held to maturity before being released, and a second propagation facility was established on Amchitka. Twenty geese raised from Buldir goslings at Northern Prairie Research Center, together with 75 birds from Patuxent, were sent to Amchitka in fall 1977 to initiate that operation. In 1977 and 1978, 150 goslings were raised at Amchitka.

First release of 75 one- two- and three-year-old geese was on fox-free Amchitka in the spring of 1971, but all birds disappeared soon afterwards, some because of predation by bald eagles. The second release was on Agattu in the summer of 1974, when the island was almost fox-free and fox control was continuing. Four pairs of geese nested and 2 pairs raised 5 young. Other released geese remained near the release site all summer. Nine molting geese were brought to Agattu from Buldir to serve as guides for captive-reared birds in the fall migration. The geese departed Agattu on 4 September, headed east. In the winter and spring of 1974-75, three of the released birds, identified by white bands, were reported on the northwest coast of California. Released birds did not return to Agattu in 1975 nor were they found

on Buldir with the wild birds (Byrd and Springer 1976, Springer et al. 1978).

In the spring and fall 1976, a release of 30 pen-reared birds and 3 wild guide birds was again made on Amchitka. Most of the birds disappeared from unknown causes, but at least 5 were killed by eagles. Eight birds were recaptured and held at Amchitka (J. L. Martin pers. comm.). A fourth release of 117 pen-reared birds and 22 wild guide birds was made on Agattu in 1978; it is too early to determine the success of this effort (P. F. Springer pers. comm.).

Monitoring of geese banded on Buldir and Agattu has now established fairly well their migration routes, their principal wintering areas in California, and their staging area for spring migration. Further plans for monitoring include careful counts at Castle Rock spring staging area in northwestern California and several likely spots to the north for migrants. Some captive-reared and wild geese are equipped with colored neck collars for easier location.

Based on times and places of band recoveries and sightings in 1975, the California Department of Fish and Game closed the northwest coastal counties of Del Norte, Humboldt, and Mendocino, to hunting for the entire 1976 season, and also closed part of the Sacramento Valley in Glenn and Colusa counties from the opening of the season in mid-October to mid-December, and part of the San Joaquin Valley in San Joaquin, Stanislaus, and Merced counties from mid-December to the close of the season in mid-January. Subsequently, on the basis of additional recoveries, the closed area of the Sacramento Valley was extended to include parts of Butte and Sutter counties and the San Joaquin Valley closure now starts during the last week in November. Because of lack of recoveries or sightings of banded wild birds in Mendocino County, this county was reopened to Canada goose hunting in 1977. It seems probable that the increased goose population in California since 1975 is due to the restrictions on hunting.

AUTHORITIES

Dennis W. Woolington
Paul F. Springer
Wildlife Research Station
Humboldt State University
Arcata, California 95521

G. Vernon Byrd
Aleutian Islands N.W.R.
Box 5251
Adak, Alaska 98791

Hawaiian Islands N.W.R.
Box 87
Kilauea, Kannaï, Hawaii 96754

Ray C. Erickson
Patuxent Wildlife Research Center
Laurel, Maryland 20811

Robert D. Jones, Jr.
U.S. Fish and Wildlife Service
1011 E. Tudor Rd.
Anchorage, Alaska 99507

Daniel R. Yparraguirre
California Department of Fish and Game
2166 Carriro Brazos
Pleasanton, California 94566

Karl W. Kenyon
11964 Lakeside Place
N.E. Seattle, Washington 98125

PREPARER'S COMMENTS

Good progress has been made in management of the Aleutian Canada Goose. If the recovery plan is carried out, particularly with respect to fox control and reintroduction of geese in Aleutian Islands and hunting control in migration and wintering areas, the prospects look very good for recovery — John W. Aldrich.

LITERATURE CITED/SELECTED REFERENCES

- Aldrich, J. W. 1946. Speciation in the white-checked geese. *Wilson Bull.* 58:94-103.
- Austin, O. L., Jr. and N. Kuroda. 1953. Birds of Japan. *Bull. Mus. Comp. Zool. Harvard* 109(4).
- Bent, A. C. 1912. Notes on birds observed during a brief visit to the Aleutian Islands and Bering Sea in 1911. *Smithsonian Misc. Colls.* 56(32): 1-29.
- Bent, A. C. 1925. Life histories of North American Wild Fowl. Part II. *U.S. Nat. Mus. Bull.* 130.
- Byrd, G. V., and D. W. Woolington. Breeding biology, habitat utilization and population structure of Aleutian Canada geese on Buldir Island. Unpublished manuscript. Aleutian Islands National Wildlife Refuge. 110 p.
- Byrd, G. V. and P. F. Springer. 1976. Recovery program for the endangered Aleutian Canada goose. *Cal-Neva Wildlife Transactions* 1976: 65-73.
- Clark, A. H. 1910. The birds collected and observed during the cruise of the United States Fisheries steamer "Albatross" in the North Pacific Ocean, and in the Bering, Okhotsk, Japan, and Eastern Seas, from April to December 1906. *Proc. U.S. Nat. Mus.* 38:25-74.
- Delacour, J. 1951. Preliminary note on the taxonomy of Canada Geese, *Branta canadensis*. *Amer. Mus. Novits.* 1537:1-10.
- Delacour, J. 1954. The Waterfowl of the world. Vol. 1. London. Country Life Limited.
- Grinnell, J., H. C. Bryant, and T. I. Storer. 1918. The game birds of California. University of California Press, Berkeley. 642 pp.
- Hansen, H. A., and H. K. Nelson. 1964. Honkers large and small. P. 109-124 in J. P. Linduska, ed. *Waterfowl Tomorrow*. U.S. Fish and Wildlife Service. 770 pp.
- Jochelson, W. 1933. History, ethnology, and anthropology of the Aleut. *Carnegie Inst. Wash. Publ.* 432. 91 pp.
- Johansen, H. 1961. Revised list of the birds of the Commander Islands. *Auk* 78:44-56.
- Johnson, D. H., D. E. Timm, and P. F. Springer. Morphological characteristics of Canada geese in the Pacific Flyway. Paper to be presented at Symposium on Biology and Management of Pacific Flyway Geese, Portland, Or., Feb. 16, 1979. 24 pp.
- Jones, R. D., Jr. 1963. Buldir Island, site of a remnant breeding population of Aleutian Canada Geese. *Ann. Rep. Wildfowl Trust* 14: 80-84.
- Kenyon, K. W. 1961. Birds of Amchitka Island Alaska, *Auk* 78:305-320.
- Krog, J. 1953. Notes on the birds of Amchitka Island, Alaska. *Condor* 55:299-304.
- Murie, O. J. 1959. Fauna of the Aleutian Islands

- and Alaska Peninsula. North Amer. Fauna. 61:364 pp.
- Nelson, E. W. 1883. Birds of the Bering Sea and the Arctic Ocean. Cruise of the Revenue-Steamer Corwin in Alaska and the N.W. Arctic Ocean in 1881. Washington, D.C. Government Printing Office.
- Palmer, R. S. *ed.* 1976. Handbook of North American Birds, Vol. 2. New Haven, Yale Univ. Press. p. 211.
- Snow, H. J. 1897. Notes in the Kuril Islands. Royal Geographical Society, London. 91 pp.
- Springer, P. F., G. V. Byrd, and D. W. Woolington. 1978. Reestablishing Aleutian Canada geese. P. 331-338 *in* S. A. Temple, ed. Endangered birds: management techniques for threatened species. University of Wisconsin Press, Madison. 446 pp.
- Stejneger, L. 1885. Results of ornithological expeditions in the Commander Islands and Kamschatak. Bull. U.S. Nat. Mus. 29:1-382.
- Stejneger, L. 1887. Revised and annotated catalogue of the birds inhabiting the Commander Islands. Proc. U.S. Nat. Mus. 10:117-145.
- Turner, L. M. 1886. Contributions to the natural history of Alaska. Results of investigations made chiefly in the Yukon, District and the Aleutian Islands; conducted under the auspices of the Signal Service United States Army, extending from May, 1874, to August, 1881. No. II. Arctic Series of Publications in connection with the Signal Service, U.S. Army. Washington, Government Printing Office.
- Woolington, D. W., P. F. Springer, and D. R. Yparraguirre. Migration and wintering distribution of Aleutian Canada geese. Paper to be presented at Symposium on Biology and Management of Pacific Flyway Geese, Portland, Or., Feb. 16, 1979. 11 pp.
- Woolington, D. W., and D. R. Yparraguirre. Progress report on restoration of Aleutian Canada geese on Agattu Island, 1978. Unpublished manuscript. Aleutian Islands National Wildlife Refuge. 74 pp.

Biological Services Program

FWS/OBS-80/01.35
MARCH 1980

**Selected Vertebrate Endangered Species
Of the Seacoast of the United States-**

WEST INDIAN MANATEE



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES

WEST INDIAN MANATEE

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior

winter range. During exceptionally cold weather, water temperatures suitable for the animals may not be maintained. During the prolonged and exceptionally cold winter of 1976-77, 34 manatees died in northern and central Florida in areas north of their historic winter range; many of them had been associated with power plant effluents (Campbell and Irvine 1978).

PRIORITY INDEX

Not assigned.

DESCRIPTION

The manatee is a large gray or brown fusiform aquatic mammal that lacks a dorsal fin. It is nearly hairless except for stiff whiskers covering the muzzle and widely scattered, fine hairs on the back. The forelimbs are modified into flippers, and the paddle-shaped tail is flattened horizontally. Hind limbs are absent. The sexes are distinguished by the position of the genital opening; the distance from the anus is greatest in males. Within its range, the manatee is the only large aquatic mammal exhibiting these characteristics.

Manatees are usually 3 m long, with a maximum length of 4.6 m reported (Hartman 1979b). Adult weights range between 360 and 540 kg, with a maximum of approximately 1,000 kg (Hartman 1979b).

Illustrations of manatees have been published in many popular and scientific articles: Simpson (1930), Ledbetter (1960), Walker, et al. (1964), Hartman (1969), Stephens (1972), Okeefe (1973), Viemeyer (1974), Campbell and Powell (1976), Hartman (1979a), and Reynolds (1979).

RANGE

During the winter months, U.S. populations appear to be restricted to peninsular Florida, south of Crystal River on the Gulf coast and Titusville on the Atlantic coast. In the St. Johns River, the animals occur from Jacksonville south to at least Lake Monroe (Layne 1965; Hartman 1974).

During the winter, manatees in northern and central Florida congregate around natural and industrial warm-water sources (see Hartman 1974 for a list of sites). Winter distribution has expanded northward during the last few decades from 27° 52' to 39° 21' on the east coast and from 26° 45'

to 27° 45' on the west coast. The expansion is probably due to the proliferation of industrial and power-generating plant warm-water discharges (Moore 1951b, 1953; Layne 1965; Hartman 1974).

During the summer, manatees that congregate at winter warm water refugia appear to disperse, moving north along the Atlantic and Gulf coasts, occasionally as far as the Carolinas and extreme western Florida. Rarely, sightings are reported in Louisiana and Mississippi and historic records document sightings as far north as New Jersey (Hartman 1974, Campbell and Powell 1976). Sightings north of Georgia are unusual and may represent vagrant individuals. Historic information suggests that the northern Gulf of Mexico coast may once have been more frequented by manatees during the summer than it is now (Lowery, 1974). It is unlikely that manatees could survive there in the winter due to the low water temperatures.

Occasional sightings in extreme southern Texas may represent remnants of a population on the northern Mexico Gulf coast (Husar 1977).

Trichechus manatus occurs around many of the Caribbean islands: Puerto Rico, Hispaniola, Jamaica, Cuba, and Andros (Husar 1977). Recent sightings have been reported for Grand Bahama Island (Odell et al. 1968).

In Central and South America, the West Indian manatee occurs from at least central Mexico south along the coast to the region of Alagoas State, Brazil (Bertram and Bertram 1973, Whitehead 1977). It also penetrates the Orinoco River in Venezuela to Apure Falls (Mondolfi, 1974) and up the Amazon River an undetermined distance (Bertram and Bertram 1973).

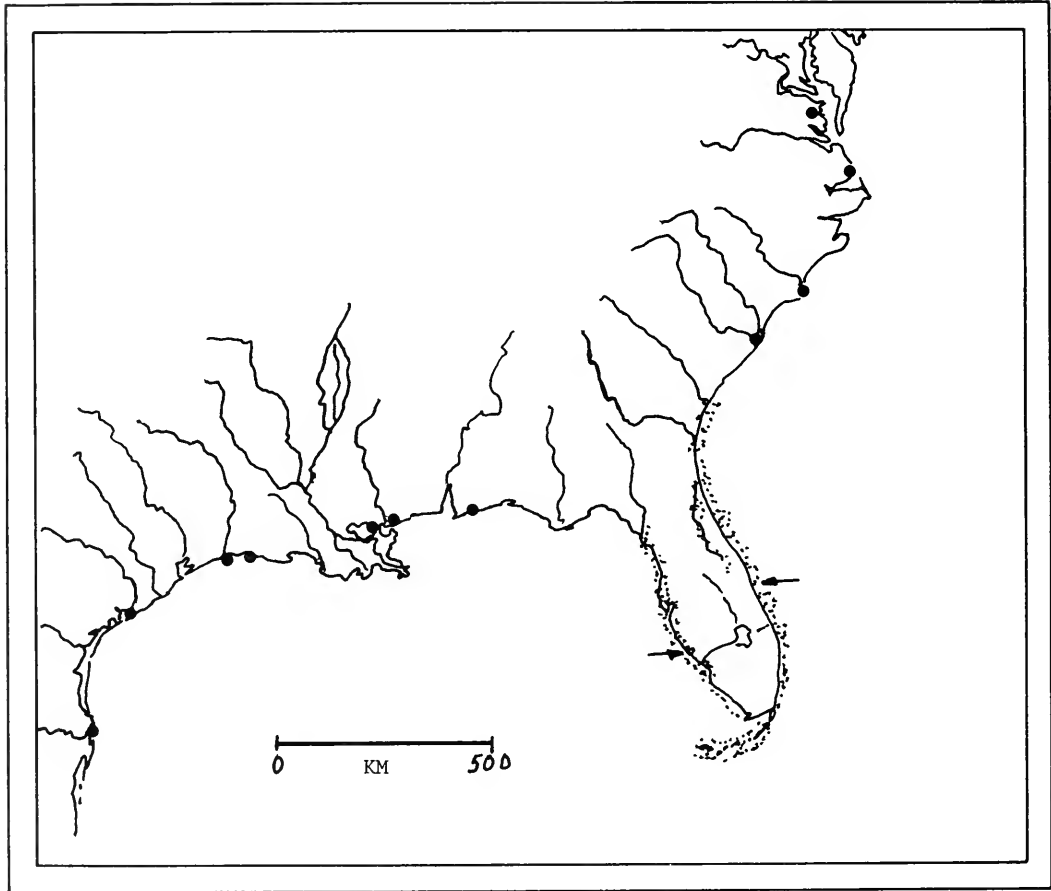
RANGE MAP

The range maps (following) show the present distribution, historic range, peripheral sightings, and critical habitat of the West Indian manatee in the United States.

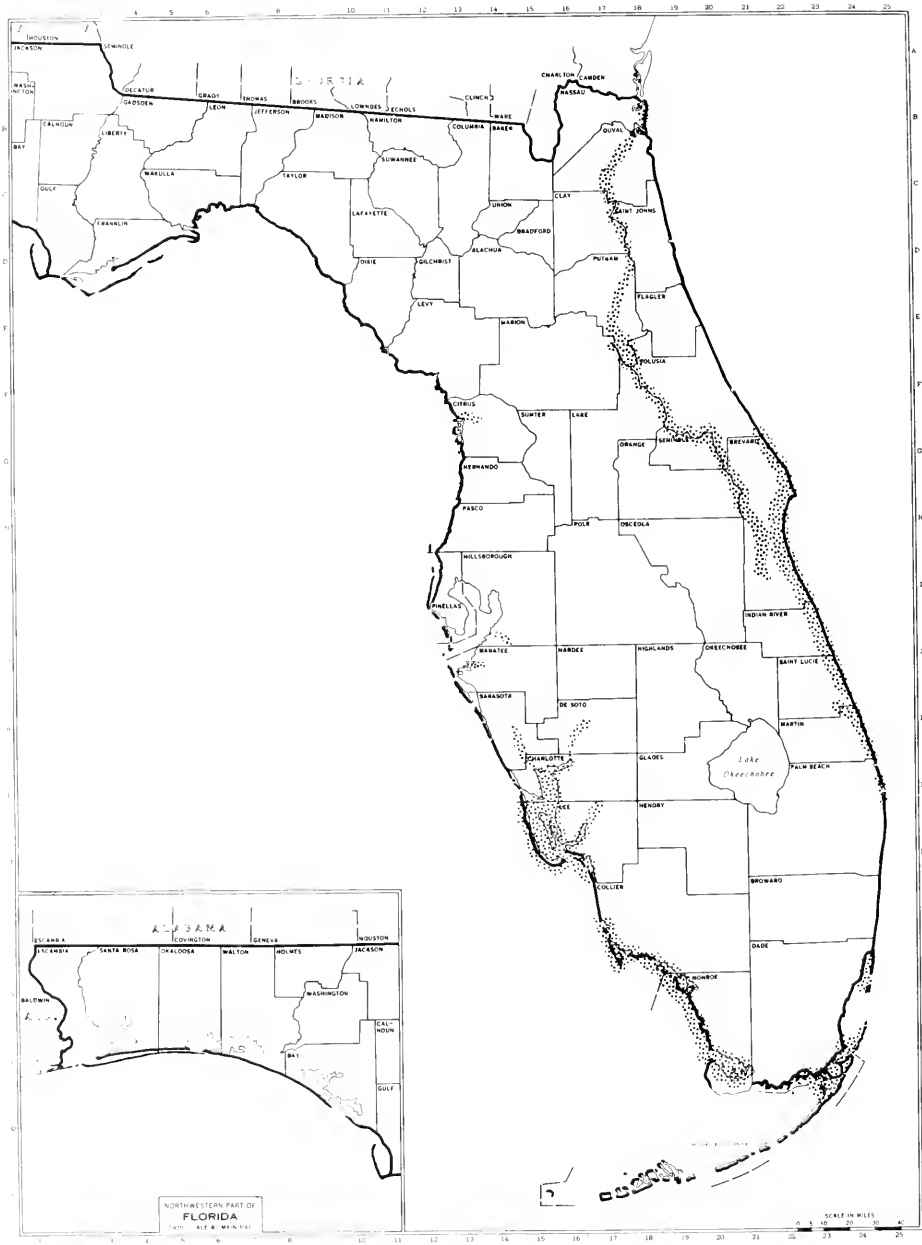
STATES/COUNTIES

Alabama: Baldwin, Mobile.

Florida: Bay, Brevard, Broward, Charlotte, Citrus, Clay, Collier, Dade, De Soto, Dixie, Dural, Escambia, Flagler, Franklin, Gilchrist, Glades, Gulf,



Distribution of *T. manatus* in the southeastern United States (shaded area: summer distribution; dots: peripheral sightings; arrows; northern limits of historic range)



Critical habitat of *Trichechus manatus* in the United States.

Hendry, Hernando, Highlands, Hills-Borough. Indian River, Jefferson, Lake, Lafayette, Lee, Levy, Manatee, Marion, Martin, Monrow, Okaloosa, Okeechobee, Orange, Osceola, Palm Beach, Pasco, Pinellas, Polk, Putnam, St. Johns, St. Lucie, Santa Rosa, Sarasota, Seminole, Suwannee, Taylor, Volusia, Wakulla, Walton.

Georgia: Bryan, Camden, Chatham, Glynn, Liberty, McIntosh.

Louisiana: (Parishes): Cameron, Iberia, Jefferson, Lafourche, Plaquemines, St. Bernard, St. Mary, Terrebonne, Vermilion.

Mississippi: Hancock, Harrison, Jackson.

North Carolina: Beaufort, Bertie, Brunswick, Camden, Carteret, Chowan, Currituck, Dare, Hyde, New Hanover, Onslow, Pamlico, Pasquotank, Pender, Perquimans, Tyrrell, Washington.

South Carolina: Beaufort, Berkeley, Charleston, Colleton, Georgetown, Horry.

Texas: Aransas, Brazoria, Calhoun, Cameron, Chambers, Galveston, Jefferson, Kennedy, Kleberg, Matagorda, Nueces, Wilacy.

HABITAT

Manatees inhabit both fresh and salt water of sufficient depth (1 meter or more) throughout their range. They may be encountered in waterways with access to coastal habitats, including canals, sluggish rivers, estuaries, and saltwater bays. They also have been seen as far as 6 km off the coast of Florida in the Gulf of Mexico (Hartman 1974). Between October and April in Florida, manatees concentrate near warm water (Hartman 1974, 1979), but during other months they appear to choose areas with adequate food near sources of fresh water (Huser 1977, Hartman 1979a).

FOOD AND FORAGING BEHAVIOR

Manatees consume almost any vegetation available. Comprehensive lists of plant species recorded in their diet have been published by Hartman (1971) and Campbell and Irvine (1977).

Emergent and floating plants, and even vegetation along the shore are acceptable but they prefer submergents, emergents, and floating vegetation in that order (Hartman 1979a). A partial list of plants known to be eaten by manatees illustrates the variety of their diet:

Floating fern (*Ceratophyllum pteridoides*)
Pondweed (*Diplanthera wrightii*)
Water-hyacinth (*Eichhornia crassipes*)
Waterweed (*Elodea*)
Hydrilla (*Hydrilla verticillata*)
Water milfoil (*Myriophyllum*)
Widgeon grass (*Ruppia maritima*)
Manatee-grass (*Syringodium filiforme*)
Turtle grass (*Thalassia testudinum*)
Eelgrass (*Vallisneria neotropicalis*)
Saw palmetto (*Serenoa repens*)
Various types of algae

While generally considered completely herbivorous, there are instances of wild manatees feeding on fish (Powell 1978) and captive manatees will take fish if available (Jenkins 1979).

SHELTER REQUIREMENTS

During hurricanes, manatees may seek shelter in protected bays and canals (Hartman 1971).

NESTING OR BEDDING

Not applicable.

RITUAL REQUIREMENTS

Not applicable.

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

Manatees are adapted to both fresh- and salt-water habitats. Dependence on freshwater for drinking has been suggested by Hartman (1974, 1979a). Saltwater populations often congregate around sources of freshwater, such as offshore springs, river mouths, and marina water hoses.

Numerous accounts of manatee deaths following cold weather in Florida suggest that winter temperatures at the margin of their range may be a limiting factor for U.S. populations (Bangs 1895; Cahn 1940; Hamilton 1941; Kromholz 1943; Moore 1951b, 1956; Layne 1965). Water temperature below approximately 20° C stimulates movement into warm water refugia (Hartman 1974,

1979a; Powell 1978; Powell and Waldron 1978).

POPULATION NUMBERS AND TRENDS

Hartman (1974, 1979a) estimated the U.S. population at 750 to 850 animals with possible extremes of 600 and 1,000. More recent surveys (Irvine and Campbell 1978) suggest a minimum population between 750 and 900 animals, while Brownell et al. (1978) estimated a U.S. population of 1,000 or more.

No accurate historical population estimates are available, but numbers today are believed to be reduced compared to historical levels (Hartman 1971). Concern for reduced population levels was expressed as early as 1880 by LeBaron and 1885 by Canova. All populations throughout the species' range are believed to be critically reduced (Bertram and Bertram 1973).

United States populations appear to be increasing in some areas, decreasing in other areas, and remaining stable in some regions (Hartman 1974). Husar (1977) suggested that numbers were increasing, but Brownell et al. (1978), based on mortality figures, thought it more likely that an overall decline was occurring.

REPRODUCTION

Mating generally involves the pursuit of an estrous female by a group of courting males (Hartman 1979a). Gestation, as estimated from a captive conception and birth, is 365 days (Dekker 1977). The manatee is basically uniparous, with the possibility that twinning may occasionally occur (Hartman 1979a). Hartman (1979a) believed that there was no specific breeding season, but recovery of dead calves suggests that most of them are born in the spring and early summer (Hartman 1979a, Irvine et al. 1978). Calves are born and nursed in the water and are believed to remain with the female for up to 2 years. Reproductive maturity may be reached at 7 to 10 years (Odell et al. 1978).

The most commonly observed social unit is the cow and her calf, but larger social groups of unknown composition are observed, especially around limited resources such as warm water refugia (Hartman, 1979a).

Natural longevity is unknown, although an individual has been kept in captivity in Florida for over 29 years (Brownell et al. 1978).

MANAGEMENT AND CONSERVATION

In addition to the Endangered Species Act, manatees are protected in the United States by the Marine Mammal Protection Act of 1972 (PL 92-522; 80 stat 1027) and by various State laws, such as the Florida Manatee Sanctuary Act. Manatees are also protected in every country throughout their range, although enforcement efforts are ineffective in most areas.

The most immediate conservation need in the United States is for management (Wray 1976). Especially critical is the reduction of mortality caused by boat strikes and entrapment in water control structures (Hartman 1974, Campbell and Powell 1976, Brownell et al. 1978).

The State of Florida has designated Blue Spring State Park as a manatee sanctuary and Brevard County, Florida, has declared itself a manatee sanctuary. De facto sanctuaries exist in the Everglades National Park, various National Wildlife Refuges throughout Florida, and several Florida State Parks. Critical Habitat was designated in 1976 (41 FR 41916, 24 September 1976) (see range maps).

AUTHORITIES

Edward Asper

Seaworld of Florida
7007 Seaworld Drive
Orlando, FL 32809

Robert L. Brownell, Jr. (Recovery Team)
National Fish and Wildlife Laboratory
Museum of Natural History
Washington, D.C. 29560

John C. Oberheu (Recovery Team Leader)
Jacksonville Area Office
U.S. Fish and Wildlife Service
900 San Marco Blvd.
Jacksonville, FL 32207

Daniel K. Odell
School of Marine and Atmospheric Sciences
University of Miami
4600 Rickenbacker Causeway
Miami, FL 33149

Galen B. Rathbun
National Fish and Wildlife Laboratory
412 N.E. 16th Ave., Room 250
Gainesville, FL 32601

Patrick M. Rose
Florida Audubon Society
P.O. Drawer 7
Maitland, FL 32751

PREPARER'S COMMENTS

Literature reviews and bibliographies on *Trichechus manatus* are numerous.

LITERATURE CITED/SELECTED REFERENCES

- Allsopp, W. H. L. 1969. Aquatic weed control by manatees: its prospects and problems. In L. E. Obeng, ed. Man-made lakes. Ghana Univ. Press, Accra.
- Bangs, O. 1895. The present standing of the Florida manatee, *Trichechus [manatus?] latirostris* (Harlan), in the Indian River waters. Am. Nat. 29:783-787.
- Bertram, G. C. L., and G. K. R. Bertram. 1973. The modern sirenian: their distribution and status. Biol. J. Linn. Soc. 5:297-338.
- Brownell, R. L., Jr., Kr. Ralls, and R. R. Reeves, eds. 1978. Report of the West Indian Manatee Workshop, Orlando, Florida, 27-29 March 1978. Natl. Fish and Wildl. Lab, U.S. Fish and Wildl. Serv. Rept. 37 pp.
- Cahn, A. R. 1940. Manatees and the Florida freeze. J. Mammal. 21:222-223.
- Campbell, H. W. 1976. The Florida manatee and related species. Plaster Jacket 25:10 pp.
- Campbell, H. W. 1977. Mammalia; Sirenia; Trichechidae (Manatees). In: Endangered and Threatened Plants and Animals of North Carolina. N.C. State Museum of Natural History. 444 pp.
- Campbell, H. S., and J. A. Powell. 1976. Endangered species: the Florida manatee. Florida Nat. April:15-20.
- Campbell, H. W., and A. B. Irvine. 1977. Feeding ecology of the West Indian manatee. Aquaculture 12:249-51.
- . 1979. Manatee mortality during the unusually cold winter of 1976-1977. Proc. West Indian Manatee Workshop, 27-29 March 1978, Orlando, Florida. 12 pp.
- Canova, A. 1885. Life and adventures in south Florida. Tribune Printing Co., Tampa. 145 pp.
- Gold, J. P. 1979. The Sirenian: Dugong, manatee, Steller's sea cow, and relatives. Natl. Mus. of Natur. Hist., Smithsonian Inst. 11 pp.
- Dekker, D. 1977. Zeekoegeboorte. Artis 23(4): 111-119.
- Hamilton, W. J. 1941. Notes on some mammals of Lee County, Florida. Am. Midl. Nat. 25: 686-691.
- Hartman, D. S. 1969. Florida's manatees, mermaids in peril. Natl. Geogr. Mag. 136(3): 342-353.
- . 1971. Behavior and ecology of the Florida manatee, *Trichechus manatus latirostris* (Harlan), at Crystal River, Citrus County. Ph. D. Dissert. Cornell Univ., Ithaca, N.Y. 285 pp.
- . 1974. Distribution, status and conservation of the manatee in the United States. U.S. Fish Wildl. Ser. Unpubl. Rep. 247 pp.
- Hartman, D. S. 1979a. Ecology and Behavior of the Manatee (*Trichechus manatus*) in Florida. Am. Soc. of Mammal. Spec. Publ. 5. 153 pp.
- . 1979b. West Indian manatee. Pages 27-39 in J. N. Layne, ed. Rare and endangered biota of Florida, Vol. 1, Mammals. Univ. Presses of Florida, Gainesville.
- Husar, S. L. 1975. An annotated bibliography of the recent Sirenian (*Trichechus*, *Dugong*, *Hydrodamalis*). National Fish and Wildlife Lab., U.S. Fish and Wildlife Service Rept. 148 pp.
- . 1977. The West Indian manatee (*Trichechus manatus*). U.S. Fish and Wildl. Ser. Wildlife Res. Rept. 7, 22 pp.
- . 1978. *Trichechus manatus*. Mammalian Species 93:1-5.
- Irvine, A. B., and H. W. Campbell. 1978. Aerial census of the West Indian manatee, *Trichechus manatus*, in the southeastern United States. J. Mammal. 59(3):613-617.
- Irvine, A. B., D. K. Odell, and H. W. Campbell. 1978. Manatee mortality in the southeastern United States: 1974-1977. Proc. West Indian Manatee Workshop, 27-29 March 1978, Orlando, Florida.
- Jenkins, R. L. 1979. Captive husbandry of manatees at Marineland of Florida. In R. L.

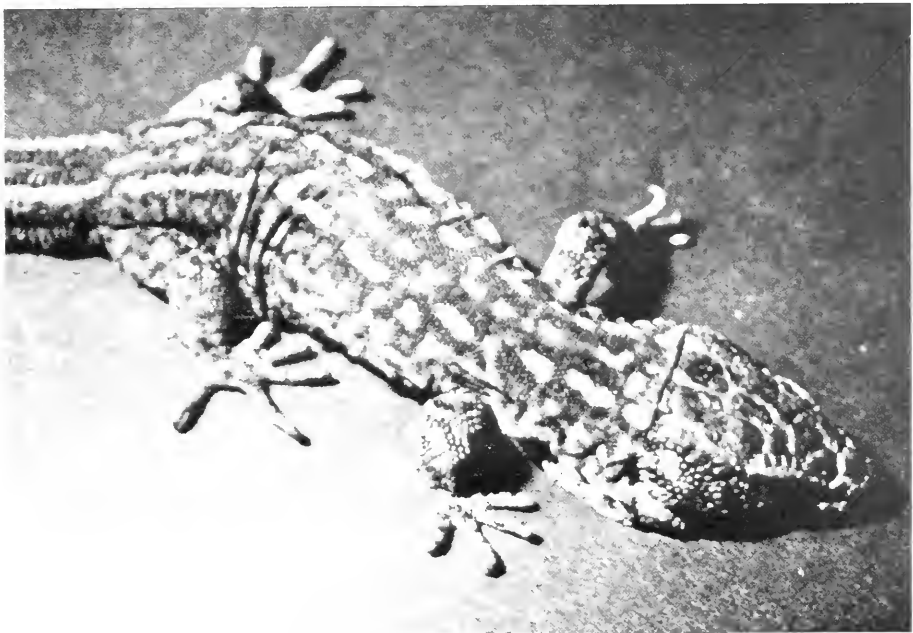
- Brownell, K. Ralls, and R. R. Reeves, eds. Proc. West Indian Manatee Workshop, 27-29 March 1978, Orlando, Florida.
- Kromholz, L. A. 1943. Notes on manatees in Florida waters. *J. Mammal.* 24:272-273.
- Layne, J. N. 1965. Observations on marine mammals in Florida waters. *Bull. Florida St. Mus. Biol. Sci.* 9:131-181.
- LeBaron, J. F. 1880. The manatee or sea cow. *Forest and Stream* 13:1005-1006.
- Ledbetter, C. S. 1960. Amazing mammals of Blue Springs Run. *Florida Wildl.* 14(2):22-24.
- Lowery, G. H. 1974. Mammals of Louisiana and its adjacent waters. Louisiana St. Univ. Press, Baton Rouge. 565 pp.
- MacDonald, K., L. J. Seeley, and E. C. Amoroso. 1978. Biological Synopsis of the manatee. International Development Research Centre, Ottawa, Canada. 112 pp.
- Marsh, H., P. W. Channells, and J. Morrissey. 1979. A bibliography of the recent Sirenia. James Cook Univ., Australia. 163 pp.
- Mondolfi, E. 1974. Taxonomy, distribution, and status of the manatee in Venezuela. *Sci. Cien. Nat. La Salle* 34(97):5-23.
- Moore, J. C. 1951a. The status of the manatee in the Everglades National Park, with notes on its natural history. *J. Mammal* 32(1):22-36.
- . 1951b. The range of the Florida manatee. *Q. J. Florida Acad. Sci.* 14(1):1-19.
- . 1953. Distribution of marine mammals in Florida waters. *Amer. Midl. Nat.* 49(1):117-158.
- . 1956. Observations of manatees in aggregations. *Am. Mus. Novitates.* 1811:1-24.
- Odell, D. K., D. J. Forrester, and E. D. Asper. 1978. A preliminary analysis of organ weights and sexual maturity in the West Indian manatee (*Trichechus manatus*). Proc. West Indian Manatee Workshop, 27-29 March 1978, Orlando, Florida.
- Odell, D. K., J. E. Reynolds, and G. Waugh. 1978. New records of the West Indian manatee (*Trichechus manatus*) from the Bahama Islands. *Biol. Conserv.* 14:289-293.
- O'Keefe, M. T. 1973. Blue Springs—haven for the manatees. *Florida Sportsman* 5(1):10-14.
- Powell, J. A., Jr. 1978. Evidence of carnivory in manatees (*Trichechus manatus*). *J. Mammal.* 59:442.
- . 1978a. Status of the manatee population in Crystal River, Citrus County, Florida. Proc. West Indian Manatee Workshop, 27-29 March, 1978, Orlando, Florida. 7 pp.
- Powell, J. A., and J. C. Waldron. 1978b. Status of the manatee population in Blue Spring, Volusia County, Florida. Proc. West Indian Manatee Workshop, 27-29 March 1978, Orlando, Florida. 10 pp.
- Reynolds, John E. III. 1979. The semi-social manatee. *Nat. Hist.* 88(2):44-53.
- Simpson, G. G. 1930. Sea sirens, the strange mammals responsible for the ancient ideas of mermaids. *Nat. Hist.* 30:41-47.
- Stephens, W. M. 1972. Florida mermaids. *Natl. Parks. Conserv. Mag.* 46(3):28-31.
- United Nations Food and Agriculture Organization Working Party on Marine Mammals. 1978. Mammals in the seas. Report of the FAO Advisory Committee on Marine Resources Research. FAO, U.N., Rome. 264 pp.
- U.S. Fish and Wildlife Service. 1979. Administration of the Marine Mammal Protection Act of 1972. April 1, 1978 to March 31, 1979. Dept. of Interior, U.S. Fish and Wildlife Service. 86 pp.
- U.S. Fish and Wildlife Service. 1979. West Indian manatee recovery plan. Tech. draft. U.S. Fish and Wildlife Service. 33 pp.
- Vietmayer, N. 1974. The endangered but useful manatee. *Smithsonian Mag.* 5(9):60-64.
- Walker, E. P. et al. 1964. Mammals of the world. Johns Hopkins Press, Baltimore. 1,500 pp.
- Whitehead, P. J. P. 1977. The former southern distribution of New World manatees (*Trichechus* spp.). *Bio. J. Linn. Soc.* 9:165-189.
- Whitfield, W. K. and S. L. Farrington. 1975. An annotated bibliography of Sirenia. *Fla. Marine Res. Publ.* 7:1-44.
- Wray, P. 1976. The North American manatee. *Endangr. Species Productions, Inc.* Ayer, Maine. 26 pp.
- Wray, P. 1978. The West Indian manatee (*Trichechus manatus*) in Florida. U.S. Dept. Commerce, NTIS, PB-285-410, 89 pp.

Biological Services Program

FWS/OBS-80/01.36

March 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States- **ISLAND NIGHT LIZARD**



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

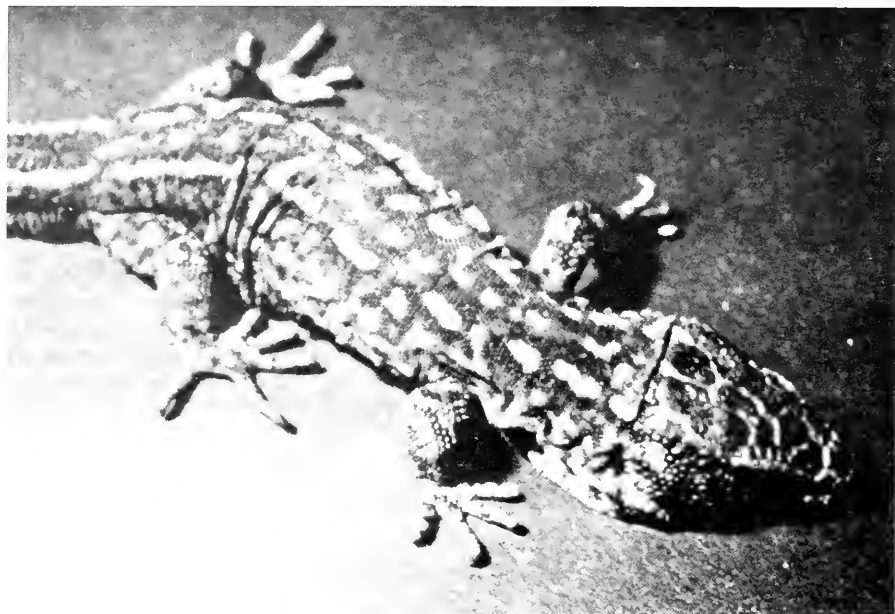
Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES
ISLAND NIGHT LIZARD

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: STEVE BUSACK

ISLAND NIGHT LIZARD

Xantusia riversiana

KINGDOMAnimalia
 CLASS Reptilia
 ORDER.....Squamata
 FAMILY..... Xantusiidae
 OTHER COMMON NAMES None

DATE

Entered into SWIS.....To be determined
 Updates..... 15 October 1978

LEGAL STATUS

Federal Threatened (42 FR 40682, 11 Aug 1977).
 States Not nominated

REASONS FOR CURRENT STATUS

This lizard is known only from three major California islands: Santa Barbara, San Nicolas, and San Clemente. Island habitats and animal populations have been severely modified as a result of the introduction of new species, especially feral cats, goats, pigs, and rabbits.

PRIORITY INDEX

Not assigned.

DESCRIPTION

Xantusia riversiana was once assigned to a separate genus, *Klauberina* (Savage 1957). This lizard is 5.8 to 8.0cm in snout-to-vent length, with soft granular scales and folds of skin on the

neck and along the sides of the body. The back is mottled with pale ash gray or beige and yellow brown, darkened in varying amounts with black. Occasional individuals have a pale gray dorso-lateral stripe on each side, edged with brown and black; a brown vertebral stripe may also be present. It is pale gray below, sometimes with a bluish cast suffused on the belly and often on the tail with yellow. Underside of feet may be yellowish (Stebbins 1966). A photograph is in the Endangered Species Technical Bulletin (1977, Vol. 2, No. 9).

RANGE

Island night lizards occur on Santa Barbara, San Nicolas, and San Clemente Islands, in the California Channel Islands group (Stebbins 1966, Savage 1967). A small population has recently been discovered on Sutil Island (J. M. Brode pers comm). Stebbins (1954) indicated that *X. riversiana* occurred on Santa Catalina Island, but this record needs confirmation.

RANGE MAP

Arrows on the accompanying map indicate islands where *X. riversiana* occurs.

STATES/COUNTIES

California: Los Angeles, Ventura.

HABITAT

The species inhabits grassland brushy areas, clumps of cactus (*Opuntia*), cliffs, and rocky beaches (Stebbins 1954, 1966).

FOOD AND FORAGING BEHAVIOR

X. riversiana is an omnivorous, opportunistic feeder, eating a large variety of arthropods — spiders, marine isopods, scorpions, centipedes, mites, aphids, wasps, flies, moths, silverfish, etc (Stebbins 1954). Brattstrom (1952) notes that ants and beetles are the most important food items for this species; 31% of the animals he examined from San Clemente Island had also ingested plant matter consisting of flowers, leaves, stems, and seeds (*Mesembryanthemum*, etc). These lizards are thought of as active mostly at

night, but they have been seen foraging in the daytime (Stebbins 1954).

SHELTER REQUIREMENTS

X. riversiana seeks shelter under rocks, driftwood, and fallen branches (Stebbins 1966).

NESTING AND BEDDING

No information is available concerning nesting.

RITUAL REQUIREMENTS

Not known.

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

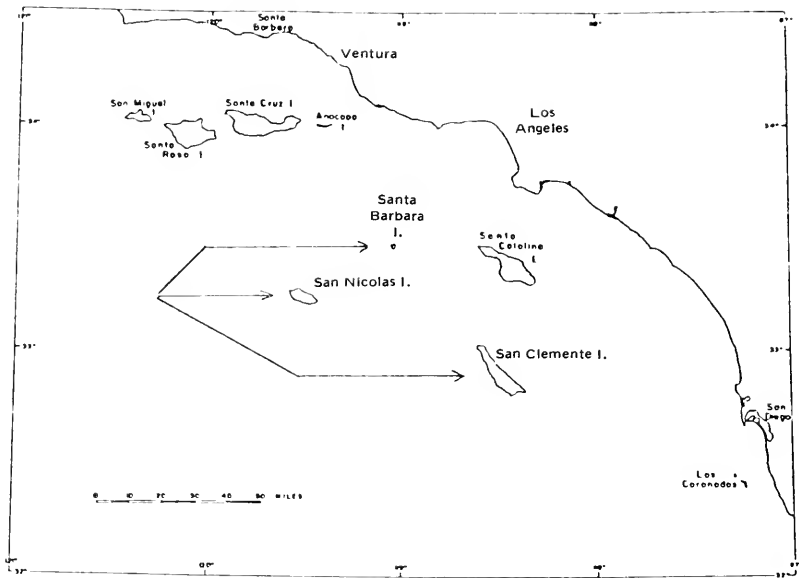
Not known.

POPULATION NUMBERS AND TRENDS

No data are available on absolute densities. Bezy (1976) indicated that *X. riversiana* was widespread on San Clemente Island, restricted but locally common on San Nicolas Island, and restricted by limited habitat but moderately abundant on Santa Barbara Island. He notes serious threats to *X. riversiana* or to its habitat on all islands due to populations of introduced animals (See Management and Conservation).

REPRODUCTION

X. riversiana is viviparous. Spermiogenesis begins in March and concludes in June; females ovulate from late May to early June (Goldberg and Bezy 1974). Breeding probably occurs from May through June. Goldberg and Bezy (1974) report a range of 3 to 9 young per breeding female per year, with a mean of 3.76 for San Clemente Island females. They estimate that about half of the female population is reproductively active in a given year. Young are born in September, following a 14-week gestation period. Goldberg and Bezy (1974) estimate that sexual maturity is attained in the spring of the third or fourth year. They consider *X. riversiana* to be a K-selected species, being relatively late-maturing, long-lived, with single broods, large adult body



Distribution of the island night lizard *Xantusia riversiana*.

size, and large clutches, and demonstrating a low reproductive potential.

MANAGEMENT AND CONSERVATION

The greatest threats to this lizard are predation and habitat destruction from introduction of exotic species into these fragile island ecosystems. Bezy (1976) notes that feral goats could have a serious impact on this partially herbivorous lizard and its habitat. He also notes that feral pigs and cats undoubtedly feed on the lizard to some extent.

There is evidence of predation by feral housecats on *X. riversiana* on San Clemente Island, but the magnitude of this loss has not been determined. A feral-cat removal program is being planned for San Nicolas Island (Steele 1979). The California Department of Fish and Game and the U.S. Navy are currently considering a removal program for some feral animals on San Clemente Island. The Navy has a program for the control of feral goats, but it is currently inactive (Federal Register 42, No. 155).

The alligator lizard (*Gerrhonotus multicarinatus*) has been accidentally introduced on San Nicolas Island. Bezy (1976) feels that this lizard may be a competitor with *X. riversiana*. *G. multicarinatus* and *X. riversiana* have exclusive distributions on the California Channel Islands (Savage 1967), which suggests that alligator lizards may displace the smaller-sized island night lizard.

AUTHORITIES

Robert L. Bezy
Section of Herpetology
Natural History Museum
Los Angeles, California 90007

John M. Brode
California Department of Fish and Game
1701 Nimbus Road
Rancho Cordova, California 95670

PREPARER'S COMMENTS

Bezy (1972, 1976) indicated that there is moderate morphological differentiation between the three island populations of *X. riversiana*. Variation within the species needs further study.

The impact of predation by feral animals on

San Clemente and San Nicolas Island populations of *X. riversiana*, and the potential competitive impact by *Gerrhonotus multicarinatus* on San Nicolas Island populations are both in need of immediate investigation. Control of these introduced animals may be critical to the survival of the endemic island night lizard. Remaining habitat on San Nicolas and Santa Barbara Islands should be protected from further decimation.

LITERATURE CITED/SELECTED REFERENCES

- Bezy, R. L. 1972. Karyotypic variation and evolution of the lizards in the family Xantusiidae. Los Angeles Nat. Hist. Mus., Contri. Sci., 227: 1-29.
- . 1976. Letter in response to federal proposal of threatened or endangered status for *Klauberina riversiana*. (42 FR 155: 40682-40683.
- Brattstrom, B. H. 1952. The food habits of the night lizard, genus *Xantusia*. Copeia 1952 (2):168-172.
- Goldberg, S. R. and R. L. Bezy. 1974. Reproduction in the island night lizard, *Xantusia riversiana*. Herpetologica 30:350-360.
- Savage, J. M. 1957. Studies on the lizard family Xantusiidae. III. A new genus for *Xantusia riversiana* Cope, 1883. Zoologica 42: 82-86.
- . 1967. Evolution of the insular herpetofauna. Pages 219-227 in Philbrick, R. N. (ed.) Proceedings of the Symposium on the Biology of the California Islands. 363 pp.
- Schwenkmeyer, R. C. 1949. Food habits of the island night lizard, *Xantusia riversiana reticulata*, from San Clemente Island. Nat. Hist. Misc. 38:1-3.
- Stebbins, R. C. 1954. Amphibians and reptiles of western North America. McGraw-Hill, New York. 537 pp.
- . 1966. A field guide to the western reptiles and amphibians. Houghton Mifflin,

Boston. 279 pp.

Steele, J. 1979. San Nicolas Island – home of Indian artifacts, unusual wildlife and guided missiles. *Outdoor Calif.* 40(5): 29-30.

ACCOUNT PREPARED BY/UPDATED BY

National Fish and Wildlife Laboratory
1300 Blue Spruce Drive
Fort Collins, Colorado 80524

Biological Services Program

FWS/OBS-80/01.37

MARCH 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States-

THE DELMARVA PENINSULA FOX SQUIRREL



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

FWS/OBS-80/01.37
March 1980

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—

THE DELMARVA PENINSULA FOX SQUIRREL

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: WILLIAM H. JULIAN

DELMARVA PENINSULA FOX SQUIRREL

Sciurus niger cinereus Linnaeus

KINGDOMAnimalia
 CLASSMammalia
 ORDER..... Rodentia
 FAMILY..... Sciuridae
 OTHER COMMON

NAMES..... Bryant's fox squirrel,
 peninsula fox squirrel, stump-eared squirrel.

DATE

Entered into SWIS..... to be determined
 Updates.....30 September 1978

LEGAL STATUS

Federal: Endangered (32 FR 4001; 11 Mar. 1967).
 States: Endangered: Maryland.

REASONS FOR CURRENT STATUS

Primary factors for current status are destruction of habitat from timber cutting, agricultural clearing, construction, development (Flyger 1964; IUCN 1972; Taylor and Flyger 1973; USFWS 1973; DFSRT draft); and competition with the gray squirrel (*Sciurus carolinensis*) in areas of sub-optimal habitat. Minor mortality results from hunt kills and road kills (Delmarva Fox Squirrel Recovery Team [DFSRT] draft).

PRIORITY INDEX

Not assigned.

DESCRIPTION

The Delmarva Peninsula fox squirrel is a fairly large squirrel (larger than gray squirrel) with pelage a uniform light grizzled-grayish with steel-blue cast dorsally and white ventrally. The feet are white and the tail has a pronounced black

stripe on outer edge. Melanistic forms occur with black both dorsally and ventrally. Pictures are in Taylor (no date) and DFSRT (draft).

RANGE

The squirrel is presently restricted to local disjunct populations in portions of four eastern shore counties of Maryland (Allen 1942; Masueti 1950; Paradiso 1969; J. Taylor personal communication). There is an introduced population on Chincoteague National Wildlife Refuge, Virginia (IUCN 1972; USFWS 1973).

The species' former distribution included southeastern Pennsylvania, eastern shore of Maryland and Delaware (Delmarva Peninsula), the eastern shore of Virginia into Northampton County, and possibly southern New Jersey (Abbot 1830, Rhoads 1903, Poole 1932, 1944, Hall and Kelson 1959).

RANGE MAP

Diagonal hatching on the following map depicts present range; shading indicates former range (Taylor and Flyger 1973, DFSRT draft).

STATES/COUNTIES

Maryland: Dorchester, Kent, Queen Annes Talbot.

Virginia: Accomack.

HABITAT

The squirrel prefers mature mixed timber with a minimum of undergrowth (Taylor and Flyger 1973; Taylor 1976). It is thought to be closely associated with stands of loblolly pine (*Pinus taeda*) (IUCN 1972). However, others argue that this may not be correct, because its former distribution was north of the distribution of loblolly pine (Taylor and Flyger 1973, Taylor 1976).

It is often found in savanna areas, oak openings and in narrow tree zones along rivers and streams. It does occur sparingly in areas with dense undergrowth, but is then forced to compete with the gray squirrel.

FOOD AND FORAGING BEHAVIOR

A variety of large trees provide adequate mast in fall. Trees utilized include oak, hickory, walnut, and loblolly pine. In spring the squirrel consumes buds and flowers of trees, fungi, insects, fruits, seeds, and occasionally bird eggs and young (Smith and Folmer 1972; DFSRT draft; Taylor no date).

They will consume a large variety of agricultural products such as corn, soybeans, or other crops in fields and orchards. They are more terrestrial than the gray squirrel and will venture farther into open fields.

SHELTER REQUIREMENTS

See nesting or bedding.

NESTING OR BEDDING

Tree dens and leaf nests are built with local materials. They appear to use den nests in the winter and leaf nests in the summer (G. J. Taylor personal communication). Paradiso (1969) states that nests are placed near the tips of branches in old pines, from 9 to 15 m above the ground.

RITUAL REQUIREMENTS

Not known.

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

In north central populations of *Sciurus niger*, home ranges average about 4 ha. The seasonal average for home range is approximately 16 ha (Allen 1943). They are not disturbed by human activity any more than gray squirrels, provided habitat is satisfactory (DFSRT draft).

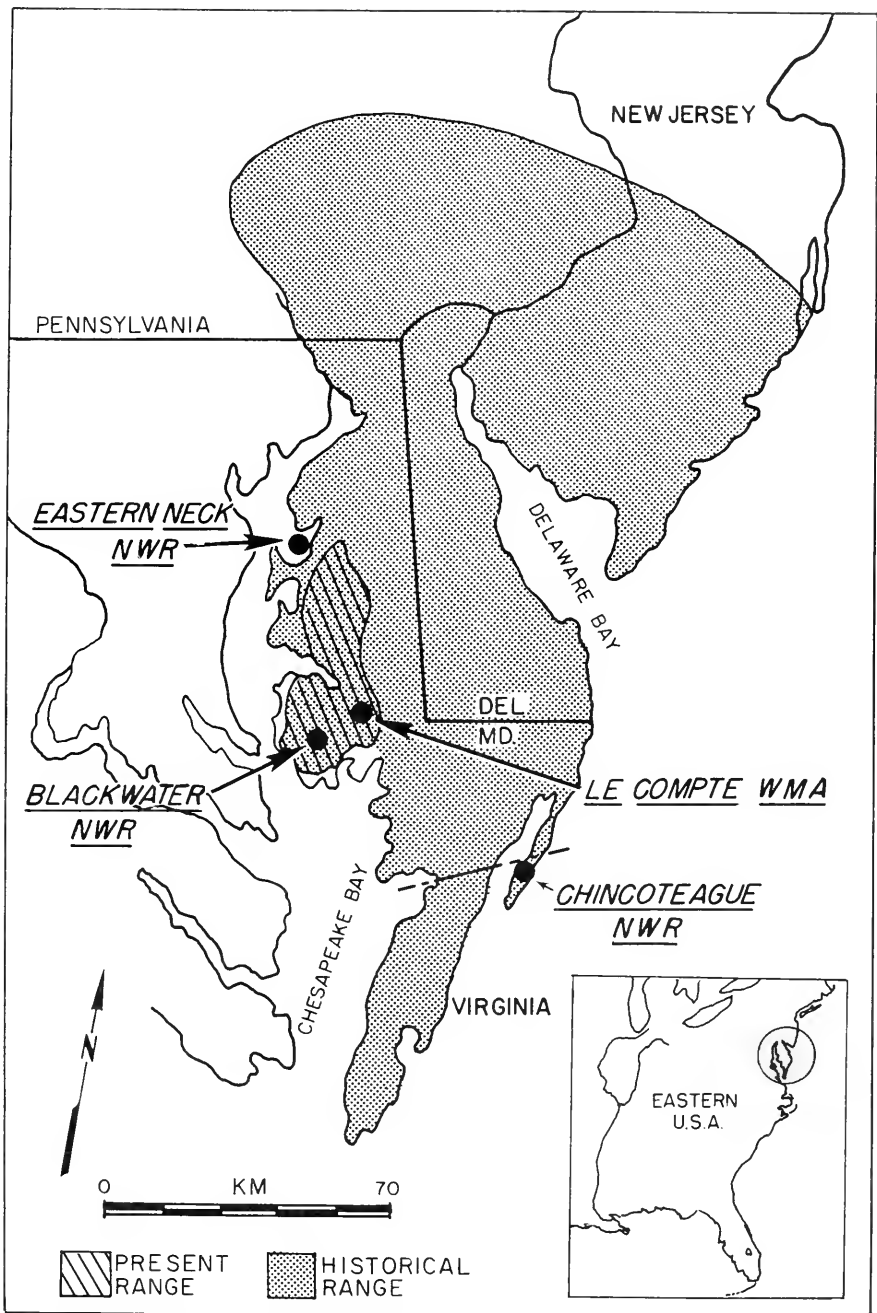
This species encounters potential competition in areas of local sympatry with the gray squirrel in suboptimal habitat.

POPULATION NUMBERS AND TRENDS

There are no estimates of the total number of individuals. They are considered abundant only at Eastern Neck Island National Wildlife Refuge, Kent County, Maryland (DFSRT draft). Radio-collaring projects are underway to provide information on numbers.

REPRODUCTION

Fox squirrels are polygamous and after mating, the female raises the young alone. The breeding season is extended, with peaks in February and March, and in July and August (DFSRT draft). Gestation period is 45 days (Asdell 1964). Litter size is 2 to 4 with an average of 3 (IUCN 1972); 1 to 2 litters are produced per year. The amount of food available seems to govern the size as well as the number of litters (DFSRT draft). Young are born naked. Eyes open at 5 weeks and young are weaned at 9 to 12 weeks.



This map depicts the historical and present range of the Delmarva Peninsula fox squirrel.

Females may breed at 10 to 11 months. Young can be disturbed and handled with minimal adverse effects. Females will not abandon young if disturbed but may move them to a different location (DFSRT draft).

MANAGEMENT AND CONSERVATION

The establishment of Blackwater National Wildlife Refuge (1933) in Maryland has helped protect some habitat (IUCN 1972). LeCompte Wildlife Management Area, Maryland, was designated as a refuge for this species in 1970. Maryland closed the hunting season on this species in 1971. The species was successfully introduced at Chincoteague National Wildlife Refuge, Virginia, in 1968.

Several hundred nest boxes have been placed in selected habitats and many used in Chincoteague National Wildlife Refuge. Several thousand nest boxes have been built, and some put out in Maryland. Studies with gray squirrels have indicated that provision of nest boxes nearly doubled the population (Barkalow and Soots 1965; Burger 1969).

Management proposals by the State of Virginia include establishing a nest box program and surveying for additional sites of suitable habitat for reestablishment (Taylor and Fisher 1978). The State of Maryland's proposals include, in addition, the use of abundance and life history studies (G. J. Taylor personal communication).

A recovery team has been formed and a final draft recovery plan will be formulated by late 1978. The primary objective of the recovery plan is the restoration of the Delmarva fox squirrel to a secure status throughout its former range (DFSRT draft). The plan includes three primary actions: (1) preservation and management of essential denning and feeding habitat; (2) release of Delmarva fox squirrels into suitable habitat; (3) protection of populations through law enforcement, reduction of squirrel competition and predation; and (4) promotion of public support. Tentative plans also include acquisition of private lands on which this species occurs. Designation of Critical Habitat will be proposed by 30 June 1979.

The following is a list of public lands on which the squirrel occurs and related population estimates (F = Federal, S = State, NWR = National Wildlife Refuge).

State	County	Location/ Ownership	Pop.	Source
Md.	Dorchester	Blackwater NWR (F)	450	W.H. Julian pers. com.
	Kent	Eastern Neck NWR (F)	250	P. Feiger pers. com.
	Dorchester	LeCompte Wildl. Man. Area (S)	no estimate	
Va.	Accomack	Chincoteague NWR (F)	80-100	DFSRT pers.com.

AUTHORITIES

Vagn Flyger (Recovery Team)
1222 H. J. Paterson Hall
University of Maryland
College Park, MD 20742

Bernard F. Halla (Recovery Team)
Nongame Wildlife Program,
Maryland Department of Natural Resources
Wildlife Administration
Tawes State Office Building
Annapolis, MD 21401

William H. Julian (Recovery Team)
U.S. Fish and Wildlife Service
Blackwater National Wildlife Refuge
Rt. 1, Box 121
Cambridge, MD 21613

Gary J. Taylor (Recovery Team)
Nongame and Endangered Species Program
Manager
Maryland Department of Natural Resources
Wildlife Administration
Tawes State Office Building
Annapolis, MD 21401

PREPARER'S COMMENTS

Known in literature as *Sciurus niger bryanti*, *S. n. neglectus*, and *S. n. cinereus*.

LITERATURE CITED/SELECTED REFERENCES

Abbott, C. C. 1890. The geological survey of New Jersey, 1890. Vol. 2, Part 2:500. John Murphy Co., Trenton.

- Allen, C. M. 1942. Extinct and vanishing mammals of the western hemisphere. Am. Comm. Int. Wildl. Port. Spec. Publ. 11:45-46.
- Allen, D. C. 1943. Michigan fox squirrel management. Mich. Dep. Conserv. Game Div. Publ. 100. Lansing.
- Asdell, S. A. 1964. Patterns of mammalian reproduction. Cornell Univ. Press, Ithaca. 670 pp.
- Bakken, A. 1952. Interrelationships of *Sciurus carolinensis* (Gmelin) and *Sciurus niger* (Linnaeus) in mixed popula. Ph.D. Dissert. Univ. Wisconsin. 188 pp.
- Barkalow, F. S., Jr. and R. F. Soots, Jr. 1965. An analysis of the effect of artificial nest boxes on a gray squirrel population. Trans. N. Am. Wildl. Natur. Resour. Conf. 30:349-360.
- Burger, G. V. 1969. Response of gray squirrels to nest boxes at Remington Farms, Maryland. J. Wildl. Manage. 33:796-801.
- DFSRT (Delmarva Fox Squirrel Recovery Team). Draft. Delmarva fox squirrel recovery plan. U.S. Fish Wildl. Serv. 39 pp.
- Dozier, H. L., and H. E. Hall. 1944. Observations on the Bryant's fox squirrel, *Sciurus niger bryantii*, (Bailey). Md Conserv. 21:1-12.
- Flyger, V. 1964. Urban sprawl endangers native Maryland mammals. Md. Conserv. 41:6-7.
- Hall, E. R., and K. R. Kelson. 1959. Mammals of North America. 2 vols. Ronald Press, New York. 1,083 pp.
- IUCN. 1972. Red data book. Vol. I, Mammalia. Compiled by H. A. Goodwin and C. W. Holloway. IUCN, Morges, Switzerland.
- Lustig, L. W., and V. Flyger. 1976. Observations and suggested management practices for the endangered Delmarva fox squirrel. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 29: 433-440.
- Mansueti, R. 1950. Extinct and vanishing mammals of Maryland and the District of Columbia. Md Natur. 20:1-48.
- Moore, J. C. 1946. Mammals from Welaka, Putnam County, Florida. J. Mammal. 27:490-59.
- . 1957. The natural history of the fox squirrel *Sciurus niger shermani*. Bull. Am. Mus. Natur. Hist. 113:1-70.
- Paradiso, J. L. 1969. Mammals of Maryland. N. Am. Fauna 66:1-93.
- Poole, E. L. 1932. A survey of the mammals of Berks County, Pennsylvania. Reading Pub. Mus. Art Gall. Bull. 13.
- . 1944. The technical names of the north-eastern fox squirrels. J. Mammal. 25:315-317.
- Rhoads, S. N. 1903. The mammals of Pennsylvania and New Jersey. Philadelphia.
- Smith, C., D. Follmer. 1972. Food preferences of squirrels. Ecology 53:82-91.
- Taylor, G. J. 1974. Present status and habitat survey of the Delmarva fox squirrel (*Sciurus niger cinereus*) with a discussion of reasons for its decline. Proc. Annu. Conf. Southeast. Assoc. Game Fish Comm. 27:278-189.
- . 1976. Range determination and habitat description of the Delmarva fox squirrels in Maryland. M.S. Thesis. Univ. of Maryland, College Park.
- . No date. Maryland's Delmarva fox squirrel. Maryland Dep. Natur. Resour. Fact Sheet. 2 pp.
- Taylor, G. J., and V. Flyger. 1973. Distribution of the Delmarva fox squirrel (*Sciurus niger cinereus*) in Maryland. Chesapeake Sci. 14: 59-60.
- Taylor, W. H., and E. Fisher. 1978. Delmarva fox squirrel investigations. Performance report from July 1977 to June 1978. Proj. No. E-2. Commonwealth of Virginia, Comm. Game Fish, Richmond. 3 pp.
- USFWS. 1973. Threatened wildlife of the United States. Compiled by Office of Endangered Species and International Activities, Bur. Sport Fish. Wildl. Resour. Publ. 114. U. S. Gov. Printing Office, Washington, D.C. 289 pp.

ACCOUNT PREPARED/UPDATED BY:

National Fish and Wildlife Laboratory
412 N.E. 16th Avenue, Room 250
Gainesville, FL 32601

Biological Services Program

FWS/OBS-80/01.38

MARCH 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States-

THE HOUSTON TOAD



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

FWS/OBS-80/01.38
March 1980

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—

THE HOUSTON TOAD

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: ROBERT THOMAS

HOUSTON TOAD

Bufo houstonensis Sanders

KINGDOMAnimalia
CLASS Amphibia
ORDER Anura
FAMILYBufonidae
OTHER COMMON NAMESWottring's toad

DATE

Entered into SWIS. to be determined
Updates. 1 January 1978, 31 March 1978,
22 May 1979

LEGAL STATUS

Federal: Endangered (35 FR 16047, 13 October 1970)

States: Endangered: Texas.

REASONS FOR CURRENT STATUS

Populations are extremely small and their known distribution is restricted to two or three disjunct localities. Early field studies indicated Houston toads preferred temporary rain pools for breeding sites, whereas other native toads generally used more permanent bodies of water. Man's alteration of natural watersheds has reduced the availability of temporary pools, forcing Houston toads to breed in larger ponds, lakes, and creeks where they have hybridized with the Gulf Coast toad (*B. valliceps*) and the Woodhouse's toad (*B. woodhousei*) (Brown 1971). The problem is compounded because population levels are so low that the probability of a female Houston toad finding a conspecific mate in a mixed chorus of toad species is slim (Brown 1971).

The Houston toad is generally considered a post-Pleistocene relict of the more northerly distributed American toad (*B. americanus*) (Blair 1958, 1965) and may be ill-adapted to southern environments (Brown 1971). If true, this may explain the species' apparent failure to adapt to habitat alterations.

PRIORITY INDEX

Not assigned.

DESCRIPTION

A small toad, the Houston toad is similar to the American toad, but with heavier cranial crests, especially behind the eyes. Males have a 49- to 66-mm snout-to-vent length; females measure 57 to 80 mm. The dorsum is light brown to cream with a variable number of dark brown to black spots, each with one or more warts. The venter is cream, usually heavily mottled. A light mid-dorsal stripe is usually present. Tadpoles are virtually indistinguishable from American toad larvae (Altig 1970). The mating call consists of a long (7- to 22-sec), high-pitched (1,646- to 2,300-Hz) trill with 14 to 16 pulses per second (Brown 1973).

Photographs appear in Sanders (1953), Blair (1959, 1972), Kennedy (1962), Brown (1971), Thomas (1975), Thomas and Potter (1975), Ehrenfield (1976), and Hardy (1977). Audio-spectrograms of the mating call are given in Brown (1971, 1973).

RANGE

The species' historical range included the following localities: northwest and southeast Houston, Harris County; Lake Woodrow, Burleson County; 6 miles south of Liberty, Liberty County; Austin County; and 6 and 12.6 miles east of Columbus, Colorado County (Sanders 1953). Brown (1971) also reported populations 2 miles west of Fresno in Fort Bend County and in the vicinity of Bastrop and Buescher State Parks in Bastrop County.

The species has not been found in Liberty, Austin, Colorado, or Fort Bend counties since originally reported. It is now known to exist only in the vicinity of Bastrop and Buescher State Parks, Bastrop County; Lake Woodrow, Burleson County; and possibly southeast Houston, Harris County.

RANGE MAP

Historic localities are designated on the following map by triangles; present known localities are indicated by dots. Critical Habitat as designated in 43 FR 4022, 31 January 1978, is shown on a separate map.

STATES/COUNTIES

Texas: Austin,¹ Bastrop, Burleson, Colorado,¹ Fort Bend,¹ Harris, Liberty.¹

HABITAT

Houston toads are restricted to areas characterized by sandy soils. Localities in Bastrop and Burleson Counties are heavily wooded with loblolly pine (*Pinus taeda*) and/or mixed deciduous forest, interspersed with open grassy areas. The southeast Houston locality is residential with open, grassy fields.

Breeding habitats include roadside ditches, temporary ponds in residential areas and pastures, and other seasonally flooded low spots. Houston toads also breed in Lake Woodrow and nearby permanent ponds.

FOODS AND FORAGING BEHAVIOR

Bragg (1960) reported captives feeding on various insects and smaller toads. Thomas (unpublished data) examined 17 specimens and found unidentified red ants in one and beetle remains in another.

SHELTER REQUIREMENTS

Apparently requires sandy loamy soils for burrowing.

NESTING OR BEDDING

The species breeds in temporary rain pools, flooded fields, and permanent ponds.

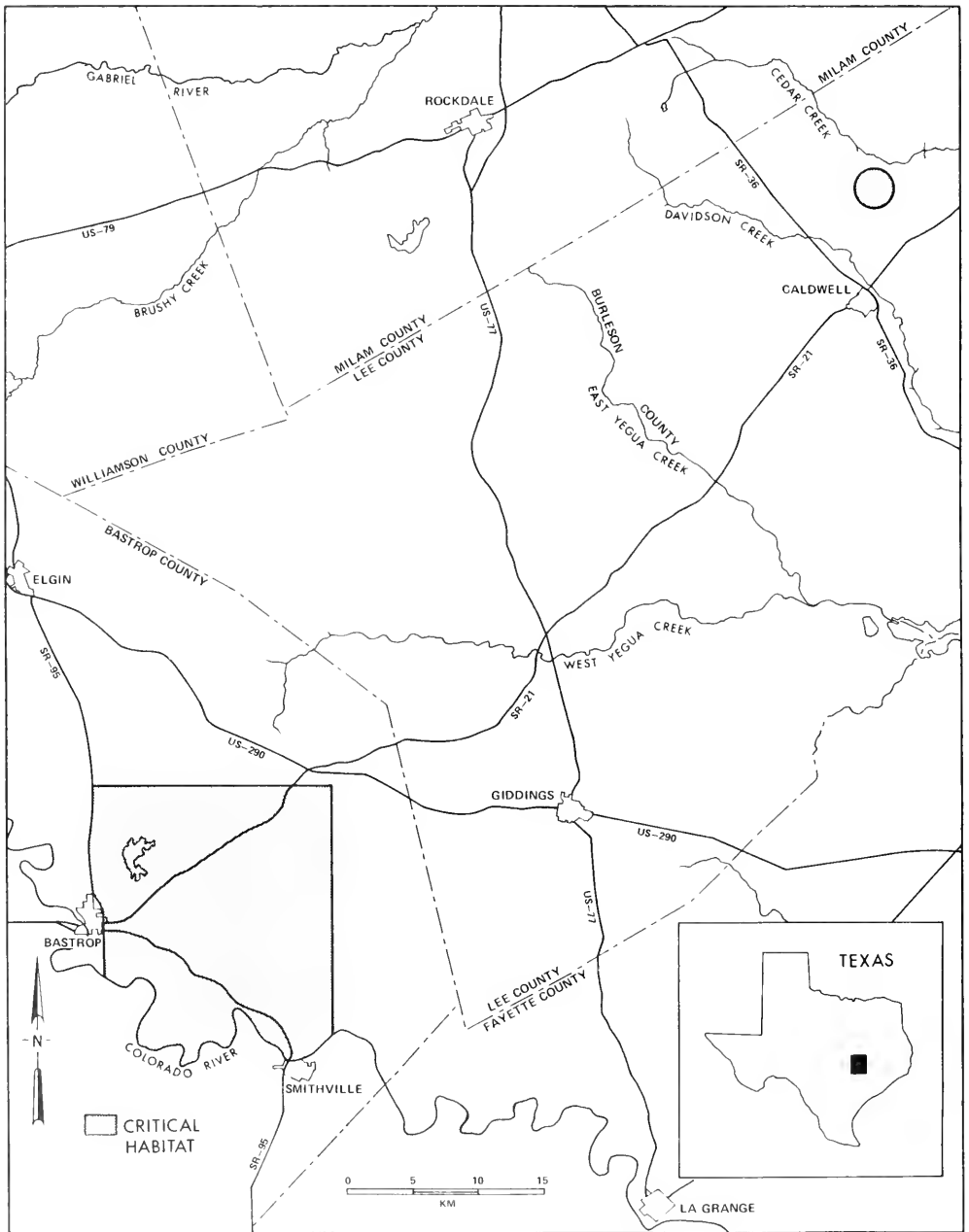
RITUAL REQUIREMENTS

Males call from small mounds of soil or grass surrounded by water, or from shallow water.

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

Not known.

¹ Believed extirpated in these counties.



Critical habitat of the Houston toad, as designated in 43 FR 4022, 31 January 1978, is depicted by shading in this map.

POPULATION NUMBERS AND TRENDS

Populations of Houston toads in Harris County have decreased markedly since the late 1940's, but the rate has not been documented. John Wottring, the naturalist responsible for recognition of the Houston toad as a distinct species, reported collecting 66 from a single chorus in 1949, and "quite a lot" in 1953 (from his field notes). Brown (1967, 1971) found only three during the breeding seasons in 1965, 1966, and 1967. Extensive surveys in 1974, 1975, and 1976 revealed the presence of two Houston toads in southeastern Houston (R. Thomas unpublished data). Surveys in 1978 failed to locate any Houston toads in Harris County (Jameson and Handenstein unpublished).

Populations in Bastrop and Burleson Counties have apparently remained stable during the past 10 years, estimated at a maximum of 300 individuals (Brown 1975).

Thomas and Potter (1975) estimate the total population to be near 1,500 individuals. Mark-recapture studies have not been attempted.

REPRODUCTION

Breeding is initiated by heavy rains from February to June and lasts only a few nights (Kennedy 1962). One female laid 728 eggs (Kennedy 1962). Hybridization with Woodhouse's toads (fertile hybrids) and Gulf Coast toads (infertile hybrids) has been documented (Brown 1971).

MANAGEMENT AND CONSERVATION

A Recovery Team was appointed in January 1978 to develop a plan for removal of this species from endangered status. Critical Habitat has been designated (43 FR 4022, 31 January 1978). Areas of land, water, and airspace in two counties were designated: (1) Bastrop County, from the junction of line corresponding to 30°12'00"N and Texas State Highway 95 east along a line corresponding to 30°12'00"N, to where it intersects a line corresponding to 97°17'30"W, to where it intersects the Colorado River, west and northwest along the north bank of the Colorado River to the due southward extension of Texas State Highway 95, and north along the extension and Texas State Highway 95 to where it intersects a line corresponding to 30°12'00"N; (2) Burleson County: a circular area with a 1.6-km radius, the center being the north entrance to Lake Woodrow from Texas FM 2000.

About 285 ha at Buescher State Science Park are reportedly being maintained in a condition as favorable for Houston toads as possible (F. Potter personal communication).

The endangered Houston toad has received considerable publicity and most local land owners are aware of the problem.

Houston toads were reared at the Houston Zoo in 1978 and 1979. The first project involved collecting eggs in the wild and then releasing over 1,000 tadpoles back into the wild. In 1979, eggs from Houston toads were spawned at the zoo and at the time this report was prepared (May 1979), tadpoles were being raised for subsequent release.

AUTHORITIES

Lauren E. Brown (Recovery Team)
Department of Biological Sciences
Illinois State University
Normal, IL 61761

William L. McClure (Recovery Team)
Houston Urban Project
P.O. Box 187
Houston, TX 77001

Floyd E. Potter (Recovery Team)
Texas Parks and Wildlife Department
4200 Smith School Road
Austin, TX 78744

Norman J. Scott, Jr. (Recovery Team)
U S FWS
Natl. Fish & Wildl. Lab.
Albuquerque, NM

Robert A. Thomas (Recovery Team)
Louisiana Nature Center
4100 One Shell Square
New Orleans, LA 70139

Okla. W. Thornton
5525 4th Street No. 99
Lubbock, TX 79416

PREPARER'S COMMENTS

There is an obvious paucity of base-line ecological information about the Houston toad. Proper management of the species will require such data.

LITERATURE CITED/SELECTED REFERENCES

- Altig, R. 1970. A key to the tadpoles of the Continental United States and Canada. *Herpetologica* 26(2):180-207.
- Blair, W. F. 1956. Call difference as an isolation mechanism in southwestern toads (genus *Bufo*). *Texas J. Sci.* 8:87-106.
- . 1958. Distributional patterns of vertebrates in the southern United States in rela-

- tion to past and present environments. Pages 433-468 in Hubbs, C. L., ed. Zoogeography. Am. Assoc. Adv. Sci. Publ. 51.
- . 1959. Genetic compatibility and species groups in U.S. toads (*Bufo*). Texas J. Sci. 427-453,
- . 1963. Intragroup genetic compatibility in the *Bufo americanus* species group of toads. Texas J. Sci. 15:15-34.
- . 1965. Amphibian speciation. Pages 543-556 in Wright, H. E. and D. G. Frey, eds. The Quarternary of the United States. Princeton Univ. Press, Princeton.
- . ed. 1972. Evolution in the genus *Bufo*. Univ. Texas Press, Austin.
- Bragg, A. N. 1960. Feeding in the Houston toad. Southwest Natur. 5:160.
- Brown, L. E. 1967. The significance of natural hybridization in certain aspects of the speciation of some North American toads (genus *Bufo*). Ph. D. Dissert. Univ. Texas, Austin.
- . 1971. Natural hybridization and trend toward extinction in some relict Texas toad populations. Southwest Natur. 16:185-199.
- . 1973. *Bufo houstonensis* Sanders. Cat. Am. Amphib. Rep. 133.1-1-133.2.¹
- . 1975. The status of the near-extinct Houston toad (*Bufo houstonensis*) with recommendations for its conservation. Herp. Rev. 6:37-38.
- Ehrenfeld, D. W. 1976. The conservation of non-resources. Am. Sci. 64:648-656.
- Guttman, S. I. 1969. Blood protein variation in the *Bufo americanus* species group of toads. Copeia 1969:243-249.
- Hardy, M. 1977. Froggie goes to court. Texas Monthly 5:76.
- Kennedy, J. P. 1962. Spawning season and experimental hybridization of the Houston toad, *Bufo houstonensis*. Herpetologica 17:239-245.
- Sanders, O. 1953. A new species of toad with a discussion of the bufonid skull. Herpetologica 9:25-47.
- Thomas, R. A. 1975. Investigation on the status of the Houston toad, *Bufo houstonensis* Sanders. Unpubl. Final Rep. to the U.S. Fish Wildl. Serv. Contract 14-16-0002-3557.
- . 1975. (Cover photo: *Bufo houstonensis*). Herp. Rev. 6(2).
- Thomas, R. A., and F. E. Potter, Jr. 1975. Species status account: *Bufo houstonensis* Sanders. Texas Parks Wildl. Dep. Job Perform. Rep. 70:1-11.

GATEKEEPER

To be designated by Office of Endangered Species.

ACCOUNT PREPARED/UPDATED BY:

Louisiana Nature Center
4100 One Shell Square
New Orleans, LA 70129

and

National Fish and Wildlife Laboratory
412 N.E. 16th Avenue, Room 250
Gainesville, FL 32601

¹ Contains complete bibliography for the species through 1973.

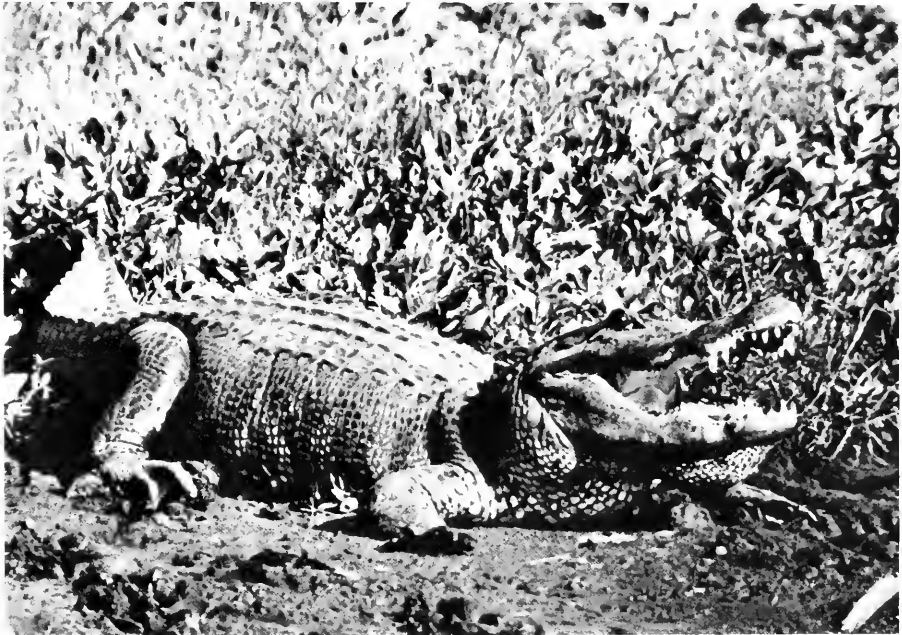
Biological Services Program

FWS/OBS-80/01.39

MARCH 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States-

THE AMERICAN ALLIGATOR



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

FWS/OBS-80/01.39
March 1980

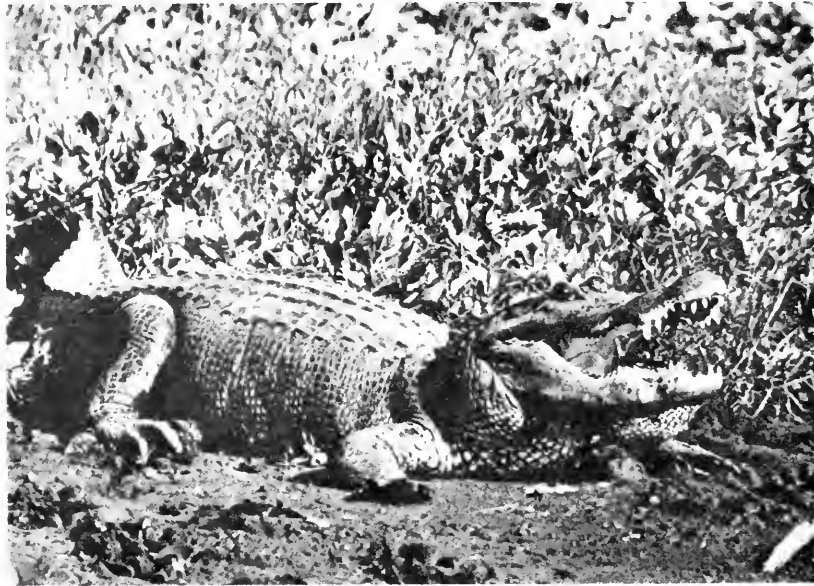
SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—

THE AMERICAN ALLIGATOR

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: LUTHER C. GOLDMAN

AMERICAN ALLIGATOR
Alligator mississippiensis (Daudin)

KINGDOMAnimalia
 CLASS Reptilia
 ORDER..... Crocodylia
 FAMILY.....Alligatoridae
 OTHER COMMON
 NAMES..... alligator, gator

DATE

Entered into SWIS..... to be determined
 Updates.....21 August 1978.

LEGAL STATUS

Federal: Endangered (40 FR 44418, 26 September 1975), wherever found in wild except where threatened (42 FR 2076, 10 January 1977; 44 FR 37132, 25 June 1979; 44 FR 49084, 12 October 1979) or protected by Similarity of Appearance (40 FR 44418, 26 September 1975; 44 FR 37132, 25 June 1979; 44 FR 59084, 12 October 1979).

Threatened (42 FR 2076, 10 January 1977; 44 FR 37132, 25 June 1979; 44 FR 59084, 12 October 1979) in Florida and along the southern Coastal Plain within the following boundaries: from Winyah Bay near Georgetown, S.C., west of U.S. Highway 17 to Georgetown; thence west and south on U.S. Alternate Highway 17 to junction with U.S. Interstate Highway 95 near Watersboro, S.C.; thence south on U.S. Interstate Highway 95 (including incomplete portions) to junction with U.S. Highway 82; thence southwest on U.S. Highway 82 to junction with U.S. Highway 84 at Waycross, Ga., thence west on U.S. Highway 84 to the Alabama-Georgia border; thence south along this border to the Florida border and following Florida border west and south to its termination at the Gulf of Mexico; then from the Mississippi-Louisiana border at the Gulf of Mexico north along this border to its junction with U.S. Interstate Highway 12;

thence west on U.S. Interstate Highway 12 (including incomplete portions) to Baton Rouge, La.; thence north and west along corporate limits of Baton Rouge to U.S. Highway 190; thence west on U.S. Highway 190 to junction with Louisiana State Highway 12 at Ragley, La., thence west on Louisiana State Highway 12 to the Beauregard-Calcasieu Parish border; thence north and west along this border to the Texas-Louisiana State border; thence south on this border to Texas State Highway 12; thence west on Texas State Highway 12 to Vidor, Tex., thence west on U.S. Highway 90 in the Houston, Tex., corporate limits; thence north, west, and south along Houston corporate limits to junction on the west with U.S. Highway 59; thence south and west on U.S. Highway 59 to Victoria, Tex., thence south on U.S. Highway 77 to corporate limits of Corpus Christi, Tex.; thence southeast along the southern Corpus Christi corporate limits to Laguna Madre; thence south along the west shore of Laguna Madre to the Nueces-Kleberg county line; thence east along the Nueces-Kleberg county line to the Gulf of Mexico.

Threatened (Similarity of Appearance to Endangered and Threatened populations) (40 FR 37132, 25 June 1979) in the wild in Cameron, Vermilion, Calcasieu, Ibemia, St. Mary, St. Charles, Terrebonne, Lafourche, St. Bernard, Jefferson, St. Tammany, and Plaquemine Parishes in Louisiana.

States: Endangered: Delaware, Georgia, Massachusetts, Mississippi, North Carolina, Texas.

Threatened: Florida.

REASONS FOR CURRENT STATUS

Although the range of the American alligator is but slightly reduced from historic boundaries, population levels over much of the present range are reduced due to loss of habitat and overharvest. The low point in population decline was reached in the late 1950's to mid-1960's, and in 1967 the species was listed by the United States as endangered.

Man and his associated technology are the major threats. Alligators were killed for food by the early settlers, to a lesser extent for leather, in many cases out of fear, and because of livestock depredation. It was not until 1855, however, that any attempt was made to take large numbers for their leather. This activity was interrupted to some extent by the Civil War, although limited commercial use by the Confederacy for leather and grease continued during the war (Audubon 1931). By 1870, alligator leather again became fashionable, and alligators were killed in the southeast from 1870 until the mid-1960's. Smith (1893) stated that at least 2,500,000 were killed in Florida from 1800 to 1891. Early estimates indicate that the number surviving in Florida and Louisiana in 1902 was less than 20% of what it had been 20 years earlier (Stevenson 1904).

From the late 1940's through the mid-1960's, the remaining wetland areas were opened up. Improved marsh transportation such as airboats and marsh buggies placed unreasonable pressure on remaining alligator populations. Chabreck (1967) estimated that between the late 1940's and late 1950's, populations in Louisiana declined by 90%.

Outright destruction of wetlands has had serious effects upon alligators throughout their range. Millions of hectares of wetlands that at one time were prime alligator habitat have been drained throughout the southeast. Areas in south Florida that harbored impressive numbers of alligators as late as 1954 are now dewatered and in agricultural production (Florida Game and Fresh Water Fish Commission, unpubl. data). Other areas have experienced dramatic changes in annual water-level fluctuations, which have affected populations. Hines et al. (1968) documented severe nest losses in the Everglades due to flooding. Man's drainage and diking activities have increased the frequency and magnitude of water-level fluctuations in the Everglades, resulting in frequent nest destruction, undoubtedly an important factor limiting reproduction in that part of Florida.

State and Federal protection has reversed the population decline, and alligators are now stabilized or increasing in numbers in most of their range.

The chief threat to the American alligator is now probably the rapid urbanization underway throughout its range and the increasing conversion of habitat to recreational use and development. The alligator is a large predatory species, and, in close contact with human populations,

may constitute an apparent threat as both a competitor to and predator on man. Thus, even a few homes on a lake or river can generate considerable pressure for a reduction in the local alligator population, especially the larger individuals. Growing human intolerance could result in serious and possibly insurmountable obstacles to maintaining the species over much of its present range.

PRIORITY INDEX

Not assigned.

DESCRIPTION

The alligator is a lizard-like reptile that reaches lengths of more than 4 m and weights up to 150 kg. Adults are generally dark gray or black, but the young are brightly patterned with black and yellow. The body is covered with rough scales dorsally and smooth scales ventrally. The tail is strongly compressed laterally and crested with high, pointed scales.

The only native species with which the alligator might be confused is the American crocodile. The alligator has a broad, rounded snout, whereas the crocodile's snout is sharply tapered forward of the eyes. The fourth tooth in the crocodile's lower jaw is exposed when the mouth is closed; in the alligator, this tooth is covered by the upper lip. Crocodiles are generally lighter colored as adults than alligators, being light gray or olive as compared to the alligator's dark gray or black. Young crocodiles are olive with black bars and markings, rather than black and yellow. Most standard field guides and reptile books illustrate the differences between these species (e.g., Ditmars 1953, Carr and Goin 1955, Pope 1955, Bothwell 1962, Neill 1971, Conant 1975, Perrero 1975). All these works, as well as a wide range of texts, magazines, and general outdoor publications provide color and black-and-white photographs.

RANGE

Alligators range throughout wetland habitats in the coastal region of southeastern United States from central North Carolina to Texas and north along the Mississippi River drainage into extreme southeastern Oklahoma and southern Arkansas (Joanen 1974).

The present range approximates the historical range. There is evidence that the species once ranged north of central North Carolina into the Dismal Swamp region of southeastern Virginia

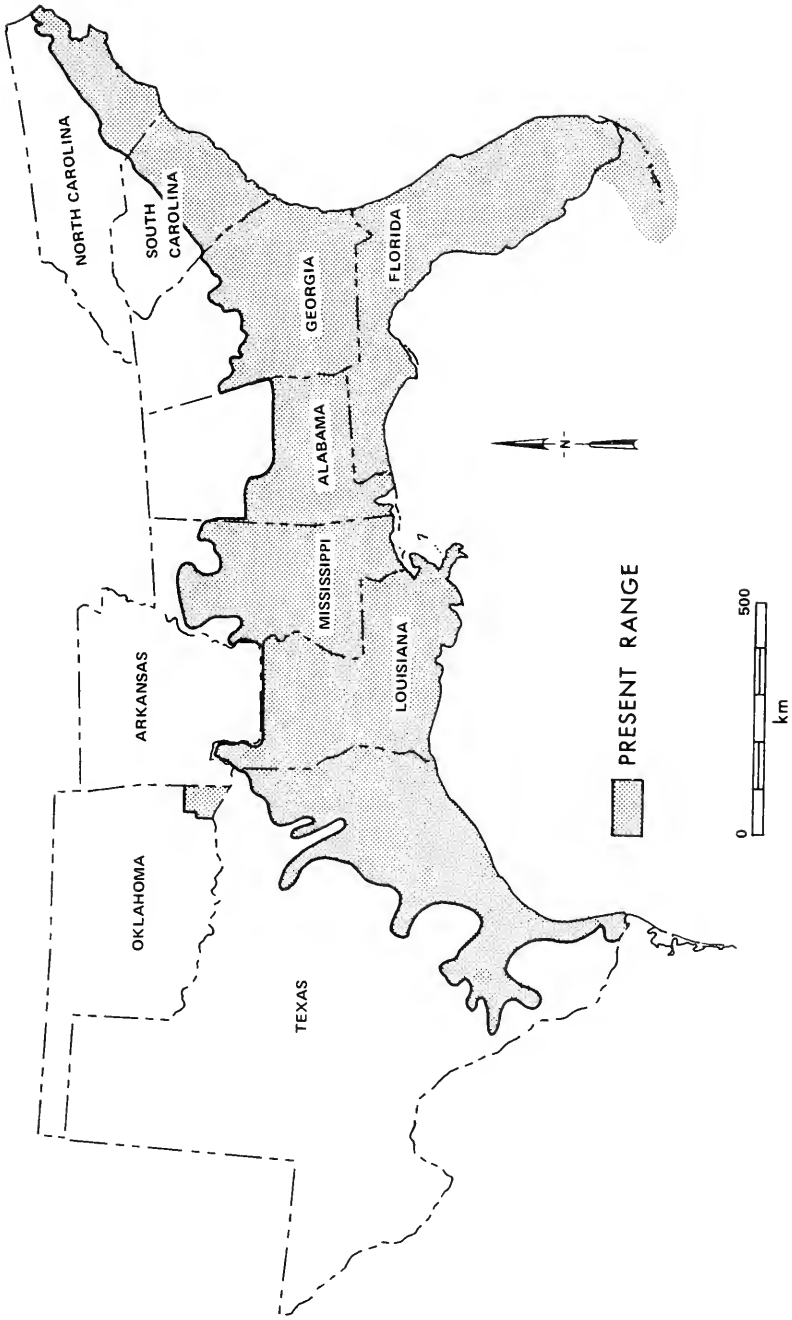
and northeastern North Carolina (Neill 1971). The southern extent of its historic range in Texas and possibly northeastern Mexico is unknown; however, records exist from the Rio Grande, indicating the possibility that it once ranged into the extensive aquatic habitats of northeastern Tamaulipas, Mexico.

RANGE MAP

Range is delineated by shading on the following map (T. Joanen personal communication).

STATES/COUNTIES

- Alabama: Autauga, Baldwin, Barbour, Bullock, Butler, Choctaw, Clarke, Coffee, Conecuh, Covington, Crenshaw, Dale, Dallas, Escambia, Geneva, Greene, Hale, Henry, Houston, Lowndes, Macon, Marengo, Mobile, Monroe, Montgomery, Perry, Pickens, Pike, Russell, Sumter, Tuscaloosa, Washington, Wilcox.
- Arkansas: Hempstead, Lafayette, Miller.
- Florida: All.
- Georgia: Appling, Atkinson, Bacon, Baker, Baldwin, Ben Hill, Berrien, Bibb, Bleckley, Brantley, Brooks, Bryan, Bullock, Burke, Calhoun, Camden, Candler, Charlton, Chatham, Chathahoochee, Clay, Clinch, Coffee, Colquitt, Cook, Crawford, Crisp, Decatur, Dodge, Dooly, Early, Echols, Effingham, Emanuel, Evans, Glynn, Grady, Hancock, Harris, Heard, Houston, Irwin, Jeff Davis, Jefferson, Jenkins, Johnson, Jones, Lanier, Laurens, Lee, Liberty, Long, Lowndes, Macon, Marion, McIntosh, Meriwether, Miller, Mitchell, Montgomery, Muscogee, Peach, Pierce, Pulaski, Putnam, Quitman, Randolph, Richmond, Schley, Screven, Seminole, Stewart, Sumter, Talbot, Tattnall, Taylor, Telfair, Terrell, Thomas, Tift, Toombs, Treutlen, Troup, Turner, Twiggs, Upson, Ware, Washington, Wayne, Webster, Wheeler, Wilcox, Wilkinson, Worth.
- Louisiana: All.
- Mississippi: Adams, Amite, Attala, Carroll, Claiborne, Clarke, Clay, Coahoma, Copiah, Covington, Forrest, George, Greene, Grenada, Hancock, Harrison, Hinds,



The shaded area on this map represents the present range of the American alligator in the United States.

Holmes, Humphreys, Issaguena, Jackson, Jefferson, Jones, Lafayette, Lamar, Lauderdale, Lawrence, Leake, Leflore, Lincoln, Lowndes, Madison, Marion, Monroe, Montgomery, Neshoba, Newton, Noxubee, Panola, Pearl River, Perry, Pike, Quitman, Scott, Sharkey, Simpson, Smith, Stone, Tallahatchie, Walthall, Warren, Washington, Wayne, Wilkinson, Yazoo.

North

Carolina: Beaufort, Bladen, Brunswick, Carteret, Columbus, Craven, Cumberland, Dare, Duplin, Hyde, Jones, New Hanover, Onslow, Pamlico, Pender, Pitt, Robeson, Sampson, Scotland, Tyrrell, Washington.

Oklahoma: McCurtain.

South

Carolina: Aiken, Allendale, Bamberg, Barnwell, Beaufort, Berkeley, Calhoun, Charleston, Chesterfield, Clarendon, Colleton, Darlington, Dillon, Dorchester, Florence, Georgetown, Hampton, Horry, Jasper, Kershaw, Lee, Lexington, Marion, Marlboro, Orangeburg, Richland, Sumter, Williamsburg.

Texas: Anderson, Angelina, Aransas, Archer, Atascosa, Austin, Beck, Bexar, Brazoria, Brazos, Burleson, Calhoun, Cameron, Cass, Chambers, Collin, Colorado, Dimmit, Ellis, Fort Bend, Freestone, Frio, Galveston, Goliad, Grimes, Hardin, Harris, Harrison, Henderson, Houston, Jackson, Jasper, Jefferson, Jim Wells, Johnson, Karnes, Kimble, Kleberg, Lamar, La Salle, Lavaca, Leon, Liberty, Live Oak, Madison, Marion, Matagorda, McMullen, Montgomery, Morris, Nacogdoches, Navarro, Newton, Nueces, Orange, Polk, Refugio, Robertson, Sabine, San Augustine, San Jacinto, San Patricio, Shelby, Smith, Travis, Trinity, Tyler, Victoria, Walker, Waller, Webb.

HABITAT

Alligators inhabit, or inhabited, practically all fresh and brackish water habitats in their range except as excluded by man. Large marsh-bordered lakes, fresh and brackish marshes, and savannas appear to provide optimal habitat and support the densest populations (Reese 1915, McIlhenny 1935, Fogarty 1974).

FOOD AND FORAGING BEHAVIOR

The food of alligators consists of virtually any animal small enough to be captured and swallowed (Kellogg 1929, McIlhenny 1935). Available data indicate some variation between size classes (Kellogg 1929) and between habitat types (Chabreck 1971). Small alligators feed extensively on invertebrates, including crayfish, aquatic and terrestrial insects, and mollusks (Fogarty and Albury 1967, Neill 1971, Valentine et al. 1972), while larger individuals take vertebrate prey, including wading birds, snakes, turtles, small mammals, and fish. Very large alligators may attack and eat large animals such as deer, cattle, and even man (Neill 1971, Hines and Keenlyne 1977).

SHELTER REQUIREMENTS

Adults often dig dens or 'gator holes' at the edges of rivers or lakes and in marsh habitats. An underground tunnel with an underwater entrance will lead into an underground cave a short distance back from the water (Kellogg 1929; McIlhenny 1935; Craighead 1969; Joanen and McNease 1971, 1972; Neill 1971).

NESTING AND BEDDING

Alligators build mound nests of heaped-up vegetation in clearings in marshes or along the edges of lakes or rivers. Mounds are generally about 2 m in diameter and 0.5 to 1 m high (McIlhenny 1935, Joanen 1969, Joanen and McNease 1972, Neill 1971).

RITUAL REQUIREMENTS

Not known.

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

Not known.

POPULATION NUMBERS AND TRENDS

Joanen (1974) provided estimates of alligator populations in all areas throughout the range. The total estimated population for the species was 738,384. In addition, the estimated available habitat was given as 116,550 km² for an average of six alligators per km² of suitable habitat.

Trends in alligator populations have been monitored by the Cooperative Alligator Survey, a yearly night survey over standardized survey routes throughout the range (Chabreck 1974). These data indicate a generally increasing trend. Joanen (1974) also presents data that support this

observation. Outside of Florida, 168 counties had increasing populations, 157 had stable populations, and 25 had decreasing populations.

Joanen's (1974) data are summarized by States below.

Alabama: Some 12,715 alligators were reported from 28 counties. Only two counties report decreasing populations, while 15 report increasing and 11, stable populations. There is a trend for increasing populations over much of the southern half of Alabama, with relatively greater abundance in the region east and north of Mobile Bay.

Arkansas: Most of the previous range is apparently now uninhabited; 1,900 alligators were present in three counties in the southwestern corner of the State. These individuals are presumed to have been transplanted into the area from Louisiana over the past few years.

Florida: Alligators are reported in every responding county. Over 407,500 alligators were estimated for the State. No population trend estimates were given. In general, peninsular Florida, roughly south of the Suwannee Strait, supports moderate to large alligator populations that are either increasing or remaining stable in areas of increasing urbanization except in intensive development centers. The panhandle supports generally lower populations, with local pockets of abundance.

Georgia: 95 counties, essentially all counties within the historical range of the species in the State, report alligator populations; 45 counties report populations increasing and 32 report stable populations.

Available National Wildlife Refuge, State, and other data show that there are alligator populations in the coastal counties and the Okefenokee Swamp area that are subjectively as large as, or larger than, those in southeastern South Carolina and northern Florida. As to the remainder of the State's populations, it can only be said that they are generally widespread and may be locally abundant, although less so than in the southeastern sector.

Louisiana: A total of 200,682 alligators distributed over 63 parishes with 40 reporting increasing populations, and 22 stable. The extensive coastal marshes of southern Louisiana probably support the largest alligator populations anywhere in the species' range, although some other local populations, e.g., Okefenokee Swamp in Georgia, may have an equal density. The situation in the northern, non-marsh, parishes is less clear, but numbers

there are clearly low and apparently similar to other areas of the species' range.

Mississippi: Only 4,740 alligators were found in 55 counties — 13 with increasing populations and 38 stable. Coastal counties generally support the highest populations.

North Carolina: Reports 1,300 alligators on about 2,590 km² of habitat. Highest populations are in central and southern coastal counties. No alligators are reported between Albemarle Sound and the Dismal Swamp, Virginia, an area within the recent historical range of the species. Only 4 of 21 reporting counties show an increase in population.

Oklahoma: Estimates 10 alligators in one southeastern county. Supplemental data from field biologists and State agencies suggests that considerable unoccupied habitat exists in the southeast corner of the State.

South Carolina: Reports 48,700 alligators on 9,479 km² of habitat. Ten of the 28 responding units report increases, while the others have stable populations. As in North Carolina, populations in the southeastern coastal counties are the largest, and are generally increasing. Reports of increases in some inland and northern counties suggest that the species has responded well to protection throughout the State.

Texas: Has 26,784 alligators in 74 counties. Populations are reported increasing in 35 and stable in 22. Several reporting units appear to represent introduced alligators outside of the historic range of the species. Large, increasing populations are recorded for counties adjacent to the coastal Louisiana parishes, and south along the Gulf coast to Matagorda Bay. Interior counties appear to support small scattered populations which are generally increasing or stable.

REPRODUCTION

Alligators and other crocodylians exhibit the most elaborate social behavior of any reptile, most of which is related to reproduction (McIlhenny 1935, Carr 1967, Joanen and McNease 1971, Campbell 1972, Kushlan 1973, Carr 1976, Pooley and Gans 1976).

Reproductive behavior begins with bellowing by males and females, usually in March or April, depending on local climate. The bellow has been reported to serve as a territorial signal and as a component of male-female interaction, but data

are not available to fully document its function (Campbell 1973, Herzog 1974, Garrick and Lang 1977).

Copulation takes place in the water (McIlhenny 1935, Joanen 1969). Nests are built and eggs laid in May to June depending on local climate, and eggs hatch in August to September (Kellog 1929, McIlhenny 1935, Joanen 1969, Neill 1971). Clutch size varies from 20 to 60 eggs.

At least some females are protective of the nest and remain nearby during the incubation period. Eggs hatch in about 9 weeks. The 23 cm hatchlings are very vocal with a high-pitched "umph, umph" which may stimulate the female to help open the nest. The young often stay together in a "pod" for the rest of the summer (McIlhenny 1935, Campbell 1973, McNease and Joanen 1974). Tagged young have been recaptured near the nest site as long as 3 years after hatching (McIlhenny 1935, Joanen 1969, Campbell 1973, McNease and Joanen 1974, Metzner 1979).

Survival rate is unknown except in local situations, but is expected to be low in mature populations and higher in depleted populations. Variation in water level appears to be the major limiting factor on nesting success (Hines et al. 1968, Joanen 1969, Nichols et al. 1976).

Growth rates of the young vary widely but may approach 0.3 m per year with optimal habitat and food availability (McIlhenny 1935, Joanen and McNease 1975). Subadults often stay together in loose groups until they are about 1 m long; those over 1.5 m long often make extensive presumed dispersal movements (Chabreck 1965, McNease and Joanen 1974).

MANAGEMENT AND CONSERVATION

Laws protecting alligators were, with some exceptions, ineffective until amendment of the Lacey Act in 1969 enabled the federal government to control interstate shipment of alligator hides. By the late 1960's, populations began to increase in the Louisiana coastal marshes due to better law enforcement and excellent landowner cooperation. However, populations in other States did not begin to increase on a wide scale until interstate control of marketing of illegal hides was achieved (Chabreck 1971b). With effective control of poaching since 1969, alligator populations have made substantial recoveries in most areas of the species' range.

The rapid resurgence suggests that the species is highly responsive to conservation efforts and amenable to standard management programs.

Managed harvests are now being made in three Louisiana parishes — Calcasieu, Cameron, and Vermillion — which are listed as threatened (Similarity of Appearance) on the Endangered Species List of the U.S. Department of Interior. A sport hunting program is being developed in the same area. A control program for nuisance alligators in Florida derives much of its overhead from commercial use of the skins.

The U.S. Fish and Wildlife Service's Recovery Plan for the species is in draft form and a complex set of regulatory and management recommendations for dealing with regional and local problems and opportunities will soon be proposed.

AUTHORITIES

Frosty Anderson (Recovery Team)
National Audubon Society
Miles Wildlife Sanctuary
Sharon, CT 06069

Howard W. Campbell (Recovery Team)
National Fish and Wildlife Laboratory
412 N.E. 16th Avenue, Room 250
Gainesville, FL 32601

Robert Chabreck (Recovery Team)
School of Forestry and Wildlife Management
Louisiana State University
Baton Rouge, LA 70803

Tommy Hines (Recovery Team)
Florida Game and Fresh Water
Fish Commission
4005 South Main Street
Gainesville, FL 32601

Ted Joanen (Recovery Team Leader)
Rockefeller Wildlife Refuge
Route 1, Box 20-B
Grand Chenier, LA 70643

Larry McNease
Rockefeller Wildlife Refuge
Route 1, Box 20-B
Grand Chenier, LA 70643

Thomas Murphy
Biologist
Coco Sabo Plantation
Greenpond, SC 29446

Ronald R. Odom (Recovery Team)
Georgia Game and Fish Division
Endangered Species Program
Route 2
Social Circle, GA 30279

A. William Palmisano (Recovery Team
Consultant)
Natl. Fish and Wildlife Lab
Alaska Field Station
4454 Business Park Blvd.
Anchorage, AL 99503
Jake Valentine (Recovery Team)
Wildlife Biologist
U.S. Fish and Wildlife Service
Box 4753, Univ. of Southwestern Louisiana
Lafayette, LA 70501

PREPARER'S COMMENTS

None.

LITERATURE CITED/SELECTED REFERENCES

- Audubon, J. J. 1931. Observations of the natural history of the alligator. *Louisiana Conserv. Rev.* 2(3):3-8.
- Bothwell, D. 1962. The great outdoors book of alligators and other crocodilia, Great Outdoors Publ. Co. St. Petersburg. 88 pp.
- Brazaitis, P. 1973. The identification of living crocodylians. *Zoologica* 58:(3-4):59-101.
- Campbell, H. W. 1972. Ecological or phylogenetic interpretations of crocodylian nesting habits. *Nature* 238:404-405.
- . 1973. Observations on the acoustic behavior of crocodylians. *Zoologica* 1973 (Spring):1-10.
- Carr, A.F. 1967. Alligators, dragons in distress. *Natl. Geogr. Mag.* 131:133-148
- . 1976. Excerpts from the life an alligator: a reappraisal of "the alligator's life history." Foreword to McIlhenny, E. A. 1935. The alligator's life history. Facsimile reprint, 1976. Soc. Study Amphib. Reptiles Misc. Publ.
- Carr, A. F. and C. J. Goins. 1955. Guide to the reptiles, amphibians, and fresh-water fishes of Florida. Univ. Florida Press, Gainesville 341 pp.
- Chabreck, R. H. 1965. The movement of alligators in Louisiana. Proc. Annu. Conf. Southeast Assoc. Game Fish Comm. 19:102-110.
- . 1967. The American alligator: past present and future. Proc. Annu. Conf. Southeast Assoc. Game Fish Comm. 21:554-558.
- . 1972. The food and feeding habits of alligators from fresh and saline environments in Louisiana. Proc. Annu. Conf. Southeast Assoc. Game Fish Comm. 25:117-124.
- . 1971b. The management of the American alligator. Proc. 1st Working Meeting of the Crocodile Specialists. IUCN Suppl. Paper 32:137-144.
- . 1974. Cooperative surveys of the American alligator in the southeastern United States, Mimeo report.
- Conant, R. 1975. A field guide to reptiles and amphibians of eastern and central North America. Houghton Mifflin Co., Boston. 429 pp.
- Craighead, F. C. 1968. The role of the alligator in shaping plant communities and maintaining wildlife in the southern Everglades. *Fla. Natur.* 41:2-7, 69-74.
- Ditmars, R. L. 1953. The reptiles of North America. Doubleday & Co., Inc., New York. 476 pp.
- Fogarty, M. J. 1974. The ecology of the Everglades Alligator. in P. J. Gleason. ed., *Environments of South Florida: Past and Present.* Mem. Miami Geol. Survey 2. 482 pp.
- Fogarty, M. J. and J. D. Albury. 1967. Late summer foods of young alligators in Florida. Proc. Annu. Conf. Southeast Assoc. Game Fish Comm. 21:220-222.
- Garrick, L. D. and J. W. Lang. 1977. Social signals and behaviors of adult alligators and crocodiles. *Am. Zool.* 17:225-239.
- Giles, L.W. and V. L. Childs. 1949. Alligator management on the Sabine National Wildlife Refuge. *J. Wildl. Manage.* 13(1):16-28.
- Herzog, H. A., Jr. 1974. The vocal communication system and related behaviors of the American alligator (*Alligator mississippiensis*) and other crocodylians. M. S. Thesis, Univ. Tennessee, Knoxville. 87 pp.
- Hines, T. C., M. J. Fogarty, and L. C. Chappell. 1968. Alligator research in Florida: a progress report. Proc. Annu. Conf. Southeast Assoc. Game Fish Comm. 22:166-180.

- Hines, T. C. and K. D. Keenlyne. 1977. Two incidents of alligator attacks on humans in Florida. *Copeia*. 1977(4):735-738.
- Joanen, T. 1969. Nesting ecology of alligators in Louisiana. Proc. Annu. Conf. Southeast Assoc. Game Fish Comm. 23:141-151.
- , 1974. Population status and distribution of alligators in the southeastern United States. Southeastern Regional End. Sp. Workshop, Wildl. Soc. Tallahassee, Fla. Sept. 1974. Unpaged.
- Joanen, T. and L. McNease. 1971. A telemetric study of nesting female alligators on Rockefeller Refuge, Louisiana. Proc. Annu. Conf. Southeast Assoc. Game Fish Comm. 24: 175-193.
- , 1972. A telemetric study of adult male alligators on Rockefeller Refuge, Louisiana. Proc. Annu. Conf. Southeast Assoc. Game Fish Comm. 26:252-275.
- , 1976. Notes on the reproductive biology and captive propagation of the American alligator. Proc. Annu. Conf. Southeast Game Fish Comm. 29:407-415.
- Kellogg, R. 1929. The habits and economic importance of alligators. U.S. Dept. Agric. Tech. Bull. 147:36 pp.
- Kushlan, J. A. 1973. Observations on maternal behavior in the American alligator, *Alligator mississippiensis*. *Herpetologica* 29(3): 256-257.
- , 1974. Observations on the role of the American alligator (*Alligator mississippiensis*) in the southern Florida wetlands. *Copeia* 1974 (4):993-996.
- McIlhenny, E. A. 1935. The alligator's life history. Christopher Publ. House, Boston. 116 pp.
- McNease, L. and T. Joanen. 1974. A study of immature alligators on Rockefeller Refuge, Louisiana. Proc. Annu. Conf. Southeast Game Fish Comm. 28:482-500.
- Metzen, W. D. 1979. Nesting ecology of alligators on the Okefenokee National Wildlife Refuge. Proc. Annu. Conf. Game Fish Comm. 31.
- Neill, W. T. 1971. The last of the ruling reptiles: alligators, crocodiles, and their kin. Columbia Univ. Press, Columbia. 486 pp.
- Nichols, J. O., L. Viehman, R. H. Chabreck, and B. Fenderson. 1976. Simulation of a commercially harvested alligator population in Louisiana. Louisiana Agric. Exp. Stn. Bull 691. 59 pp.
- O'Neil, T. 1949. The muskrat in Louisiana coastal marshes. Louisiana Wildl. Fish Comm., New Orleans. 159 pp.
- Perrero, L. 1975. Alligators and crocodiles of the world. Windward Publ. Co., Miami. 64 pp.
- Pooley, A. C. and C. Gans. 1976. The Nile crocodile. *Sci. Am.* 234(4):114-124.
- Pope, C. H. 1955. The reptile world. Alfred A. Knopf, New York. 325 pp.
- Reese, A. M. 1915. The alligator and its allies. G. P. Putnam's Sons, New York. 368 pp.
- Smith, H. M. 1893. Notes on the alligator industry. Bull. U.S. Fish Comm. 11:343-345.
- Stevenson, C. H. 1904. Utilization of the skins of aquatic animals. U.S. Comm. Fish Rep. 1902: 281-532.
- Valentine, J. M., Jr., J. R. Walther, K. M. McCartney, and L. M. Ivy. 1972. Alligator diets on the Sabine National Wildlife Refuge, Louisiana. *J. Wildl. Manage.* 36(3):809-815.

ACCOUNT PREPARED/UPDATED BY:

National Fish and Wildlife Laboratory
412 N.E. 16th Avenue, Room 250
Gainesville, FL 32601

Biological Services Program

FWS/OBS-80/01.40
MARCH 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States- **BROWN PELICAN** Eastern and California Subspecies



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

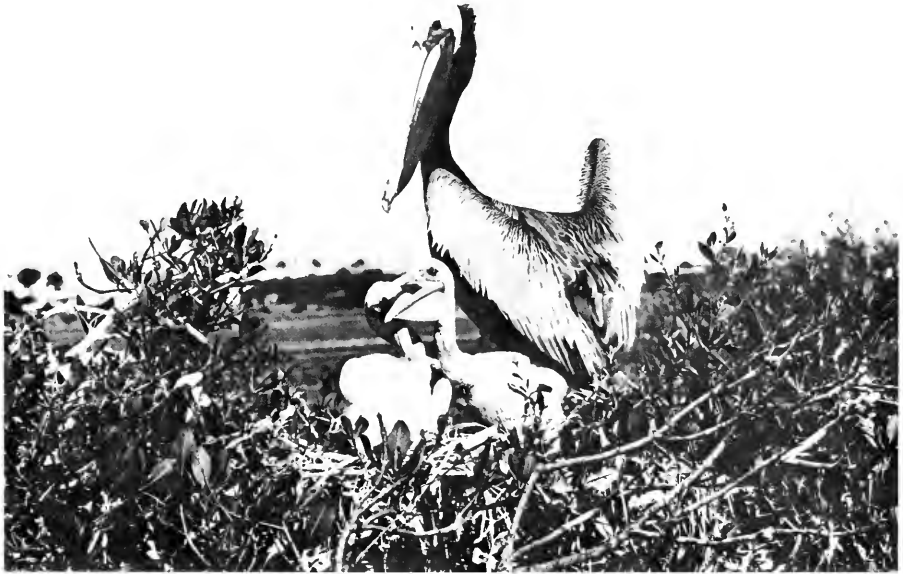
SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—

BROWN PELICAN
Eastern and California Subspecies

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: L. WILLIAMS

BROWN PELICAN

(Eastern subspecies—*Pelecanus
occidentalis carolinensis* Gmelin)
(California subspecies—*Pelecanus
occidentalis californicus* Ridgway)

KINGDOMAnimalia
CLASSAves
ORDER.....Pelecaniformes
FAMILY.....Pelecanidae
OTHER COMMON NAMES

Eastern subspecies..... Eastern brown pelican
California subspecies... California brown pelican

DATE
Entered into SWIS..... to be determined
Updates.....

LEGAL STATUS

Federal: Endangered: (35 FR 16047, 13 October
1970; 35 FR 18319, 2 December 1970).
States: Endangered: Georgia, Mississippi,
South Carolina, California.
Threatened: Florida.

REASONS FOR CURRENT STATUS

Both the eastern and California subspecies have been greatly reduced in numbers. The main reason for their decline is accumulation of chlorinated hydrocarbon residues, which have been shown to cause eggshell thinning and subsequent crushing of eggs under the weight of parent birds (Heath et al. 1969, Peakall 1970, Wiemer and Porter 1970). The principal residues involved are DDT compounds (DDE, DDD, and DDT), polychlorinated biphenyls (PCB's), dieldrin, and endrin (Schreiber and Risebrough 1972, Blus et al. 1974a). The correlation between eggshell thinning and DDE concentrations is highly significant (Schreiber and Risebrough 1972, Blus et al. 1975). Blus et al. (1974b) demonstrated that the success of 93 brown pelican nests was related to low levels of DDE and dieldrin.

Other factors affecting pelican populations are availability of food supply and human disturbance of nesting colonies. Parent pelicans flushed from nests exert forces large enough to break eggs. Normally, one of the parents remains on the

nest throughout incubation. Desertion of the nest can result in losses to predation as well as temperature stresses on the eggs and young (Schreiber and Risebrough 1972, Schreiber 1979).

Mercury may also interfere with reproduction; mercury has been found in some pelican eggs at levels known to have adverse effects on other species (Blus et al. 1974a).

Eastern subspecies

Along the Atlantic Coast, eggshell thinning is more acute at the northern end of the pelican's range (Blus et al. 1970). From 1969 to 1974, Blus et al. (1974a) noted that 17% eggshell thinning in North Carolina populations was associated with subnormal reproductive success. By 1975, eggshell thinning had decreased to 10% (L. J. Blus personal communication). The present Florida population is stable, eggshell thickness has been reduced about 9%, and about 3% of all eggs on the west coast of Florida have been thin-shelled and crushed. The effects of these factors on population levels may not be apparent, for in 1975 and 1976, eggs in Florida had little or no thinning or crushing (R. W. Schreiber personal communication).

In Louisiana and Texas, where the pelican populations have declined rapidly and dramatically, the levels of pollution are higher (Schreiber and Risebrough 1972). In Louisiana, eggs from transplanted Florida birds showed a steady decline in shell thickness from 1970 to 1973. Levels of DDE were generally lower than those associated with subnormal reproductive success in South Carolina, but dieldrin levels were slightly higher. Half the eggs examined contained levels of dieldrin considered potentially detrimental to reproductive success (Blus et al. 1975).

Forty percent of a small population transplanted to Louisiana from Florida died of endrin poisoning in the spring and summer of 1975 (Winn 1975).

Freezes, hurricanes, and beach erosion may have affected population numbers (Schreiber and Risebrough 1972). Blus et al. (1974a) believe that in South Carolina, storms and other natural factors have minimal effects on pelican populations because, while they may temporarily disrupt nesting activities, the birds are persistent re-nesters in that area.

Human disturbance that causes the parent birds to desert the nests can result in serious losses to predation by fish crows (*Corvus ossifragus*), as well as in temperature stress on eggs and young

(Schreiber and Risebrough 1972, Schreiber 1979).

In Florida, a significant number of pelicans (500 or more) are killed each year after being caught on fishhooks or entangled in monofilament fishlines. Some are also maliciously killed or maimed by people (Schreiber 1979).

The decline of the pelicans in South Carolina in the 1950's coincided with a decline in Atlantic menhaden (*Brevoortia* spp.). There is some evidence that food shortages occur, especially in Florida, and the red tide (*Gymnodinium*) has probably affected pelican food supplies on the west coast of Florida at times (Williams et al. 1976).

California subspecies

Pelican losses in California resulting from paratyphoid infections have probably had little effect on the total population (Bond 1942). The complete failure of reproductive efforts on the California Channel Islands in 1968, reported by Schreiber and DeLong (1969), probably resulted from chlorinated-hydrocarbon pollution. Levels of residues as high as 84.4 ppm were found in the muscles of birds from Monterey Bay in December of 1966 (Risebrough et al. 1971). Reproduction on Anacapa Island, California, and Los Coronados and San Martin Islands in Baja California, was almost entirely unsuccessful from 1969 to 1972. Success varied on San Benito Island in Baja California (400 miles south of the U.S. border) and on remote islands in the Gulf of California. Farther south, reproductive success was more satisfactory. The U.S. Fish and Wildlife Service (1973) attributed the poor reproductive success to eggshell thinning brought about by contamination with DDE.

In 1974, eggshell thinning was much less evident than in previous years on the Pacific Coast, and many more young were produced in some of the colonies where egg collapse had been severe. More adults bred in 1974, as well. However, collapsed eggs and lowered productivity continued to be evident. Production on San Martin Island failed completely in 1974, presumably because of human disturbance.

In the Gulf of California, where production had been comparatively good, it was very poor in 1974. The cause appeared to be poor food conditions, although the presence of DDE in the food chain may have contributed. A decrease in the availability of anchovies brought about by overfishing is thought to have affected brown pelican reproduction (Keith 1978). Recent studies indi-

cate that minor restrictions in food supply seriously impair reproduction and that the presence of DDE intensifies the effects of food deprivation (U.S. Fish and Wildlife Service, Denver Wildlife Research Center ms. 1974; Keith 1978).

PRIORITY INDEX

Eastern subspecies: None assigned.

California subspecies: 13.

DESCRIPTION

Eastern subspecies

P. o. carolinensis is a large bird, with a total length of 114 to 137 cm and a wingspan of 2 m. It has a long bill and a large gular pouch, which is colored greenish during the breeding season. Adults have a black belly with gray wings and back. The head is yellow from early autumn until late spring, when it turns white. The neck is white in the fall and winter, but becomes chestnut brown during the breeding season.

Immatures are brown with white bellies for the first 3 to 5 years (Schreiber 1979). Photographs may be found in Bent (1922), Peterson (1947), and Palmer (1962), among others.

California subspecies

P. o. californicus is distinguished from the eastern subspecies by its larger size and darker coloration. The brown color of the back of the neck is almost black, and the gular pouch is reddish instead of greenish during the breeding season (Baird et al. 1884, U.S. Fish and Wildlife Service 1973, Bent 1922, Wetmore 1945). The young have white down when first hatched.

The eggs of both subspecies are lusterless white, becoming dirty during incubation. The measurements of the eastern birds' eggs average 73 to 46 mm and those of the California birds, 78.5 by 50.6 mm. Pelicans typically fly by alternate flapping and soaring. The California birds can be seen to take advantage of updrafts produced when winds are deflected by the coastal bluffs, soaring considerable distances without flapping and thus reducing the energy required for flight (Woodward 1921).

RANGE

Eastern subspecies

On the eastern seaboard, the pelican ranges from North Carolina to Florida, around the Gulf

Coast to Texas and Mexico, and southward to Venezuela. It also inhabits the West Indies and many islands in the Caribbean. Casual or sporadic sightings have been reported from Nova Scotia, Michigan, Wyoming, Colorado, and Bermuda (Bent 1922).

Breeding colony sites are listed in Schreiber and Risebrough (1972), Blus et al. (1974a) and Williams et al. (1976).

Pelicans are usually resident near their breeding grounds, although young birds tend to wander. Schreiber (1976a) color-marked individuals and observed that the majority of fledglings moved south away from the colony during the first months out of the nest. Some individuals wander extensively.

The Florida population has been found to be divided into east- and west-coast groups that do not appear to mix. Birds in South Carolina and on the east coast of Florida move south in the fall, but remain on the east coast and in the upper Florida Keys. Pelicans hatched at Tampa Bay also move southward in the fall, being common at Flamingo, upper Florida Bay, and the lower Keys.

The former range is the same as the present one, except that the pelican was once a common breeder on the coast of Louisiana; it has been unknown there since 1966 except for a small group transplanted from Florida. The Texas and northern Mexico populations have been much reduced (U.S. Dept. of the Interior 1973, Schreiber 1979). Brown pelicans breed only on coastal islands and in Florida; fewer than 50 islands are currently in use (Schreiber 1979).

On the 45 sites occupied since 1950, 26 (58%) are in State ownership; 9 (20%) are Federally owned; 5 (11%) are in miscellaneous or uncertain ownership. Only the Federally owned sites are considered secure (Williams et al. 1976).

California subspecies

At present, this species breeds locally on islands along the Pacific coast from Anacapa Island, Ventura County, California to Los Coronados, San Martin, and San Benito Islands off the coast of Baja California; on islands in the Gulf of California, and south to Tres Marias Islands off Nayarit. Historical nesting sites are Santa Cruz and San Miguel Islands, Santa Barbara County, and Bird Rock, Point Lobos, Monterey County, California. Postbreeding movement of birds northward along Pacific Coast in late summer and fall is common (Wetmore 1945; A.O.U. 1957; Anderson and Anderson 1976; Fish and Wildlife

Service 1973; Jehl 1973; Williams 1931). Between breeding seasons, the range extends northward along the coast to southern British Columbia (Burrard Inlet) and inland to Central British Columbia (Chilcotin District) and southward along the Pacific Coast of Mexico an unknown distance, but at least to Colima (Bond 1942). The main northward movements are in July.

Rarely, pelicans wander inland in California (Stanislaus County, 19 Sept. 1913) (Wetmore 1945; Bent 1922), but usually stay very closely restricted to the seashore. Sightings in the interior are rare (Mailliard 1913); Grinnell and Miller 1944; Wetmore 1945). Of 71 recoveries of pelicans banded as young on Anacapa Island, taken mostly along the coast from Marin County, California south to Nayarit, Mexico, 4 were recovered inland at: Potrero, San Diego Co. (40 km inland); San Gabriel, Los Angeles Co. (34 km inland); Santa Maria, Santa Barbara Co. (18 km inland); and Petrolia, Humboldt Co. (9 km inland) (Bond 1942, 1948). Of 31 band recoveries or sightings of brown pelicans marked as nestlings in the Gulf of California area and recorded north of the nesting area, 7 (33%) were from inland areas in the Southwest Desert; all were first-year recoveries. Record numbers of brown pelicans were reported during July 1972 in the Tucson-Phoenix, Arizona vicinity and the Salton Sea in California in July and August 1972. Anderson et al. (1972a, 1977) suggested that such dispersal results from dominant south winds, often with heavy thunderstorms that ground the birds, rather than being the result of searching for food.

RANGE MAPS

The distribution of the eastern brown pelican is indicated by shading, and its breeding colonies are represented by dots on the following maps.

The breeding range of the California subspecies is shown on the range map for this group.

STATES/COUNTIES

Eastern subspecies

Alabama: Baldwin, Mobile.
 Florida: Bay, Brevard, Broward, Charlotte, Citrus, Collier, Dade, Dixie Duval, Escambia, Flagler, Franklin, Gulf, Hernando, Hillsborough, Indian River, Jefferson, Lee, Levy, Manatee, Martin, Monroe, Nassau, Okaloosa, Palm Beach, Pasco, Pinellas, Santa Rosa, Sarasota, Seminole, St.

Johns, St. Lucie, Taylor, Volusia, Wakulla, Walton.

Georgia: Bryan, Camden, Chatham, Glynn, Liberty, McIntosh.
 Louisiana: Cameron, Jefferson, LaFourche, Plaquemines, St. Bernard, St. Mary, Terrebonne, Vermilion.
 Mississippi: Hancock, Harrison, Jackson.
 N. Carolina: Brunswick, Carteret, Currituck, Dare, Hyde, New Hanover, Onslow, Pamlico, Pender.
 S. Carolina: Beaufort, Charleston, Colleton, Georgetown, Horry.
 Texas: Aransas, Brazoria, Calhoun, Cameron, Chambers, Galveston, Jefferson, Kenedy, Kleberg, Matagorda, Nueces, San Patricio, Willacy.

California subspecies

California: Del Norte, Humboldt, Los Angeles, Marin, Monterey, Orange, San Diego, San Luis Obispo, Santa Barbara, Santa Cruz, Stanislaus, Ventura.

HABITAT

Eastern subspecies

Pelicans usually feed in shallow estuarine waters, although they are sometimes seen 30 to 60 km offshore (Schreiber 1979). Groups are often observed flying over the surf on both the Atlantic and Gulf shores of Florida, occasionally feeding beyond the breakers. Schreiber (1979) states that sandspits and offshore sandbars are used for loafing in the daytime and roosting at night.

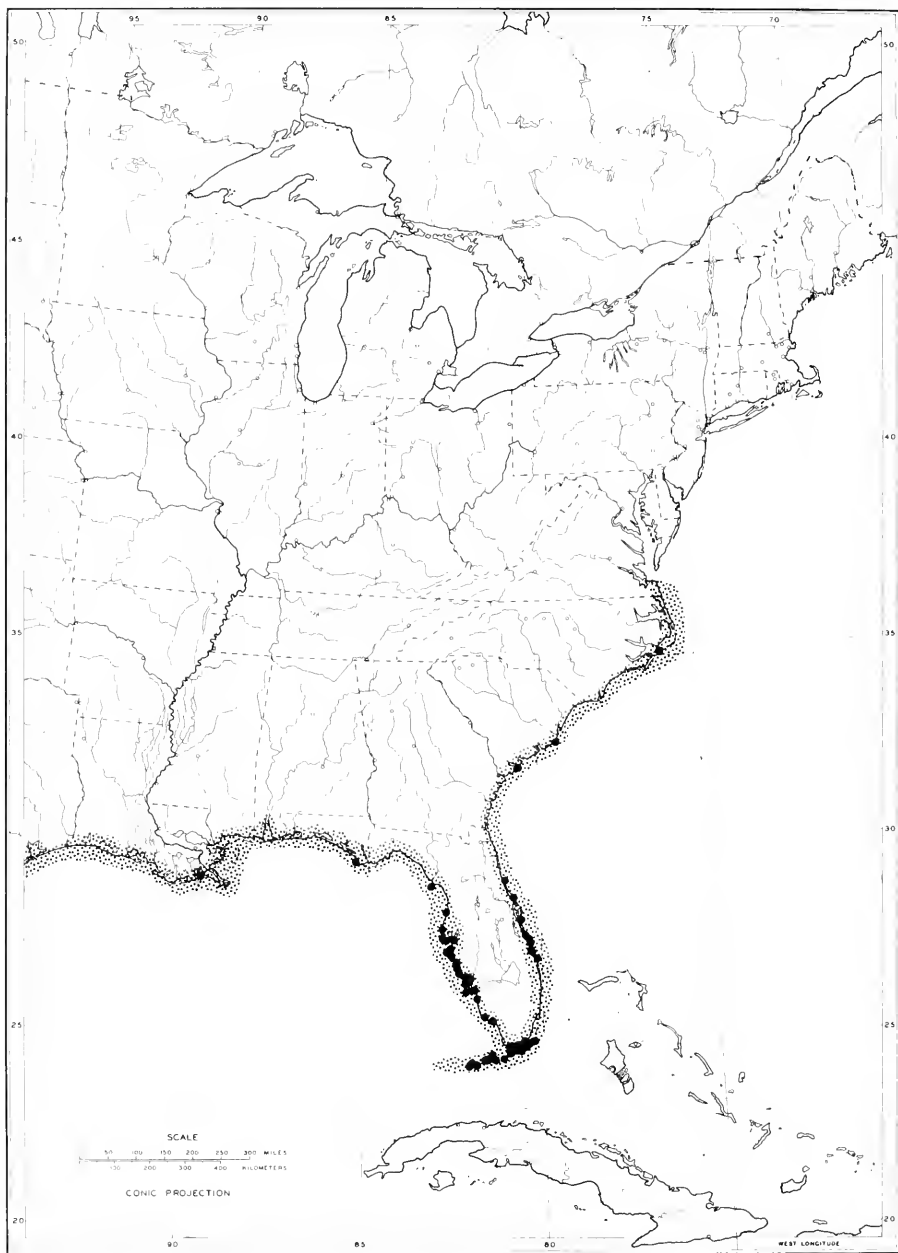
Brown pelicans, especially juvenile birds, frequent fishing piers where scraps are available (Schreiber 1979).

Habitat photographs are found in Bent (1922).

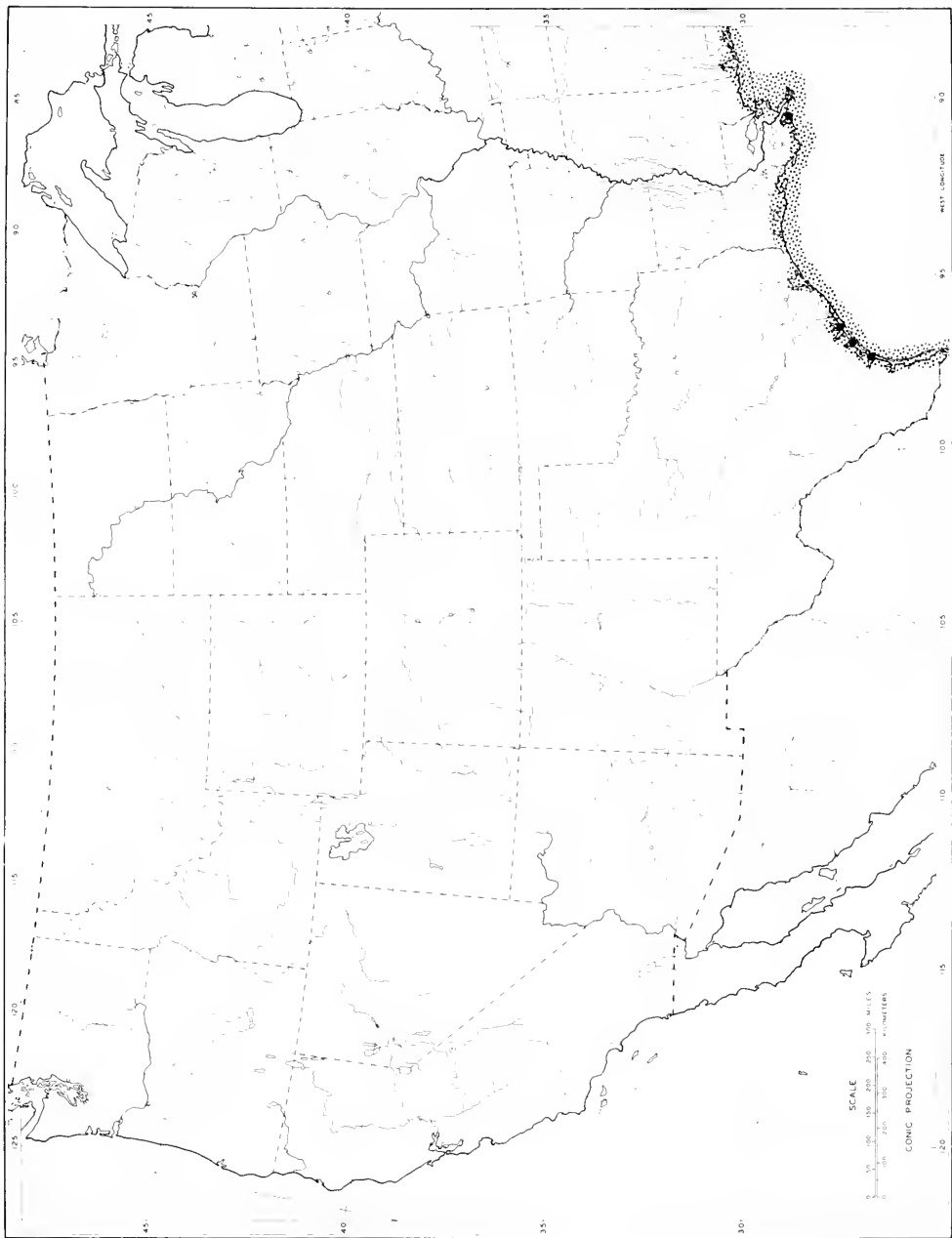
California subspecies

The primary habitat is the ocean littoral just outside the surf line. This pelican rarely strays either inland or far offshore. It is confined to the semiarid western coast, bathed by the relatively cool waters of the California current, which probably limits its range southward (Murphy 1936, Anderson and Anderson 1976).

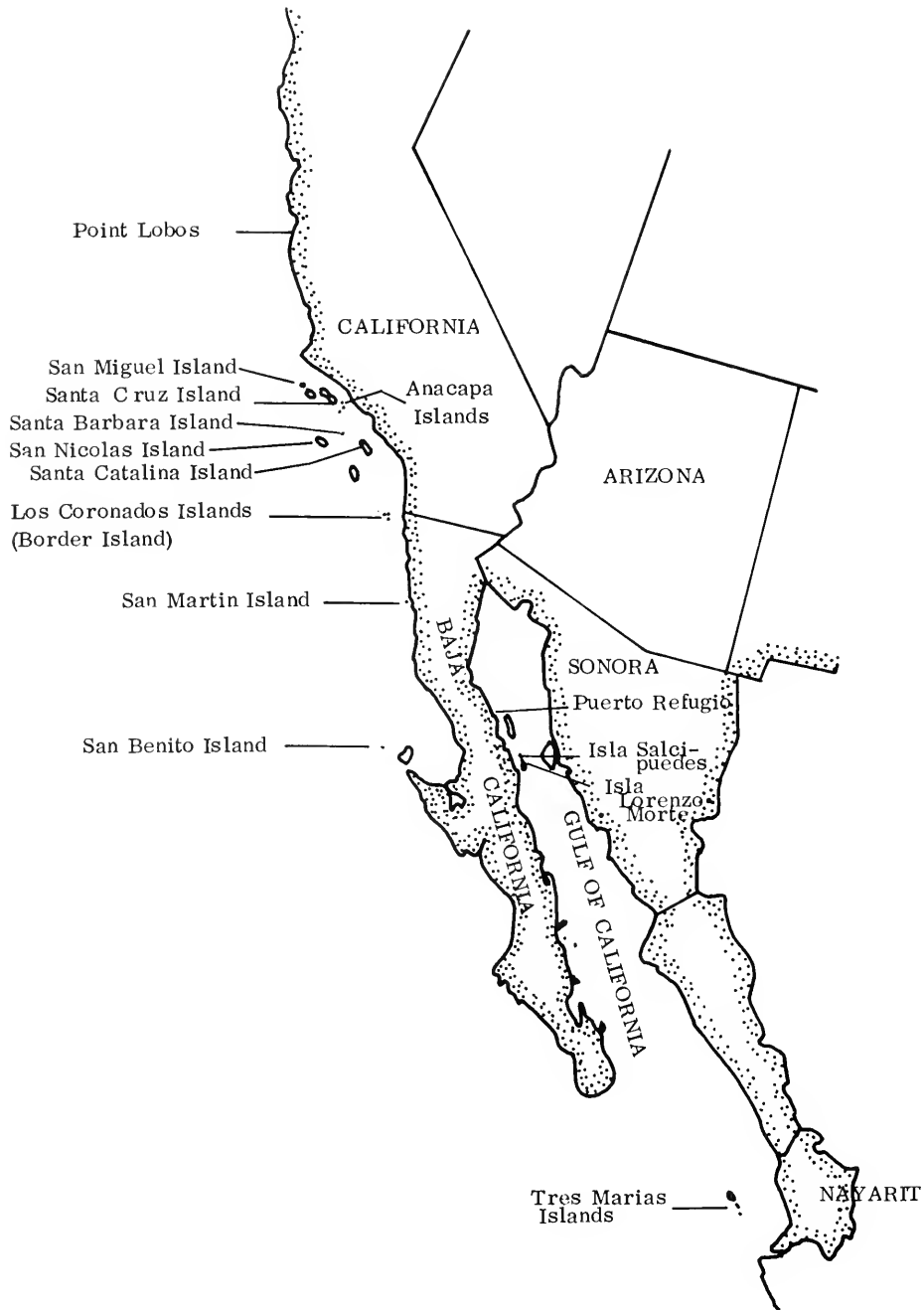
The preferred nesting habitat is on offshore islands, although some individuals nest in mangrove growing in estuarine locations along the Sinaloa coast.



The distribution of the brown pelican in the eastern U.S. is depicted by shading, dots indicating locations of active colony sites.



The distribution of the eastern brown pelican in the central U.S. is depicted by shading. Dots indicate the location of active Colony Sites.



Breeding range of the California brown pelican.

FOOD AND FORAGING BEHAVIOR

The mode of prey capture and the type of food are the same for both subspecies. The birds fly low over the water, spot a potential prey fish, and dive to capture it. The fish is then transferred to the gular pouch. The particular species of fishes making up most of the diet of the eastern subspecies are menhaden (*Brevoortia*), mullet (*Mugil*), sardines (*Sardinella*), and pinfish (*Lagodon*) (Bent 1922, Schreiber 1979).

The California subspecies feeds mostly on anchovies and other members of the family Engraulididae; Scombridae; and Pacific sardines (*Sardinops sagax*) when available. The Pacific sardines and another former food fish, the Pacific mackerel (*Scomber japonicus*) are now essentially gone from California waters, but northern anchovies appear to have replaced them, and most biologists believe that the long-term decline of pelicans on the west coast is unrelated to changes in food supply (Anderson and Anderson 1976). Keith (1978), however, believes that former sardine fishermen in the Gulf of California have switched to anchovy fishing to the probable detriment of pelican food supply. Bostic and Banks (1966) found stingrays (*Dasyatidae*) and tonguefish (*Cunoglossidae*) in the pouch of a dead pelican near San Felipe in the Gulf of California. A stingray spine embedded in the bird's throat probably caused its death.

SHELTER REQUIREMENTS

None noted.

NESTING OR BEDDING

Pelicans prefer to nest on offshore island sites that are protected from flooding, human disturbance, and terrestrial predators such as raccoons (*Procyon lotor*) (Blus et al. 1974a, Schreiber personal communication). Although there are distinct similarities, there are also conspicuous differences in the types of nest sites selected by the two subspecies.

Eastern subspecies

Eastern brown pelicans build nests on the ground, on mud lumps, or in trees (Bent 1922). In Florida, they nest primarily in mangrove trees (*Avicennia germinans* and *Rhizophora mangle*) from 1 to 10 m above the high-tide mark (Schreiber 1979).

Ground nests vary greatly in size and structure from practically nothing to large, well-built

nests of sticks, reeds, straw, palmetto leaves, and grasses. Remains of old nests are often used, and fresh material may be stolen from newly constructed nests when the owner is gone. Nest diameter on Pelican Island, Florida, ranges from 46 to 61 cm, and height ranges from 10 to 13 cm. Arboreal nests are more firmly built of similar materials, on substantial stick platforms securely interwoven with the branches of the supporting tree (Bent 1922).

Pelicans are colonial nesters, and generally select small coastal islands in salt or brackish water and lying landward of barrier islands or reefs where they are protected from the surf and ocean storms (Williams et al. 1976).

California subspecies

The California brown pelican prefers to nest on steep, rocky slopes of islands, building its nests of sticks, grasses, and rubbish. In some areas, nests are reused year after year, accumulating filth and reaching heights as great as 1 m. On 12 April 1888, A. W. Anthony (*in* Bent 1922) found nests in groups of 20 to 30 on San Martin Island, located about 0.4 km from the beach and about 76 m above the sea. Most of the nests were built on the tops of low bushes, but many were on bare ground or blocks of lava. Sticks, twigs, kelp, sea-grass, and even a few bird bones were used as building material. On 16 April 1939, Bond (1942) found several nests on Anacapa Island in island oak (*Quercus tomentella*) and toyon (*Photinia arbutifolia*), at heights 3.2 to 4.8 m above the ground—an unusual nesting situation for the species.

Williams (1927) found nests on top of mats of poison oak at Point Lobos. Nests on mangroves over water on the Sinaloa coast are reported in a manuscript of the Denver Wildlife Research Center, U.S. Fish and Wildlife Service (1974).

RITUAL BEHAVIOR

S. C. Arthur (*in* Bent 1922) describes courtship behavior of a male *P. o. occidentalis* as a slow circling of the motionless female with ponderous elephantine tread, while he lifted his wings slightly and tilted his head far back. It is presumed that the courtship behavior of *P. o. californicus* is similar.

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

None other than noted elsewhere.

POPULATION NUMBERS AND TRENDS

Eastern subspecies

The Florida population is stable with an adult breeding population of 6,705 to 7,690 pairs in 1968-1970 (Williams and Martin 1968, 1970) and 6,000 to 8,000 pairs for the last 6 years. The estimated total population in Florida is less than 30,000 birds (Schreiber 1979).

Blus et al. (1974a) state that the South Carolina population declined from 5,000 to 1,000 pairs by the late 1960's.

Schreiber and Risebrough (1972) give a detailed breakdown of the status of the brown pelican population in each State. In North Carolina, the population on Shell Castle Island (northernmost breeding colony on the Atlantic coast) has fluctuated between 11 and 100 from 1960 through 1967. Fewer than 30 young were believed fledged in 1970. In South Carolina, colonies are found on the Cape Romain Wildlife Refuge and at Deveaux Bank south of Charleston. At Cape Romain Refuge, populations have fluctuated drastically from year to year. The Deveaux Bank colony has undergone a 90% reduction in the last 10 years, due perhaps to much of the bank's washing away. Brown pelicans have probably never nested in Georgia. There has been no nesting in Alabama since 1900, and in 1956-57, the local nonbreeding population declined sharply with no recovery as of 1972. In Louisiana, the once large population, estimated at between 75,000 and 85,000 (Arthur 1931), had decreased to four individuals by 1960, according to Audubon Christmas Bird Count estimates. Although Florida pelicans were released in Louisiana from 1968 to the 1970's and some were reported nesting, no native pelicans have bred since 1966 (Schreiber 1979). In Texas, fewer than 10 pairs nested in 1969 and 1970. The total population in Louisiana and Texas is now estimated to be under 500 (Schreiber 1979).

Population status is essentially unrecorded in eastern Mexico, the Caribbean, and Central America (Schreiber and Risebrough 1972).

California subspecies

About 1,000 to 1,500 adults were breeding in California in 1972; the California population has been declining 14% to 18% per year. The minimum population in Mexico and California was estimated at 100,000 (Fish and Wildlife Service 1973). Anderson et al. (1972b) estimated 21,000 resi-

dents on the California coast and somewhere near 62,000 breeding in the Gulf of California.

On Santa Barbara Island, California, between 300 and 400 birds were breeding July 1912. On Anacapa Islands, California, there were a large number of birds which apparently were not breeding on 5 July 1912 (Wright and Snyder 1913). There had been at least 500 nests there in June 1910 (Willett 1912, 1933). Willett (1910) counted 5 nests containing young on Prince Islet off San Miguel Island on 15 June 1910.

Wright (1909) and Stephens (1921) found large colonies with hundreds of nests on Los Coronados, Baja California, in early 1900's. In the early 1940's there were still several thousand pairs nesting there, according to Lewis Walker (*in* Schreiber and DeLong 1969). In 1958, pelicans were present in large numbers on Los Coronados and nesting was observed by Monte Kirven (*in* Schreiber and DeLong 1969). During the 1968 breeding season, on four occasions between April and June, only a few birds were present and none were nesting there (Schreiber and DeLong 1969). There was no nesting in 1963 (Keith et al. 1970).

For Santa Catalina, Santa Cruz, San Miguel, and San Nicolas, records are scanty but indicate that in the early 1900's irregular nesting (not every year) occurred on all of them (Willett 1912; Howell 1917). No active nests were found on those islands at any time in 1968 (Schreiber and DeLong 1969).

Historically, Santa Barbara Island has been second only to Anacapa as the most important pelican rookery on the Channel Islands. In 1912 several hundred birds bred there (Howell 1917). On 19 Aug. 1967, there were 400 to 500 on Surtill Rock just off Santa Barbara, where they nested that year. In 1968, 4 adults and 33 immatures were present on 4 April and 11 on 12 May but there was no nesting; nor was late nesting reported by the National Park Service. On Anacapa, breeding was first reported on all three islets in 1899 (Schreiber and DeLong 1969). In 1939, Bond (1942) reported about 2,000 pairs nesting on the West islet, Anacapa, which would indicate at least as many, if not more, birds present on that islet than found by previous observers. The largest number recorded for East Islet, in the Anacapa group is about 500 nests, found 5 June 1910 by Willett (1912). Pelicans nested on West Anacapa at least up until 1968, but not on East or Middle Anacapa (Bond 1942; Banks 1966; and Schreiber and DeLong 1969). On 20 March 1969, R. W.

Risebrough (Report to Patuxent Wildlife Research Center, 24 April 1969) counted 298 nests containing fresh plant material on Anacapa Island, but only 12 contained intact eggs.

The Monterey Bay and Peninsula area is very important for this species, as large numbers occur there following their northward postbreeding dispersal (Alan Baldrige *in lit.* 1968). Birds arrive there in mid-June and remain into December, with a peak of 2,243 on 23 Aug. 1968, over 1,000 present from August to October, and 2,300 counted on 15 Sep. 1968. Williams (1927) recorded the first known breeding site. He found 20 to 30 nests on 25 May 1927, 8 with eggs on 16 June 1927, and 55 with eggs on 29 May 1929 (Williams 1927, 1931). In 1966, H. L. Cogswell (*in Alan Baldrige in litt* (1968) recorded at least three nests with birds at Point Lobos, which seems to have been the last recorded breeding there.

Between 1 and 8 May 1969, there were nesting colonies in the Gulf of California at Puerto Refugio, Isla Lorenzo Norte, Isla Salsipuedes and Isla Pojio; numerous adults, nests, and intact eggs were found at all these colonies. Eggshells appeared sound, but there was evidence of abnormal reproduction including having many empty nests, collapsed and dehydrated eggs, and many nests having only 1 or 2 eggs instead of the usual 3 (Keith et al. 1970).

In 1974, about 95% of Pacific coast breeding sites were visited and found to have present about 25,000 breeding pairs and an estimated total population of about 70,000 (U.S. Fish and Wildlife Service, Denver Wildlife Research Center ms. 1974).

Pelican populations off the southern California coast appear to have oscillated historically in response to environmental changes, including changes in abundance of principal food fishes. Also the oceanic environment in that area is a constant state of flux. However, the overall trend toward population decline since the mid-1950's, with the normal oscillating pattern superimposed, has almost certainly been due to environmental pollution (Anderson and Anderson 1976).

REPRODUCTION

Eastern subspecies

The breeding season depends on location. Bent (1922) states that nesting begins on the Florida east coast in November and December, west coast in April, Louisiana coast in February, and South Carolina coast in May. However, L. J. Blus (personal communication) observed nesting

in South Carolina in March and April. Anderson and Hickey (1970) list breeding dates for the brown pelican throughout its range.

Williams and Joanen (1974) report that pelicans first nest successfully when 3 years old. All courtship activities are confined to the nest site. The male brings nesting materials to the female and she builds the nest. Normal clutch size is two or three eggs (Bent 1922, Schreiber 1979). Eggs are snowy white with blood stains when first laid, but turn dull and dirty during incubation (L. J. Blus personal communication). Eggs have a granular surface texture and average about 73 x 46.5 mm (Bent 1922). Both parents share in incubation and chick raising duties (Schreiber 1979).

Henny (1972) estimated that 1.2 to 1.5 fledglings per nesting effort are necessary to maintain a stable population. Schreiber and Risebrough (1972) state that this species is long-lived. One brown pelican banded in September 1933 was recaptured in November 1964 (Kennard 1975).

California subspecies

Like its eastern relative, *P. o. californicus* is a colonial nester. It first breeds at about 2 years of age. The timing of nesting varies considerably from year to year and between adjoining colonies during the same year. Clutch size is usually 3 eggs, less often 2. Incubation is by both sexes in turn, and requires about 4 weeks. Young are hatched over a span of days, and are fed by both parents by regurgitation. Age at first flight is 9 weeks (Palmer 1962).

On 12 April 1888, most of the nests on San Martin Island, Baja California, contained young ranging in age from just hatched to full-fledged birds capable of flying (A. W. Anthony *in Bent* 1922). Flightless young move about in flocks or "pods." They are pugnacious towards intruders, but vulnerable to attack by gulls (Wright 1919, A. B. Howell *in Bent* 1922). Egg dates for Los Coronados Islands are 29 March to 22 June (33 records) and 4 April to 6 May (17 records) (Bent 1922). On Anacapa Island, California, nest contents on 16 April 1939 ranged from fresh eggs to young about half grown with primaries just beginning to show (Bond 1942). A summary of reproduction on the Anacapa Islands from several observers shows great variation in timing, with adults carrying nesting material on 17 March 1911, while egg laying had begun 7 March 1916 on East Island and egg laying completed with one nest hatched on West Island; by 5 June 1910 on East Island, fresh eggs to nearly full grown were found; in August 1898 on West Island nearly

grown young were still present (Bond 1942).

Adult pelicans usually stayed on nests until approached within 5 or 6 m and returned by the time that observers were about 30 m away, but even so, ravens carried off at least 8 eggs when they were left exposed (Bond 1942).

On 20 March 1969, R. W. Risebrough (Report to Patuxent Wildlife Research Center, 24 April 1969) counted 298 nests containing fresh plant material, indicating occupancy, on Anacapa Islands, but only 12 contained intact eggs. Nine contained a single egg and 3 contained 2 eggs. Fifty-one nests contained a single broken egg. Eggshells were spongy in texture and slight pressure produced a change in shape. Shells appeared to have very little or no calcium carbonate, and it was apparent that the weight of incubating birds would cause breakage. One of the broken eggs had a DDE content of 68 ppm of the total contents or 522 ppm of yolk lipid. In a second colony on Anacapa on April 1969, there were 339 nests, with only 19 containing intact eggs and 1 out of 3 nests having collapsed, dehydrated eggs (Monthly Report, Denver Wildlife Research Center April 1969). On 26 and 27 July 1969, 635 nests were found on Anacapa. Two nests contained large chicks and 2 contained single incubated eggs. Thus, out of a minimum of 1272 nests built in 1969, only 5 may have produced young (F. H. Sibley, Report to Patuxent Wildlife Research Center, 28 July 1969).

There were 552 nesting attempts in two colonies on Anacapa in 1970, with but one chick produced. Reproductive failure was attributed to thin eggshells that collapsed during incubation. Aberrant behavior associated with reproduction was also observed. A survey of all traditional nesting sites in California produced no evidence of nesting. To the best of our knowledge, then, only one young pelican was hatched in California in 1970 (Gress 1970).

A total of 1,962 eggshells taken after 1949 for California oological collections were 26% below the normal weight of egg specimens taken before 1949, supporting the belief that shell thinning began after the wide-scale use of pesticides (Anderson and Hickey 1970).

By use of stepwise regression, Blus et al. (1971) found that DDE was the only residue that accounted for a significant amount of pelican eggshell thinning; accounted for a significant amount of pelican eggshell thinning; PCB's appeared to be of little, if any, importance in this respect.

On Border Island, Los Coronados, Baja California, only 19 intact eggs were found in 300 nests in April 1969. On Martin Island, 150 miles

south of the U.S. border, only 17 eggs were found in 100 nests (Monthly Report of Denver Wildlife Research Center, April 1969).

Brown pelicans showed varying reproductive success in different parts of their range and from 1969 to 1971, with the poorest off the California coast, improving slightly down the west coast of Baja California, and the best in the Gulf of California. About 4.4% of the population is suffering widespread excessively low recruitment. Of the relatively satisfactory Gulf of California population, it is estimated that 20% suffered eggshell thinning in excess of 11%. Anacapa Islands, Los Coronados, and west coast Baja California populations had the most eggshell thinning in 1968, 1970 and 1971. Here again, DDE seems to be the major factor contributing to thin eggshells and results in some reduction in reproduction. Other factors reducing reproduction related to human interference of several types. Various data suggest that the major source of DDE for brown pelicans is off Southern California (Anderson et al. 1975).

An indication of improved production on the California Islands was noted in 1972, when 112 nests were counted on Scorpion Rock off Santa Cruz Island, and 31 young had been produced there by 13 July. In the same year, 150 nests from which 26 young had been produced were found on Anacapa. Early nest failures were evident from the many cracked eggshells (from Monthly Narrative Report of Activities of Denver Wildlife Research Center, August 1972 by David W. Anderson and L. Rodney DeWeese).

In 1974, eggshell thinning was much less evident on the Pacific coast; many more young were produced and more adults bred in some colonies. About 1,400 adult pelicans were present in July on Anacapa and Santa Cruz Islands, where they build about 400 nests and produced about 300 young. However, collapsed eggs were found and 30% of nests on the islands were empty and deserted. Also, 15% of the adults were incubating addled eggs. About 0.75 young per nest were produced, which is still too little; about 1.3 to 1.5 young per adult pair are required to maintain the population. On the Coronados Islands, Baja California, the colony was much larger in 1974 than in any recent year but productivity averaged only 0.70 young per nest and collapsed eggs and nest desertions were common (up to 30% in some areas). On Isla San Martin, pelicans built 112 nests, all of which failed, probably due to human disturbance. At Isla San Benito, production was

excellent in 1974 with at least 1.5 young per nest, no nest desertion and no excessive losses of young. In the Gulf of California only about 60% of adults came to colonies to breed in 1974. Adults that did come failed to establish nests and left. In some areas, nest desertion approached 100%. Ultimate production was about 0.80 young per nest, and less than one half of adults established nests. Unusually poor food conditions were thought responsible. In recent years, severe and widespread failures in Gulf of California production has occurred during periods of food scarcity. However, it is possible that the DDE known to be present has aggravated the situation. Experiments have shown that minor restrictions of food supply seriously impair reproduction and that presence of DDE in birds increases the effect of food deprivation on reproductive condition (U.S. Fish and Wildlife Service, Denver Wildlife Research Center 1974; Keith 1978).

An asynchronous nesting pattern on Anacapa and Santa Cruz Islands in 1975 made estimates of production difficult. Production was: Anacapa - 212 nests, 182 young produced; Santa Cruz - 80 nests, 74 young produced, or 0.88 young per nest for both islands. This compares with 0.73 in 1974, 0.14 in 1973, 0.22 in 1972 and 0.007 in period 1969-71 for the same colonies. Neither DDE concentrations nor eggshell thickness differed significantly between 1974 and 1975, although the concentration of the chief food fish (anchovies) dropped. Pelican productivity is still 10% to 50% below the level necessary to maintain long-term population stability (Anderson et al. 1975; Anderson and Anderson 1976; Anderson et al. 1977).

MANAGEMENT AND CONSERVATION

State, Federal, and private cooperative research has been directed toward analysis of brown pelican eggshell conditions and the resulting reproductive failure. Waste discharge from pesticide manufacturing plants is being corrected. Population surveys have been conducted by the Fish and Wildlife Service. Continued research on the effects of environmental pollution and on life history and reproductive biology are recommended, but visits to nests should be kept to a minimum; strict regulation of the use of persistent chemical pesticides and discharge of wastes from plants that manufacture those products should be encouraged and all forms of pollution that degrade the pelican's environment should be eliminated. Sanctuary

status should be recorded for all areas with nesting colonies (U.S. Fish and Wildlife Service 1973).

Many eastern colonies are protected on Federal and State refuges and in National Audubon Society sanctuaries.

A recovery team for the eastern brown pelican has been appointed by the U.S. Fish and Wildlife Service to draft a recovery plan for reestablishing this species throughout its former range (Williams et al. 1976). The recovery outline includes restoring the pelican in vacant breeding habitat by identifying historic distribution, identifying or creating suitable breeding habitat and stocking selected sites.

In order to restock historic or depleted colonies, stocking methods must be developed and sources of birds located. The success of new colonies should be monitored for survival, reproduction, and limiting factors. Natural and restored colonies should be maintained at self-sustaining levels. Plans for monitoring populations and pertinent environmental factors vary from area to area and are outlined in Williams et al. (1976).

AUTHORITIES

Eastern subspecies

Lawrence J. Blus (Recovery Team)
U.S. Fish and Wildlife Service
Patuxent Wildlife Research Center
Laurel, MD 20810

Kirke A. King (Recovery Team)
U.S. Fish and Wildlife Service
P.O. Box 2506
Victoria, TX 77901

Larry L. McNease (Recovery Team)
Louisiana Wildlife and Fisheries Commission
Route 1, Box 25
Grand Chenier, LA 70643

Burkett S. Neely (Recovery Team)
U.S. Fish and Wildlife Service
Division of Wildlife Refuges
Washington, D.C. 20240

Stephen A. Nesbitt (Recovery Team)
Florida Game and Freshwater Fish
Commission
4005 South Main Street
Gainesville, FL 32601

Ralph W. Schreiber (Recovery Team)
Natural History Museum
Los Angeles, CA 90007

Lovett E. Williams (Recovery Team Leader)
Florida Game and Freshwater Fish
Commission
4005 South Main Street
Gainesville, FL 32601

California subspecies

Daniel W. Anderson
U.S. Fish and Wildlife Service
P.O. Box C
Davis, California 91616

Alan Baldrige
Hopkins Marine Station
Pacific Grove, California 93950

Monte N. Kirven
Natural History Museum
P.O. Box 1390
San Diego, California 12112

Robert DeLong
Department of Biology
University of California, Santa Cruz
Santa Cruz, California 95064

Fred C. Sibley
Peabody Museum
Yale University
New Haven, Connecticut 06520

Ralph W. Schreiber
Los Angeles County Museum
Exposition Park
Los Angeles, California 90007

Robert W. Risebrough
University of California
Berkeley, California 94720

Franklin Gress
University of California
Berkeley, California 94720

PREPARER'S COMMENTS

Eastern subspecies

None.

California subspecies

The California brown pelican is probably the most obvious and clearcut example of the effect of pesticide chemicals in the environment on the reproduction of birds. It is also probably the most thoroughly studied and documented example of those effects. The brown pelican, like other species that are members of oceanic current ecosystems, normally fluctuate widely in abundance

with the primary prey species (Anderson and Anderson 1976; Anderson et al. 1975). This is natural and the population dynamics of affected species is adapted to compensate for the periodic failures of food. However, the additional lowered reproduction caused by pesticide chemicals in the food, augmented by reduction in food from overfishing (Keith 1978), could easily tip the balance of survival toward extinction. Although the amount of DDE, the most important of chemicals affecting California brown pelican reproduction, has been reduced somewhat and reproduction has improved, the number of fledged young per nesting pair is still too low to maintain the pelican population. If chemical level is not further improved, and if overfishing of anchovies does go too far, it would appear that this subspecies of brown pelican is doomed to extinction.—John W. Aldrich.

LITERATURE CITED/SELECTED REFERENCES

- Addor, E. E., J. K. Stoll and V. E. LaGarde. 1973. Eastern brown pelican. *In* A user-accessed computer information system for environmentally sensitive wildlife. U.S. Army Eng. Waterways Exp. Stn. Tech. Rep. M-74-6. Rep. M-74-6.
- Anderson, D. W., and J. J. Hickey. 1970. Oological data on egg and breeding characteristics of brown pelicans. *Wilson Bull.* 82:14-28.
- Anderson, D. W., J. O. Keith, K. A. King and L. R. DeWeese. 1972. Field ecology investigations of effects of selected pesticides on wildlife populations. Post-breeding dispersal of brown pelicans and other waterbirds into the southwestern United States. U.S. Bureau of Sport Fisheries and Wildlife, Denver Wildlife Research Center Administrative Report, 4 Dec. 1972.
- . 1972a. Post-breeding dispersal of brown pelicans and other waterbirds into southwestern United States. U.S. Bureau of Sport Fisheries and Wildlife, Denver Wildlife Research Center, Ann. Prog. Rep. No. 3, 4 Dec. 1972. Prepared by D. W. Anderson and L. R. DeWeese.
- Anderson, D. W., J. O. Keith, R. E. White, K. A. King, and L. R. DeWeese. 1972. Brown Pelicans—status of *P. o. californicus*. U.S. Bur. Sport Fisheries and Wildlife, Denver Wildlife Res. Center Ann. Progress Report No. 2, 030 April 1972. Prepared by D. W. Anderson.

- Anderson, D. W., J. R. Jehl, Jr., R. W. Risebrough, L. A. Woods, Jr., L. R. DeWeese and W. G. Edgecomb. 1975. Brown Pelicans: improved reproduction off the southern California coast. *Science* 190 (4316):806-808.
- Anderson, D. W. and D. T. Anderson. 1976. Distribution and status of Brown Pelicans in the California Current. *Amer. Birds* 30:3-12.
- Anderson, D. W., L. R. DeWeese, and D. V. Tiller. 1977. Passive dispersal of California Brown Pelicans. *Bird-Banding* 48:228-238.
- A.O.U. 1957. Check-list of North American Birds, Fifth Edition. Amer. Ornith. Union, Baltimore. 691 pp.
- Arthur, S. C. 1931. The birds of Louisiana. *Bull. Louisiana Dept. Conserv.* 20:1-598.
- Baird, S. F., T. M. Brewer, and R. Ridgway. 1884. *Water Birds of North America* 2:143.
- Banks, R. C. 1966. Terrestrial vertebrates of Anacapa Island, California. *Trans. San Diego Soc. Nat. Hist.* 14:173-188.
- Bent, A. C. 1922. Life Histories of North American petrels and pelicans and their allies. *U.S. Nat. Mus. Bull.* 121:301.
- Blus, L. J. 1970. Measurements of brown pelican egg shells from Florida and South Carolina. *BioScience* 20:867-869.
- Blus, L. J., A. A. Belisle, and R. M. Prouty. 1974a. Relation of the brown pelican to certain environmental pollutants. *Pestic. Monit. J.* 7: 181-194.
- Blus, L. J., R. G. Heath, C. D. Ash, A. A. Belisle, and R. M. Prouty. 1971. Egg shell thinning in the brown pelican: implication of DDE. *BioScience* 21:1213-1215.
- Blus, L. J., T. Joanen, A. A. Belisle, and R. M. Prouty. 1975. The brown pelican and certain environmental pollutants in Louisiana. *Bull. Environ. Contam. Toxicol.* 5:231-236.
- Blus, L. J., B. S. Neeley, Jr., A. A. Belisle, and R. M. Prouty. 1974b. Organochlorine residues in brown pelican eggs: relation to reproductive success. *Environ. Pollut.* 7:81-91.
- Bond, R. M. 1942. Banding records of California Brown Pelicans. *Condor* 44:116-121.
- Bond, R. M. 1948. Returns of banded California Brown Pelicans. *Condor* 50:89.
- Bostic, D. L. and R. C. Banks. 1966. A record of stingray predation by Brown Pelican. *Condor* 68:515-516.
- Gress, F. 1970. Reproductive status of the California Brown Pelican in 1970 with notes on breeding biology and Natural History. Wildlife Management Branch Administrative Report no. 70-6. Federal Aid Project W-54-R.
- Grinnell, J. and A. H. Miller. 1944. The distribution of the Birds of California. *Pac. Coast Avifauna No.* 27:51-52.
- Heath, R. G., J. W. Spann, and J. F. Kreitzer. 1969. Marked DDE impairment of mallard reproduction in controlled studies. *Nature* 224:47-48.
- Henny, C. J. 1972. An analysis of the population dynamics of selected avian species—with special reference to change during the modern pesticide era. *U.S. Fish Wildl. Serv.—Wildl. Res. Rep.* 1. 99 pp.
- Howell, A. B. 1917. Birds of the islands off the coast of southern California. *Pac. Coast Avifauna* 12:40-41.
- Jehl, J. R., Jr. 1973. Studies of a declining population of Brown Pelicans. *Condor* 75:69-79.
- Keith, J. O. 1978. Synergistic effects of DDE and food stress on reproduction in Brown Pelicans and Ringdoves. Ph.D. thesis, Ohio State University.
- Keith, J. O., L. A. Woods, Jr., and E. G. Hunt. 1970. Reproductive failure in Brown Pelicans on the Pacific Coast. *Trans. 35th N. A. Wildlife Conf.* pp. 56-63.
- Kennard, J. 1975. Longevity records of North American birds. *Bird-Banding* 46:55-73.
- Mailliard, J. 1913. Dry season notes. *Condor* 15: 228.
- Murphey, R. C. 1936. Oceanic birds of South America. 2:808-810.
- Palmer, R. S. *ed.* 1962. *Handbook of North American birds*, Vol. 1. Yale University Press, New Haven. 567 pp.
- Peakall, D. B. 1970. p, p-DDT; effect on calcium metabolism and concentrations of estradiol in the blood. *Science* 168:592-594.
- . 1971. Effects of polychlorinated biphenyls (PCB's) on the egg shells of ring doves. *Bull. Environ. Contam. Toxicol.* 6:100-101.
- Peterson, R. T. 1947. *A field guide to the birds.* Houghton Mifflin, Boston. 230 pp.
- Risebrough, R. W., F. C. Sibley, and M. N. Kirven. 1971. Reproductive failure of the

- Brown Pelican on Anacapa Island in 1969. *Amer. Birds* 25:8-9.
- Schreiber, R. W. 1976a. Movements of color-marked brown pelicans in Florida. *Bird-Banding* 47:101-111.
- . 1976b. Growth and development of nesting brown pelicans. *Bird-Banding*.
- . 1977. Maintenance activities and communication in the brown pelican. *Am. Ornithologists' Union Monogr.* 22, 78 pp.
- . 1979. Eastern brown pelican. Pages 23-25 in H. W. Kale ed. *Rare and endangered biota of Florida, Vol. 2, Birds Univ. Presses of Florida, Gainesville.*
- Schreiber, R. W. and R. L. DeLong. 1969. Brown Pelican status in California. *Audubon Field Notes* 23:57-59.
- Schreiber, R. W. and R. W. Risebrough. 1972. Studies of the Brown Pelican, I. Status of Brown Pelican populations in the United States. *Wilson Bull.* 84:119-135.
- Schreiber, R. W., and E. A. Schreiber. 1973. Florida's brown pelican population: Christmas bird count analysis. *Am. Birds* 27:711-715.
- Schreiber, R. W., G. E. Woolfenden, and W. E. Curtsinger. 1975. Prey capture by the brown pelican. *Auk* 92:649-654.
- Sefton, J. W. 1927. The Ancient Murrelet at San Diego, with a note on the Brown Pelican. *Condor* 29:163-164.
- Stephens, F. 1921. Early spring notes on birds of Coronado Islands, Mexico. *Condor* 23:96-97.
- U.S. Fish and Wildlife Service. 1973. *Threatened Wildlife of the United States, 1973 edition.* U.S. Dept. of Interior Resource Publ. 114. GPO Washington, D.C.
- U.S. Department of the Interior. 1973. *Threatened wildlife of the United States.* Compiled by Office of Endangered Species and International Activities. *Bull. Sport Fish. Wildl. Resour. Publ.* 114. U.S. Govt. Printing Office, Washington, D.C. 289 pp.
- U.S. Fish and Wildlife Service, Denver Wildlife Research Center. 1974. *Summary of Brown Pelican research on the Pacific Coast of Mexico and the United States in 1974.* Ms. Denver Wildlife Research Center, 22 November 1974.
- Wetmore, A. 1945. A review of the forms of the Brown Pelican. *Auk* 62:577-586.
- Wiemeyer, S. W., and R. D. Porter. 1970. DDE thins egg shells of captive American kestrels. *Nature* 227:737-738.
- Willett, G. 1910. A summer trip to the northern Santa Barbara Islands. *Condor* 12:170-174.
- Willett, G. 1912. Birds of the Pacific slope of southern California. *Pac. Coast Avifauna* 7: 21.
- Willett, G. 1933. A revised list of the birds of southwestern California. *Pac. Coast Avifauna* 21:18-19.
- Williams, L. 1927. California Brown Pelicans nesting at Point Lobos, Monterey County, California. *Condor* 29:246-249.
- Williams, L. 1931. Further notes on California Brown Pelicans at Point Lobos, California. *Condor* 33:66-69.
- Williams, L. E., Jr., L. J. Blus, K. King, L. McNease, B. S. Neely, S. A. Nesbitt, and R.W. Schreiber. 1976. Recovery plan for the eastern brown pelican. Preliminary Draft.
- Williams, L. E., Jr., and T. Joanen. 1974. Age of first nesting of the brown pelican. *Wilson Bull.* 86:279-280.
- Williams, L. E., Jr., and L. Martin. 1968. Nesting status of the brown pelican in Florida in 1968. *Quart. J. Florida Acad. Sci.* 31:130-140.
- . 1970. Nesting populations of brown pelicans in Florida. *Proc. Annu. Conf. S.E. Assoc. Game and Fish Comm.* 24:154-169.
- Winn, B. 1975. Pesticides decimate transplanted pelicans. *Audubon* 75:127-129.
- Woodward, C. H. 1921. The California Brown Pelican as a navigator. *Condor* 23:137-138.
- Wright, H. 1909. An ornithological trip to Los Coronados Islands, Mexico. *Condor* 11:96-100.
- Wright, H. and G. K. Snyder. 1913. Birds observed in the summer of 1912 among the Santa Barbara Islands. *Condor* 15:86-92.

Biological Services Program

FWS/OBS-80/01.41
MARCH 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States-

THE JAGUAR



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

FWS/OBS-80/01.41
March 1980

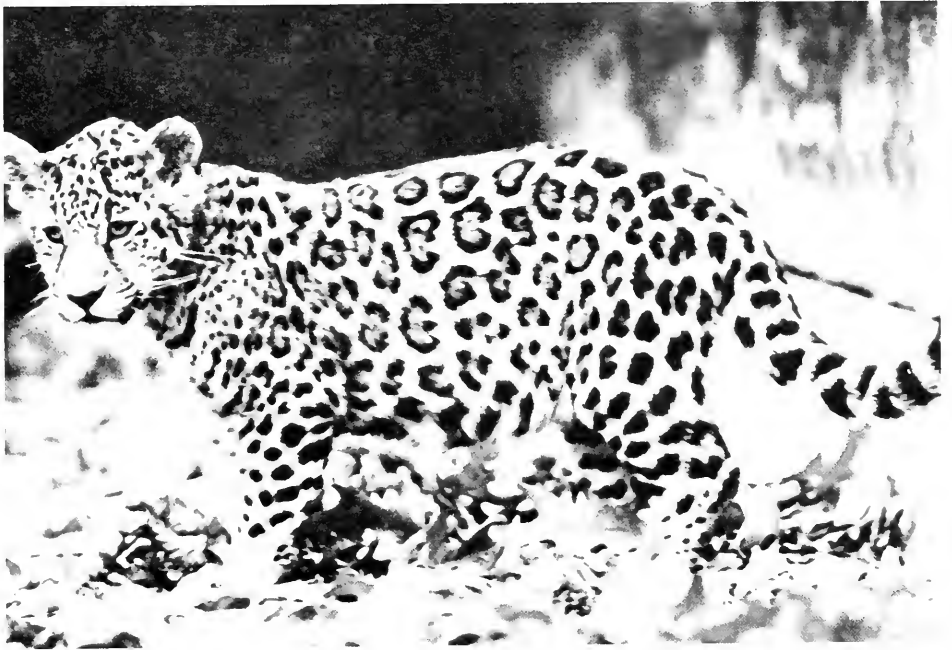
SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—

THE JAGUAR

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: SMITHSONIAN INSTITUTION

JAGUAR

Panthera onca Linnaeus

KINGDOM Animalia
 CLASS Mammalia
 ORDER Carnivora
 FAMILY Felidae
 OTHER COMMON
 NAMES spotted king cat,
 American tiger, "el tigre"

DATE

Entered into SWIS. to be determined
 Updates. May 1978.

LEGAL STATUS

Federal: Endangered (non-U.S. wild populations) (35 FR 18320, 2 December 1970); (44 FR 43705, 25 July 1979).
 Threatened (U.S. captive population) (42 FR 28956, 1 June 1977).

States: Endangered Arizona, New Mexico (extirpated), Texas.

REASONS FOR CURRENT STATUS

Deliberate persecution, excessive and illegal hunting, overexploitation by fur industry, and predator control activities have extirpated jaguars from much of their original range and seriously reduced numbers in most of the rest (IUCN 1972, Culbertson and Schmidly 1974, Davis 1974). Timber and brush clearing have degraded and destroyed habitat to the point where reestablishment of populations in the northern part of the range is doubtful (Davis 1974, Brownlee 1978). Mining and oil exploration and development have made formerly remote Central and South American areas more accessible to human activity and subsequent illegal killings of jaguars (IUCN 1972).

PRIORITY INDEX

None designated.

DESCRIPTION

The jaguar is the largest (1.5 to 2.2 m) and most robust of the American cats. The tail is short and somewhat bristly. Females average smaller than males. The ground color varies from pale yellow to rusty red dorsally, paler on the sides, and white on the underparts and inner surfaces of the legs. Markings are irregular blotches and rosettes, the latter centered with black spots. Young are more heavily spotted and their coats are woolier. Both black and albino individuals occur occasionally.

Photographs appear in Davis (1974), Guggisberg (1975), and Walker (1975).

RANGE

The jaguar was formerly distributed throughout the tropical lowlands of Mexico, Central America, and South America to about 40° S latitude (Calahane 1947, Hall and Kelson 1959, Guggisberg 1975). The former U.S. distribution included southern California (Merriam 1919, Strong 1926, Seton 1937), New Mexico (Bailey 1931, Seton 1937, Hill 1942, Halloran 1946, Findley et al. 1975), southern Arizona (Musgrave 1921, Schufeldt 1921, Poole and Schantz 1942, Hock 1955, Cockrum 1960), and possibly Louisiana (Nowak 1973, Lowery 1974), and Colorado (Seton 1920).

Today, jaguars are essentially absent from most of Mexico, Argentina, and settled provinces in the remaining Central and South American countries (IUCN 1972). There is no evidence for its present occurrence in Louisiana (Lowery 1974) or New Mexico (M. C. Conway personal communication); however, there may possibly be individuals in the border areas of the latter (Findley et al. 1975). It is essentially absent from other areas north of the Mexican border except as occasional stray individuals in the border counties of Texas and Arizona (Cockrum 1960, Davis 1974, Findley et al. 1975, Guggisberg 1975, Lowman 1975).

RANGE MAP

Crosshatched areas on the following map indicate possible range in border areas of U.S. (Cockrum 1960, Davis 1974, Findley et al. 1975, Guggisberg 1975, Brownlee 1978). Dots refer to sightings and/or kills during the past century.

STATES/COUNTIES

Arizona: Cochise, Pima, Santa Cruz.

New

Mexico: Dona Ana, Grant, Hidalgo, Luna.

Texas: Brewster, Cameron, Dimmit, Hidalgo, Kinney, Maverick, Starr, Terrell, Val Verde, Webb, Zapata.

HABITAT

The jaguar appears to require areas with cover (Ewer 1973, Lowman 1975). It inhabits tropical and subtropical forests ranging from mangrove swamps to rain forests (Alston 1882, IUCN 1972). At the southern extreme of the range, open savannas and deserts are used (IUCN 1972). Chaparral and timbered areas are preferred at the northern extreme of the range (Davis 1974). It appears to have a preference for areas near water (Davis 1974, Guggisberg 1975), but has been reported from deserts (Guggisberg 1975).

FOOD AND FORAGING BEHAVIOR

Principal foods are peccaries (*Tayassu* sp.) and capybaras (*Hydrochoerus* sp.) (Guggisberg 1975). It will also take tapirs (*Tapirus* sp.), agoutis (*Agouti* sp., *Dasyprocta* sp.), otters (*Lutra*), deer, small crocodylians, turtles and their eggs, large ground-nesting birds, and occasionally livestock (Denis 1964, Ewer 1973, Davis 1974, Guggisberg 1975, Lowman 1975).

It stalks prey until close enough to pounce (Guggisberg 1975), then drags the kill to the nearest thicket to be eaten. Remains are not usually covered (Hoffmeister 1971).

SHELTER REQUIREMENTS

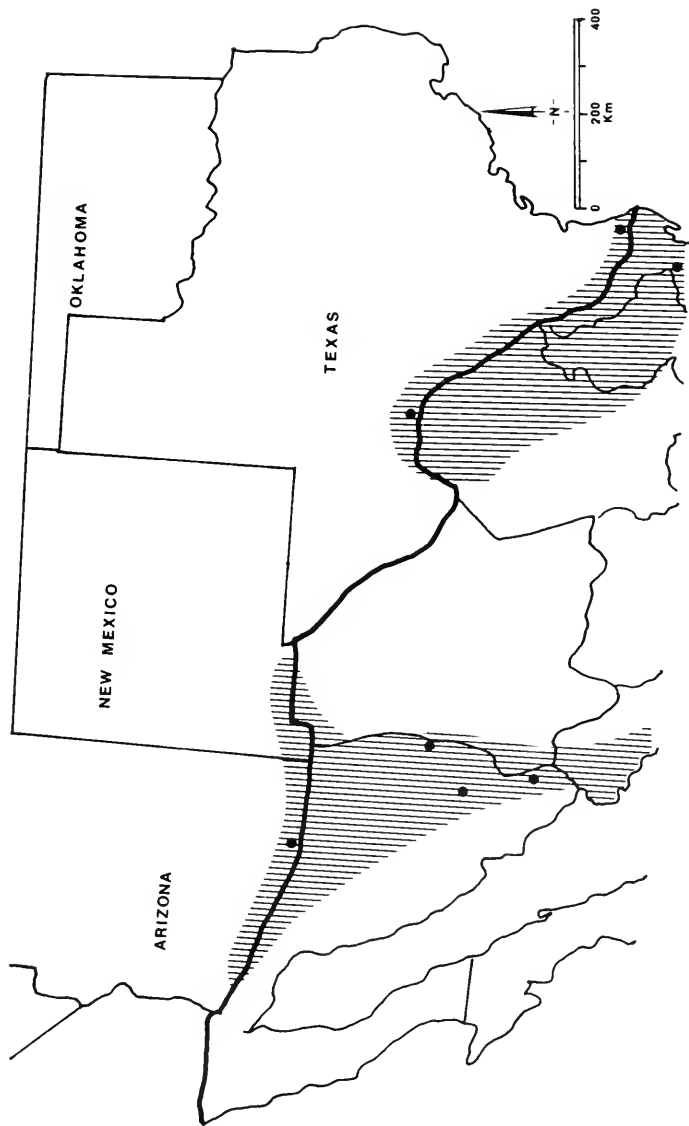
The jaguar requires dens in rocky caves or dense thickets (Davis 1974).

NESTING OR BEDDING

The jaguar raises its young in dens (see Shelter) (Davis 1974, Guggisberg 1975).

RITUAL REQUIREMENTS

The jaguar is solitary and somewhat territorial in its habits, except during the breeding season. Little is known about its territorial behavior beyond the fact that it will mark trees (Guggisberg 1975).



Possible range of the jaguar in southern United States and northern Mexico is indicated by crosshatching. Dots indicate locations of sightings or killings within the last century.

POPULATION NUMBERS AND TRENDS

Once common throughout its range, the jaguar is now uncommon to rare. Fair numbers remain in eastern Campeche, Selva Lacandone, eastern Chiapas, and eastern Oaxaca in Mexico and western El Peten in Guatemala (IUCN 1972). It is scattered and considered a pest in Argentina (IUCN 1972). North of Mexico, it occurs extremely rarely, in Texas, Arizona, and New Mexico (Hock 1955, Cockrum 1960, Culbertson and Schmidly 1974, Davis 1974). It is believed unlikely that the jaguar could reestablish in Texas, due to habitat loss (Brownlee 1978). No current population estimates are available. There are no viable breeding populations in the U.S. (W. C. Brownlee personal communication); the jaguar in the U.S. exists only as an occasional stray.

REPRODUCTION

The breeding season is year-round in tropical areas of the range (Cahalane 1946, Ewer 1975, Guggisberg 1975). In the more northern areas, breeding takes place in December and January with births in April and May (Davis 1974). Females are polyestrous (Ewer 1968) and males fight for first breeding rights (Guggisberg 1975). Gestation lasts 93 to 113 days (Asdell 1964, Denis 1964, Davis 1974). Litter size ranges from one to four with an average of two (Cahalane 1947, Denis 1964, Ewer 1973). The growth rate is not well known, but 8-week-old cubs will weigh from 2 to 3 kg (Hunt 1967). Young stay with the mother for about 2 years, at which time sexual maturity is reached (Denis 1964, Guggisberg 1975). Both parents help rear young, but the bulk of the burden is on the female (Guggisberg 1975). The family unit is maintained until the young are at least a year old (Davis 1974). Record longevity for a captive is 20 years (Guggisberg 1975).

MANAGEMENT AND CONSERVATION

No recovery team has been appointed for the jaguar. The species is protected in the U.S. and most of the Central and South American countries within its range, but laws are not adequately enforced (IUCN 1972). Colombia still allows hunting of all felid species. Protection in some Central and South American countries is provided in National Parks (IUCN 1972). Importation of skins to the U.S. is prohibited except by permit. However, illicit commerce to European and Asian markets is common (IUCN 1972).

The IUCN is surveying the jaguar's status in Latin America; in a cooperative venture, the U.S. Fish and Wildlife Service and the Direccion General de la Fauna Silvestre of Mexico with support from the National Wildlife Federation, the National Audubon Society, and the Texas and New Mexico Departments of Game and Fish, are surveying the population status in Mexico (USFWS 1978). A feline status survey by the Texas Parks and Wildlife Department has found no evidence of recent occurrence of jaguars in that State (Brownlee 1978).

Brush clearing in national wildlife refuges in the Lower Rio Grande Valley of Texas has been stopped to preserve rapidly disappearing brush habitat.

AUTHORITIES

W. C. Brownlee
Texas Parks and Wildlife Department
4200 Smith School Road
Austin, TX 78744

E. Leddell Cockrum
Department of Zoology
University of Arizona
Tucson, AZ 85719

W. B. Davis
Department of Wildlife and Fisheries Science
Texas A&M University
College Station, TX 77843

Roy McBride
Department of Biology
Sul Ross University
Box 725
Alpine, TX 79830

PREPARER'S COMMENTS

Literature is scarce on the habits and ecology of wild jaguar populations. More research is needed in this area. Status surveys are needed to assess population levels, in addition to protection of habitat.

LITERATURE CITED/SELECTED REFERENCES

- Alston, E. R. 1882. *Biologia Centrali-Americana*. Mammalia. 219 pp.
- Anthony, H. E. 1928. *Field book of North American mammals*. Putnam and Sons, New York. 674 pp.

- Asdell, S. A. 1964. Patterns of mammalian reproduction, 2nd ed. Cornell Univ. Press, Ithaca. 670 pp.
- Bailey, V. 1931. The mammals of New Mexico. N. Am. Fauna 53:283-285.
- . 1971. Mammals of the southwestern United States with special reference to New Mexico. Dover, New York. 412 pp.
- Brownlee, W. C. 1978. Feline status surveys. Job performance report. Project W-103-R-7. Tex. Parks Wildl. Dep., Austin. 4 pp.
- Cahalane, V. A. 1947. Mammals of North America. MacMillan Co., New York. 682 pp.
- Cockrum, E. L. 1960. The recent mammals of Arizona; their taxonomy and distribution. Univ. Ariz. Press, Tucson. 276 pp.
- Culbertson, K., and D. J. Schmidly. 1974. Summary statements on the state of the rare, endangered, and peripheral mammals in Texas. Tex. Organization for Endangered Species, Temple. 4 pp.
- Davis, W. B. 1974. The mammals of Texas. Tex. Parks Wildl. Dep. Bull. 41:1-294.
- Denis, A. 1964. Cats of the world. Houghton Mifflin Co., Boston. 144 pp.
- Ewer, E. F. 1968. Ethology of mammals. Logos Press Ltd., London. 418 pp.
- . 1973. The carnivores. Cornell Univ. Press. Ithaca. 494 pp.
- Findley, J. S., A. H. Harris, D. E. Wilson, and C. Jones. 1975. Mammals of New Mexico. Univ. New Mex. Press, Albuquerque. 360 pp.
- Guggisberg, C. A. W. 1975. Wildcats of the world. Taplinger Publ. Co., New York. 382 pp.
- Hall, E. R., and K. R. Kelson. 1959. The mammals of North America. 2 vols. Ronald Press, New York. 1,083 pp.
- Halloran, A. F. 1946. Mammals of the Chiricahua Mountains, Cochise County, Arizona. J. Mammal. 27:154-161.
- Hill, J. E. 1942. Notes on mammals of northeastern New Mexico. J. Mammal. 23:75-82.
- Hock, R. J. 1855. Southwestern exotic felids. Am. Midl. Natur. 53:324-328.
- Hoffmeister, D. F. 1971. Mammals of Grand Canyon. Univ. Illinois Press, Chicago. 183 pp.
- Hunt, H. 1967. Growth rate of a new-born, hand-reared jaguar (*Panthera onca*) at Topeka Zoo. Int. Zoo. Yearb. 7:147-148.
- IUCN. 1972. Red data book. Vol. I. Mammalia. Compiled by H. A. Goodwin and C. W. Hollaway. IUCN, Morges, Switzerland.
- Layne, J. N. 1974. The land mammals of Florida. In Gleason, P. J., ed. Environments of south Florida, past and present. Mem. 2. Miami Geol. Soc. 452 pp.
- Leopold, A. S. 1959. Wildlife of Mexico: the game birds and mammals. Univ. California Press, Berkeley. 568 pp.
- Lowery, G. E. 1974. The mammals of Louisiana and its adjacent waters. Louisiana State Univ. Press, Baton Rouge. 565 pp.
- Lowman, G. E. 1975. A survey of endangered, threatened, rare, status undetermined, peripheral, and unique mammals of the southeastern National Forests and Grasslands. USDA, For. Serv., Atlanta, Ga. 121 pp.
- McCarly, H. 1959. The mammals of eastern Texas. Tex. J. Sci. 2:385-426.
- Merriam, C. H. 1919. Is the jaguar entitled to a place in the California fauna? J. Mammal. 1: 38-40.
- Musgrave, M. E. 1921. Predatory animals in Arizona. Am. Game Project. Assoc. Bull. 10: 11-12.
- Nelson, E. W., and E. A. Goldman. 1929. Revision of the jaguar. J. Mammal. 14:221-240.
- Nowak, R. M. 1973. A possible occurrence of the jaguar in Louisiana. Southwest Natur. 17: 430-432.
- Pool, A. J., and V. S. Schantz. 1942. Catalog of the type specimens of mammals in the United States National Museum, including Biological Survey collection. Bull. U.S. Natl. Mus. 178: 58.
- Schufeldt, R. W. 1921. The mountain lion, ocelot, lynx, and their kin. Am. Forest. 27:629-636.
- Seton, E. T. 1920. The jaguar in Colorado. J. Mammal. 1:241.
- . 1937. Lives of game animals. Literary Guild, New York.
- Stehlik, J. 1971. Breeding jaguars; *Panthera onca*; at Ostrava Zoo. Int. Zoo. Yearb. 11:116-118.

- Strong, W. D. 1926. Indian records of California carnivores. *J. Mammal.* 7:59-60.
- Taylor, W. P. 1947. Recent record of the jaguar in Texas. *J. Mammal.* 28:66.
- USFWS. 1973. Threatened wildlife of the United States. Compiled by Office of Endangered Species and International Activities. *Bur. Sport Fish. Wildl. Resour. Publ.* 114. U.S. Gov. Printing Office, Washington, D.C. 289 pp.
- USFWS. 1978. International activities. U.S.-Mexican Cooperation. *Endangered Species Tech. Bull.* 111(3):8-9.
- Walker, E. P. 1975. *Mammals of the world.* 2 vols. Johns Hopkins Press, Baltimore. 1,500 pp.

ACCOUNT PREPARED/UPDATED BY:

National Fish and Wildlife Laboratory
412 N.E. 16th Avenue, Room 250
Gainesville, FL 32601

Biological Services Program

FWS/OBS-80/01.42

MARCH 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States-

THE GRAY BAT



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

FWS/OBS-80/01.42
March 1980

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—

THE GRAY BAT

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: R. K. LAVAL

GRAY BAT

Myotis grisescens (Howell)

KINGDOM Animalia
 CLASS Mammalia
 ORDER Chiroptera
 FAMILY Vespertilionidae
 OTHER COMMON

NAMES Gray myotis, cave bat,
 Howell's bat, Tennessee brown bat

DATE

Entered into SWIS. to be determined
 Updates 8 August 1978

LEGAL STATUS

Federal: Endangered (41 FR 17740, 28 April 1976).

States: Endangered: Florida, Georgia, Indiana, Illinois, Missouri, Tennessee, North Carolina.

REASONS FOR CURRENT STATUS

The primary cause for the species current reductions from former population levels is human disturbance of caves in which the bats roost, rear young, or hibernate (Manville 1962; Barbour and Davis 1969; Tuttle 1977, 1979). Gray bats are intolerant of human disturbance and Tuttle (1979) has shown a direct correlation between frequency of human disturbances and population reductions. Fully 95% of the entire species winters in just nine caves, and over 60% winters in a single cave in northern Alabama, making the species extremely vulnerable to significant population reductions. Gray bats, with few exceptions, also spend the summers in caves (not the same ones used for hibernation) and are equally vulnerable in these (Tuttle 1979). Deliberate vandalism as well as frequent human invasion of caves where gray bats live has eliminated many colonies and drastically reduced most others (Tuttle 1979).

Environmental disturbances such as deforestation and chemical and pesticide contamination

may also adversely affect gray bat populations. A very low reproductive rate makes recovery of depleted colonies questionable.

PRIORITY INDEX

Not assigned.

DESCRIPTION

Adults are medium sized. Forearms are 40 to 47 mm long. Summer weights are 8 to 10 g, but go as high as 16 g just prior to migration. Fur is uniformly gray immediately following molting in late June or July, and bleaches to bright russet by the following May or June, especially in reproductive females. Russet colored animals are most conspicuous in crowded or southern roosts. The most useful field mark is the bat's unicolored dorsal fur; all other southeastern bats have conspicuously bi- or tricolored dorsal fur (Barbour and Davis 1969). Illustrations appear in Barbour and Davis (1969) and Odum et al. (1977).

RANGE

The gray bat's range extends from eastern Oklahoma and Kansas eastward to southwestern Virginia and western North Carolina; southern Illinois and Indiana southward to northern Florida (Hall and Kelson 1959, Hall and Wilson 1966, Tuttle 1966, Barbour and Davis 1969, Humphrey and Tuttle 1979). Bats winter in caves, primarily in North Carolina, Alabama, Missouri, and Tennessee.

RANGE MAP

Cross-hatching on the following map shows the species' summer range. Dots indicate major winter caves (Hall and Kelson 1959, Barbour and Davis 1969, Tuttle and Robertson 1969, Tuttle 1976b, Elder and Gunier 1978).

STATES/COUNTIES

Alabama: Blount, Bullock, Calhoun, Chambers, Cherokee, Clay, Cleburne, Coffee, Colbert, Coosa, Cullman, Dale, De Kalb, Elmore, Etowah, Geneva, Henry, Houston, Jackson, Jefferson, Lauderdale, Lawrence, Limestone, Macon, Madison, Montgomery, Morgan, Pike, Randolph, Russell, St. Clair, Shelby, Talladega, Tallapoosa.

Arkansas: Baxter, Benton, Boone, Carroll, Clay, Cleburne, Conway, Craighead, Crawford, Crittenden, Cross, Faulkner,

Franklin, Fulton, Greene, Independence, IZard, Jackson, Johnson, Lawrence, Lee, Logan, Madison, Marion, Mississippi, Monroe, Newton, Poinsett, Pope, Prairie, Randolph, St. Francis, Searcy, Sharp, Stone, Van Buren, Washington, White, Woodruff.

Florida: Baker, Bay, Calhoun, Columbia, Dixie, Franklin, Gadsden, Gulf, Hamilton, Holmes, Jackson, Jefferson, Lafayette, Leon, Liberty, Madison, Nassau, Suwannee, Taylor, Wakulla, Walton, Washington.

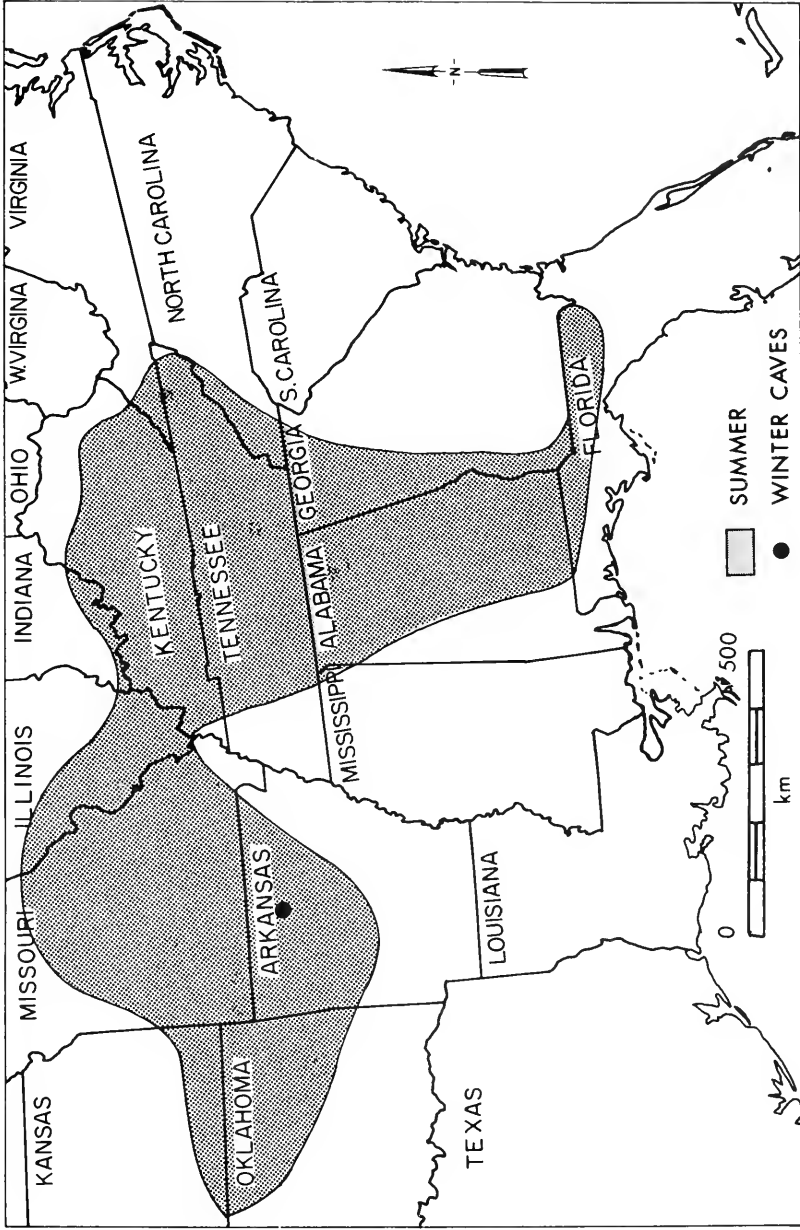
Georgia: Bartow, Carroll, Catoosa, Chattahoochee, Chattooga, Cherokee, Clay, Clayton, Cobb, Coweta, Dade, Dawson, Decatur, De Kalb, Douglas, Early, Fannin, Fayette, Floyd, Forsyth, Fulton, Gilmer, Gordon, Haralson, Harris, Heard, Lumpkin, Meriwether, Miller, Murray, Muscogee, Paulding, Pickens, Polk, Quitman, Randolph, Seminole, Stewart, Towns, Troup, Union, Walker, White, Whitfield.

Illinois: Adams, Alexander, Bond, Brown, Calhoun, Cass, Clay, Clinton, Edwards, Fayette, Franklin, Gallatin, Greene, Hamilton, Hardin, Jackson, Jefferson, Jersey, Johnson, Macoupin, Madison, Marion, Massac, Monroe, Montgomery, Morgan, Perry, Pike, Pope, Pulkaski, Randolph, St. Clair, Saline, Sangamon, Scott, Union, Wabash, Washington, Wayne, White, Williamson.

Indiana: Crawford, Dubois, Floyd, Gibson, Harrison, Knox, Orange, Perry, Pike, Posey, Spencer, Vanderburgh, Warrick, Washington.

Kansas: Barber, Bourbon, Chautauqua, Cherokee, Cowley, Crawford, Elk, Harper, Labette, Montgomery, Neosho, Sumner, Wilson.

Kentucky: Adair, Allen, Anderson, Ballard, Baren, Rath, Bell, Bourbon, Boyle, Breathitt, Breckenridge, Bullitt, Butler, Caldwell, Calloway, Carlisle, Carter, Casey, Christian, Clark, Clay, Clinton, Crittenden, Cumberland, Daviess, Edmonson, Elliott, Estill, Fayette, Fleming, Franklin, Fulton, Garrard, Grant, Graves, Grayson, Green, Hancock, Hardin, Harlan, Harrison, Hart, Hen-



Map depicts the present range of the gray bat and winter caves.

derson, Henry, Hickman, Hopkins, Jackson, Jefferson, Jessamine, Knox, Larue, Laurel, Lee, Leslie, Letcher, Lincoln, Livingston, Logan, Lyon, McCracken, McCreary, McLean, Madison, Magoffin, Marion, Marshall, Meade, Menifee, Mercer, Metcalfe, Monroe, Montgomery, Morgan, Muhlenberg, Nelson, Nicholas, Ohio, Oldham, Owen, Owsley, Perry, Powell, Pulaski, Rockcastle, Rowan, Russell, Scott, Shelby, Simpson, Spencer, Taylor, Todd, Trigg, Union, Warren, Washington, Wayne, Webster, Whitley, Wolfe, Woodford.

Mississippi: Tishomingo.

Missouri: Audrain, Barry, Barton, Benton, Bollinger, Boone, Butler, Callaway, Camden, Carter, Cedar, Christian, Cole, Cooper, Crawford, Dade, Dallas, Dent, Douglas, Franklin, Gasconade, Greene, Hickory, Howard, Howell, Iron, Jasper, Jefferson, Laclede, Lawrence, Lincoln, McDonald, Madison, Maries, Marion, Miller, Moniteau, Monroe, Montgomery, Morgan, Newton, Oregon, Osage, Ozark, Perry, Pettis, Phelps, Pike, Polk, Pulaski, Ralls, Randolph, Reynolds, Ripley, St. Charles, St. Claire, St. Francois, Ste. Genevieve, St. Louis, St. Louis City, Saline, Shannon, Stone, Taney, Texas, Warren, Washington, Wayne, Webster, Wright.

North

Carolina: Avery, Buncombe, Cherokee, Clay, Graham, Haywood, Jackson, Macon, Madison, McDowell, Mitchell, Swain, Yancey.

Oklahoma: Adair, Alfalfa, Cherokee, Craig, Creek, Delaware, Garfield, Grant, Haskell, Hughes, Kay, Kingfisher, LeFlore, Lincoln, Logan, McIntosh, Major, Mayes, Muskogee, Noble, Nowata, Okfuskee, Oklahoma, Okmulgee, Osage, Ottawa, Pawnee, Payne, Pittsburg, Pottawatomie, Seminole, Sequoyah, Rogers, Wagoner, Woods.

Tennessee: Anderson, Bedford, Benton, Bledsoe, Blount, Bradley, Campbell, Cannon, Carroll, Cheatham, Chester, Claiborne, Clay, Cocke, Coffee, Crockett, Cumberland, Davidson, Decatur, DeKalb, Dickson, Dyer, Fayette, Fentress,

Franklin, Gibson, Giles, Grainger, Greene, Grundy, Hamblen, Hamilton, Hancock, Hardeman, Hardin, Hawkins, Haywood, Henderson, Henry, Hickman, Houston, Humphreys, Jackson, Jefferson, Knox, Lake, Lauderdale, Lawrence, Lewis, Lincoln, Loudon, McMinn, McNairy, Macon, Madison, Marion, Marshall, Maury, Meigs, Monroe, Montgomery, Moore, Morgan, Obion, Overton, Perry, Pickett, Polk, Putnam, Rhea, Roane, Robertson, Rutherford, Scott, Sequatchie, Sevier, Shelby, Smith, Stewart, Sumner, Tipton, Trousdale, Union, Van Buren, Warren, Wayne, Weakley, White, Williamson, Wilson.

Virginia: Lee, Scott, Wise.

HABITAT

In summer, this migratory species inhabits areas in which open water and the banks of streams, lakes, or reservoirs are within manageable distances of roosting sites and suitable caves in which to rear young (LaVal et al. 1976, 1977; Tuttle 1976a). In winter, it inhabits caves having suitable temperatures for its hibernation.

FOOD AND FORAGING BEHAVIOR

Major food items consist of aquatic and non-aquatic soft-bodied insects (R. LaVal personal communication), especially Mayflies (Ephemeroptera) (Tuttle 1979).

Gray bats fly directly from cave to feeding site with few stops. They feed by continuous pursuits, remaining in the air most of the time. Most foraging is done over lakes and rivers where aquatic insects are abundant (Tuttle 1976a, 1979). LaVal et al. (1976, 1977) found foraging taking place along the vegetated edges of bodies of water.

SHELTER REQUIREMENTS

In winter, the species requires deep, cold caves (preferably 6° to 9° C) for hibernation. These caves average 10° below the mean annual surface temperature, and function as cold-air traps, having multiple entrances and good air flow (Tuttle and Stevenson 1979). The caves are already cold in September when the bats arrive (M. Tuttle personal communication).

NESTING AND BEDDING

In summer, females need warm caves (14° to 27° C) for rearing young. Important characteristics of bat caves include small chambers (Dwyer 1963), high places in domed ceilings (Davis et al. 1962), or domes or small pockets within these locations (Dwyer 1963, Dwyer and Hamilton-Smith 1965, Dwyer and Harris 1972), and depth of etching and porosity of the rock surface (Tuttle 1975b). Males, nonreproductive females, postlactating females, and juveniles, also use caves in summer, but not the same ones used as maternity sites (Tuttle 1976b).

RITUAL REQUIREMENTS

Not known.

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

The gray bat is perhaps the U.S. mammal most narrowly restricted to cave habitats (Hall and Wilson 1966; Barbour and Davis 1969; Tuttle 1976a, 1979). For all practical purposes, it lives in caves the year round (Tuttle 1979). It is essential that the bats choose roosts, generally caves, having temperatures appropriate to the desired metabolic processes: warm for digestion and growth in the summer, and cool for torpor in the fall and winter (Twente 1955). However, in the summer, gray bats will use man-made structures that simulate cave conditions (e.g., storm sewers in Kansas and Illinois [Hays and Bingham 1964, Elder and Gunier 1978], and a barn in Missouri [Gunier and Elder 1971]).

A minimal colony size is needed to maintain an adequate roost environment; otherwise, the colony may fail (Tuttle 1975b, 1979). Because travel is such a high-energy activity, the bats need summer caves close to feeding areas—usually within 1 km and no more than 4 km from the nearest feeding areas. The distances from maternity sites to feeding areas are important in influencing post-flight growth and survival (Tuttle 1976a).

POPULATION TRENDS

The estimated total population of the gray bat is 1 million (Tuttle 1975a). Five major caves have not been used in the past 20 years (Tuttle 1975a). Twenty-two summer localities in Tennessee and Alabama were censused in 1970 and again in 1976. A 64% reduction in numbers was recorded for this period (Tuttle 1979). The decline is attributed mainly to a marked increase in human dis-

turbance over that period (Tuttle 1979). In 1978 R. LaVal (personal communication) censused 27 Missouri caves that Myers (1964) had censused in 1964. Adult females and young had declined approximately 80%, and 16 caves occupied in 1964 had been abandoned. Estimates for the entire State are not available, but the trend is downward (R. LaVal personal communication), and is likely to continue downward because of the bats' intolerance to disturbance, their concentration in a few caves, and the possible effects of pesticide poisoning (R. LaVal personal communication).

REPRODUCTION

Copulation occurs in the fall; females store sperm over the winter (Barbour and Davis 1969). Young are born in late May to early June and fly by late June or mid-July (Tuttle 1976a). Sexual maturity is reached at 2 years (Tuttle 1976a), although LaVal et al. (1976) suggest that yearlings breed. The females bear one young, and generally, only females and young occupy the nursery cave (Tuttle 1976b). Longevity is high—to 17 years—but survival is only about 50% to maturity, so that it takes a female about 5 years to produce two surviving offspring (M. Tuttle personal communication).

MANAGEMENT AND CONSERVATION

Until recently, there has been no management or conservation effort. Most caves are in private ownership (Tuttle 1975a). Several caves have recently come under protection by Federal and private owners (Harvey 1975, Tuttle 1979), but improper gating of entrances, which results in decreased air flow, has caused the loss of several important colonies (Tuttle 1977, Tuttle and Stevenson 1978). Predation at cave entrances has increased with many types of gate. Bats slow down, circle, or climb through the gates, increasing their vulnerability to predators (Tuttle 1977). The U.S. Army Corps of Engineers Meramec Park Lake and Union Lake Projects in Missouri, which could eliminate 50% of the gray bats in that area and alter 60% of the foraging habitat, have been temporarily restrained (LaVal et al. 1976). A Recovery Team is being formed (M. Tuttle personal communication).

Tuttle (1979) makes the following recommendations for conservation of this species:

- (1) purchase several major caves, which are essential to the survival of the gray bat, and protect them by proper gating;
- (2) educate spelunkers and persons interested in visiting bats in winter

caves; (3) disclose the locations of unprotected bat caves only after providing information on the procedures necessary to avoid disturbing the bats.

AUTHORITIES

R. K. LaVal
Missouri Department of Conservation
1110 College Avenue
Columbia, MO 65201

M. D. Tuttle
Milwaukee Public Museum
800 West Wells Street
Milwaukee, WI 53233

Dr. Richard LaVal (Recovery Team Leader)
2816 Mexico Gravel Road
Columbia, Missouri 65201

Dr. Merlin Tuttle (Recovery Team)
Vertebrate Division
Milwaukee Public Museum
Milwaukee, Wisconsin 53233

Dr. Tom Kunz (Recovery Team)
Department of Biology
Boston University
2 Cummington
Boston, Massachusetts 02215

Dr. Don Wilson (Recovery Team)
National Fish and Wildlife Laboratory
National Museum of Natural History
Washington, D.C. 20560

Mr. John Brady (Recovery Team)
St. Louis District
Corps of Engineers
210 North 12th Street
St. Louis, Missouri 63101

PREPARER'S COMMENTS

None.

LITERATURE CITED/SELECTED REFERENCES

- Barbour, R. W., and W. H. Davis. 1969. Bats of America. Univ. Press, Kentucky, Lexington. 286 pp.
- Davis, R. B., C. F. Herreid, II, and H. L. Short. 1962. Mexican free-tailed bats in Texas. *Ecol. Monogr.* 32:311-346.

- Dwyer, P. D. 1963. The breeding biology of *Miniopterus schreibersi blepotis* (Temminck) (Chiroptera) in north-eastern New South Wales. *Australian J. Zool.* 11:219-240.
- Dwyer, P. D., and E. Hamilton-Smith. 1965. Breeding caves and maternity colonies of the bent-winged bat in south-eastern Australia. *Helictite* 4:3-21.
- Dwyer, P. D., and J. A. Harris. 1972. Behavioral acclimatization to temperature by pregnant (*Miniopterus*) (Chiroptera). *Physiol. Zool.* 45: 14-21.
- Elder, W. H., and W. J. Gunier. 1978. Sex ratios and seasonal movements of gray bats (*Myotis grisescens*) in Southwestern Missouri and adjacent States. *Am. Midl. Natur.* 99(2):463-472.
- Gunier, W. J., and W. H. Elder. 1971. Experimental homing of gray bats to a maternity colony in a Missouri barn. *Am. Midl. Natur.* 86:502-506.
- Hall, E. R., and K. R. Kelson. 1959. The mammals of North America. Vol. 1. Ronald Press, New York. 546 pp.
- Hall, J. S., and N. Wilson. 1966. Seasonal populations and movements of the gray bat in the Kentucky area. *Am. Midl. Natur.* 75:317-324.
- Harvey, M. J. 1975. Endangered Chiroptera of the southeastern United States. *Proc. Annu. Conf. Southeast. Assoc. Game and Fish Comm.* 29: 429-433.
- Hays, H. A., and D. C. Bingham. 1964. A colony of gray bats in southeastern Kansas. *J. Mammal.* 45:150.
- Humphrey, S. R., and M. D. Tuttle. 1979. Gray bat. Pages 1-3 in J. N. Layne, ed. Rare and endangered biota of Florida, Vol. 1, Mammals. Univ. Presses of Florida, Gainesville.
- LaVal, R. K., R. L. Clawson, W. Caire, L. R. Wingate, and M. L. LaVal. 1976. An evaluation of the status of Myotine bats in the proposed Meramec and Union Lake project areas, Missouri. School of Forestry, Fish, and Wildl. Univ. Missouri, Columbia. 136 pp.
- LaVal, R. K., R. L. Clawson, M. L. LaVal, and W. Claire. 1977. Foraging behavior and nocturnal activity patterns of Missouri bats, with emphasis on the endangered species *Myotis grisescens* and *Myotis sodalis*. *J. Mammal.* 58: 592-599.

- U.S. Fish and Wildlife Service. 1978. Osceola National Forest phosphate extraction and processing: impacts on Federally listed threatened or endangered and other species of concern. U.S. Dep. Inter., Fish Wildl. Serv., Office Biological Serv., Washington, D.C. 414 pp.
- Odum, R. R., J. L. McCollum, M. A. Neville, and D. R. Ettman. 1977. Georgia's protected wildlife. Georgia Dep. Natur. Resour., Game Fish Div., End. Wildl. Progr. 84 pp.
- Tuttle, M. D. 1975a. Proposal for inclusion of the gray bat (*Myotis grisescens*) on the U.S. Rare and Endangered Species List. U.S. Dep. Inter., Fish and Wildl. Serv., Office Endangered Species.
- . 1975b. Population ecology of the gray bat (*Myotis grisescens*): Factors influencing early growth and development. Occas. Pap. Mus. Natur. Hist., Univ. Kansas, 36:1-24.
- . 1976a. Population ecology of the gray bat (*Myotis grisescens*): Factors influencing growth and survival of newly volant young. Ecology 57:587-595.
- . 1976b. Population ecology of the gray bat (*Myotis grisescens*): Philopatry, timing and patterns of movement, weight loss during migration, and seasonal adaptive strategies. Occas. Pap. Mus. Natur. Hist., Univ. Kansas 54:1-38.
- . 1977. Gating as a means of protecting cave dwelling bats. Pages 77-82 in Natl. Cave Manage. Symp. Proc., 1976. Speleobooks, Albuquerque. 106 pp.
- . 1978. *Myotis grisescens*. In Endangered species of the Great Lakes Region. U.S. Fish Wildl. Serv. Region 3. 3 pp.
- . 1979. Status, causes of decline, and management of endangered gray bats. J. Wildl. Manage. 43(1):1-17.
- Tuttle, M. D., and P. B. Robertston. 1969. The gray bat, *Myotis grisescens*, east of the Appalachians. J. Mammal. 50:370.
- Tuttle, M. D., and D. E. Stevenson. 1978. An analysis of movement as a mortality factor in the gray bat, based on public recoveries of banded bats. Am. Midl. Natur. 97:235-240.
- . 1978. Variation in the cave environment and its biological implications. Natl. Cave Manage. Symp. Proc. 1977. In press.
- Twente, J. W., Jr. 1955. Some aspects of habitat selection and other behavior of cavern-dwelling bats. Ecology 36:706-732.

GATEKEEPER

To be designated by the Office of Endangered Species.

ACCOUNT PREPARED/UPDATED BY:

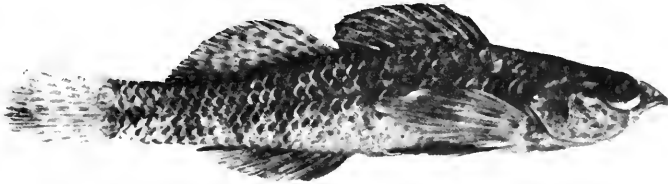
National Fish and Wildlife Laboratory
412 N.E. 16th Avenue, Room 250
Gainesville, FL 32601

Biological Services Program

FWS/OBS-80/01.43
MARCH 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States-

THE OKALOOSA DARTER



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

FWS/OBS-80/01.43
March 1980

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—

THE OKALOOSA DARTER

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior

struction, increased sedimentation, and possible construction of dams in the future (Yerger 1979). Mettee (1976) mentioned that there has been some interest in damming several of the streams occupied by this darter.

There are presently 15 impoundments on the drainage system occupied by the Okaloosa darter. Two on Tom's Creek were made by beavers and the rest were made by man. Most of these have produced little effect on darter populations above and below impoundments, but darters are unable to use the reservoir portions. Two eutrophic impoundments on the portion of Mill Creek flowing through the golf course at Eglin Air Force Base have adversely affected populations below the impoundments, presumably due to higher nutrient content, higher temperature, and increased turbidity (Crittenden 1974).

Some types of habitat alteration such as road and powerline crossings may not permanently affect darter populations. Road construction appears to be harmful for a time (due to excessive siltation), but once established, the bordering stream may support an abundant darter population due to increased sunlight, stimulating aquatic plant growth (Crittenden 1974).

In one instance (Swift Creek at State Highway 285) no specimens of Okaloosa darter were taken following road construction, while the brown darter was abundant; it is impossible to say whether habitat destruction or competition with the brown darter was responsible for the absence of Okaloosa darters at this site (Mettee et al. 1976). Right of way clearing for powerlines may be detrimental if exposure of long sections of streams to sunlight raises the water temperature (Crittenden 1974).

Presently, a new highway bypassing the cities of Niceville and Valparaiso is being constructed; it will bridge Tom's Creek and Turkey Creek. Highway 85 bridging Juniper (Ten Mile) Creek is being converted to four lanes. Okaloosa darter populations are being monitored at these sites by Crittenden and Mettee (Mettee et al. 1976).

PRIORITY INDEX:

Not assigned.

DESCRIPTION

The Okaloosa darter is a slender, small (up to 44 mm) perch-like fish with two dorsal fins, rounded caudal fins and a lateral line arched slightly upward with 32 to 37 (usually 34 to 35) lateral-line scales. There are longitudinal rows of

dark dots along the sides of the body and a series of dark blotches immediately below the lateral line. The body is reddish-brown to yellow-brown becoming lighter on lower sides; the first dorsal fin has an orange-red stripe near the margin. It is distinguished from its nearest relative, the brown darter, by an absence of conspicuous red spots and a nearly complete lateral line. Photographs appear in Collette and Yerger (1962) and Mettee et al. (1976).

RANGE

Okaloosa darters are endemic to a series of five small creeks in Okaloosa and Walton Counties in west Florida that empty into Rocky and Boggy Bayous near the western end of Choctawhatchee Bay: Rocky Creek, Swift Creek, Turkey Creek, Tom's Creek, Mill's Creek and their various tributaries (Collette and Yerger 1962, Crittenden 1974).

There are 300 km of streams in which the Okaloosa darter is found with a watershed area of 45,730 ha. Approximately 4,860 ha are in private ownership (including cities of Niceville and Valparaiso); the remainder are located within Eglin Air Force Base (Crittenden 1974).

The species' former distribution is the same as the present, but it apparently occurred at more sites on the five creeks (U.S. Department of the Interior 1973).

RANGE MAP

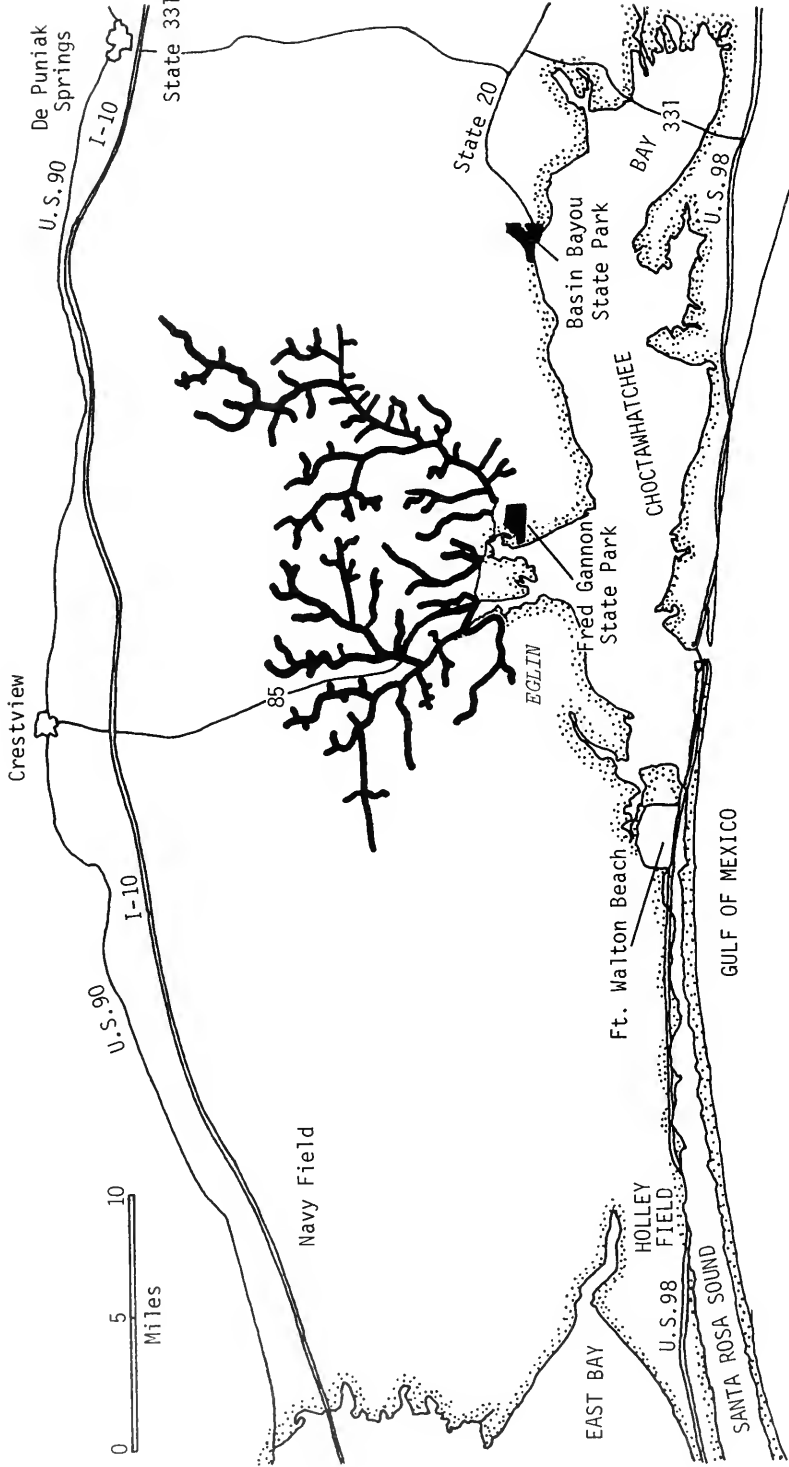
Distribution illustrated by shading. Detailed map in Draft Recovery Plan (ODRT 1977).

STATES/COUNTIES

Florida: Okaloosa, Walton.

HABITAT

The Okaloosa darter inhabits small to medium-sized (1.5 to 12.2 m wide, 0.15 to 1.2 m deep) clear streams with moderate to swift currents. Substrate is a clean sand with mud or detritus in areas of reduced current. Waters are neutral to slightly acidic. Vegetation may be absent or in scattered patches or clumps. Bulrushes (*Scirpus*), bog-moss (*Mayaca*), golden club (*Orontium aquaticum*), spatterdock (*Nuphar luteum*), green algae (*Nitella*), and pondweed (*Potamogeton*) are typical plants. Red algae (*Batrachospermum*) frequently forms thick concentrations (Collette and Yerger 1962).



— OKALOOSA DARTER STREAMS

Present range of the Okaloosa darter

Okaloosa darters usually are found in water from 0.15 to 0.61 m deep (Collette and Yerger 1962) associated with clumps of bulrushes and bur-reed (*Spartanium americanum*) where cover and protection are sought (Yerger 1979). They do not occur in impoundments (ODRT 1977).

Habitat photographs may be found in Crittenden (1974) and Mettee et al. (1976).

FOOD AND FORAGING BEHAVIOR

Not known.

SHELTER REQUIREMENTS

Not known.

NESTING OR BEDDING

Green algae clumps are used as egg-attachment sites during spawning (Collette and Yerger 1962). For water depth and flow requirements see Reproduction.

RITUAL REQUIREMENTS

Not known.

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

Nothing is known of territoriality or home range size in this species. Relationships with the brown darter are discussed under Reasons For Current Status.

Cool, running water is one requirement, and eutrophication has an undesirable effect (Crittenden 1974).

It is possible that severe rainfall with associated flooding may affect the distribution in streams at least temporarily (R. W. Britte personal communication).

POPULATION NUMBERS AND TRENDS

Estimates of population size range from 1,500 to 10,000 individuals with the true figure probably falling somewhere in between (Yerger 1976). Mettee (1976) estimates between 1,500 and 2,000 individuals.

Population levels may have been only slightly reduced in the past 15 years except in areas (parts of Rocky and Swift Creeks) where the brown darter has been introduced. Here the numbers of Okaloosa darters have been reduced, probably due to competition with sibling species (Yerger 1979).

REPRODUCTION

Spawning was observed in Tom's Creek on 25 March 1961 in swift water 0.30 to 0.46m deep over a sandy bottom at the edge of clumps of green algae. Several eggs were deposited individually in the algae and one egg hatched on 27 March in the laboratory (Collette and Yerger 1962).

On 25 March 1961, several mature adults were placed in aquaria with green algae; on 1 April 1961, six eggs were discovered individually attached to the algae (Collette and Yerger 1962).

Nothing is known of longevity or survival rates.

MANAGEMENT AND CONSERVATION

Yerger (1979) suggests that field studies be conducted to determine the species population status and details of interaction between the Okaloosa and brown darters as well as to monitor the spread of the latter species. He also suggests potential methods for controlling or eliminating introduced brown darters by physical removal. He suggests that this be done while populations are small and either before spawning has begun or long after it is over. Okaloosa darters would be returned to the water after the operation is completed. Removal should be conducted annually.

Crittenden (1974) suggests that no new impoundments be constructed on any of the Okaloosa darter drainages. If determined necessary, they should be small and at the extreme head waters of the tributaries. Measures should be taken to prevent excessive siltation. Suggestions include constructing roads at oblique angles to streams, maintaining water breaks, and seeding of road banks as soon as possible. The use of pesticides and fertilizers in this drainage area should be exercised with great caution.

A Recovery Team has been formed and a draft Recovery Plan submitted to the U.S. Fish and Wildlife Service for review. The draft plan calls for studies to determine the optimum habitat for Okaloosa darters, normal population levels and fluctuations, and potential hazards to the species' continued existence. The plan also outlines actions that could be taken if the results of research indicate a potential extirpation. These actions include defining permissible and prohibited activities, land acquisition, creating more optimum habitat, transplanting, and reducing populations of competitors or predators (ODRP 1977).

AUTHORITIES

Robert W. Britt (Recovery Team Leader)
Chief, Natural Resources Division
Directorate of Engineering
Eglin Air Force Base, FL 32542

Edward Crittenden (Recovery Team)¹
U.S. Fish and Wildlife Service
Great Smoky National Park
Gatlinburg, TN 37738

Maurice F. Mettee, Jr. (Recovery Team)
Geological Survey of Alabama
P.O. Drawer 0
University, AL 35486

Royal D. Suttkus
Museum of Natural History
Tulane University
Belle Chasse, Louisiana

Ralph W. Yerger (Recovery Team)
Department of Biological Sciences
Florida State University
Tallahassee, FL 32306

Norman Young (Recovery Team)
Florida Game and Fresh Water Fish
Commission
P.O. Box 128
DeFuniak Springs, FL 32433

Mettee, M. F. Jr. 1970. A survey of the fishes of the Choctawhatchee Bay drainage in Alabama and Florida. M.S. Thesis. Univ of Alabama. 93 pp.

———. 1976. *Etheostoma okaloosae* account. In H. O. Hillestad, D. B. Means, and W. H. Baker, eds. Endangered and threatened vertebrates of the southeastern United States. Tall Timbers Res. Stn., Misc. Pub. 4.

Mettee, M. F., Jr. and E. Crittenden. 1977. A study on the distribution of *Etheostoma okaloosa* (Fowler) and *Etheostoma edwini* (Hubbs and Cannon) in swift and rocky creeks, Okaloosa and Walton Counties, Florida, during 1975-1976. Report to U.S. Fish Wildl. Serv. 130 pp.

Mettee M. F., Jr., R. W. Yerger, and E. Crittenden. 1976. A status report on the Okaloosa darter in northwest Florida. Proc. S.E. Fishes Council. 1:1-3.

ODRT (Okaloosa Darter Recovery Team). 1977. Recovery plan for the Okaloosa darter. Draft. U.S. Fish Wildl. Serv., Office of Endangered Species 19 pp.

U.S. Department of the Interior. 1973. Threatened wildlife of the United States. Compiled by the Office of Endangered Species and International Activities, Bur. Sports Fish, Wildl. Resour. Publ. 114. U.S. Govt. Printing Office. Washington, D.C. 289 pp.

Yerger, R. W. 1979. Okaloosa darter. Pages 2-4 in C. R. Gilbert, ed. Rare and endangered biota of Florida, Vol 4, Fishes. Univ. Presses of Florida, Gainesville.

PREPARERS COMMENTS

Since all but 10% of the watershed area is under government ownership in the Eglin Air Force Base, control of many potentially detrimental factors is facilitated. Development of the area is kept to a minimum.

LITERATURE CITED/SELECTED REFERENCES

Collette, B. B. and R. W. Yerger. 1962. The American percid fishes of the subgenus *Villora*. Tulane Stud. Zool. 9(4):213-230.

Crittenden, E. 1974. Status report on the Okaloosa darter, an endangered native fish. U.S. Fish Wildl. Serv. Div. Tech. Assist. Mimeo. Rep 20 pp.

Fowler, H. W. 1941. A collection of freshwater fishes obtained in Florida 1939-1940, by Francis Harper. Proc. Acad. Natur. Sci. Philadelphia. 92:227-244.

ACCOUNT PREPARED/UPDATED BY:

National Fish and Wildlife Laboratory
412 N.E. 16th Avenue, Room 250
Gainesville, FL 32601

Biological Services Program

FWS/OBS-80/01.44

MARCH 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States-

THE EASTERN COUGAR



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

FWS/OBS-80/01.44
March 1980

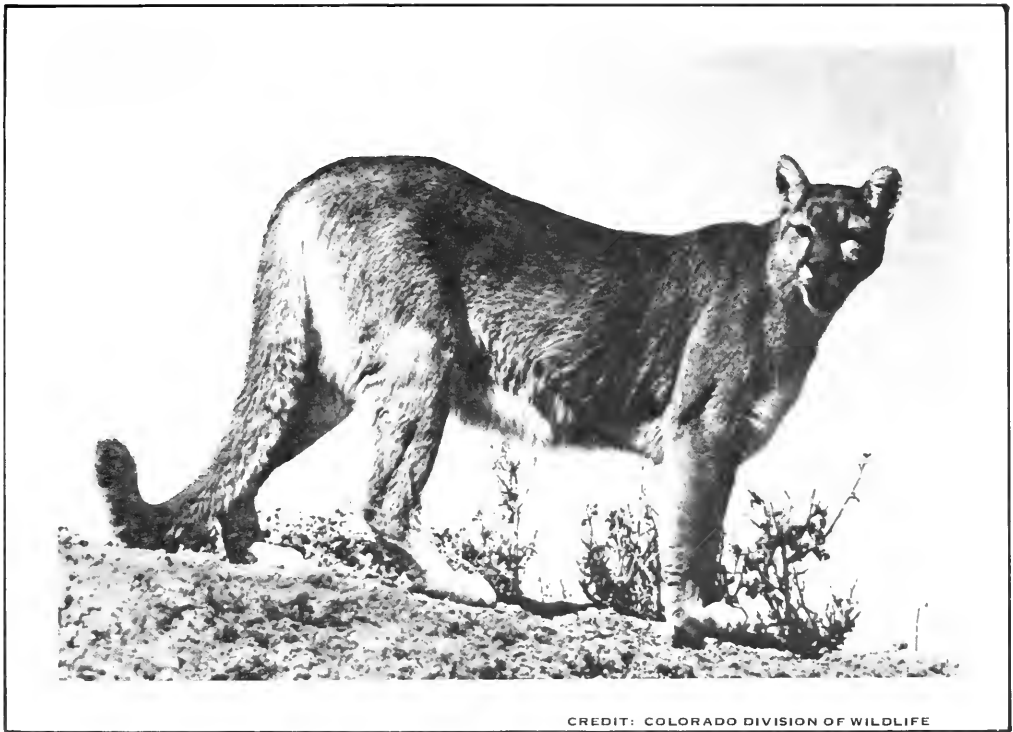
SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—

THE EASTERN COUGAR

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: COLORADO DIVISION OF WILDLIFE

EASTERN COUGAR
Felis concolor cougar Kerr

KINGDOM Animalia
CLASS Mammalia
ORDER Carnivore
FAMILY Felidae
OTHER COMMON

NAMES cougar, mountain lion,
 panther, puma, painter

DATE
 Entered into SWIS. to be determined
 Updates 31 August 1978.

LEGAL STATUS
Federal: Endangered; Eastern United States
 (38 FR 14678; 4 June 1978).
States: Endangered: Georgia, Maryland, Mas-
 sachusetts, Mississippi, Missouri,
 North Carolina, South Carolina, Ten-
 nessee, Vermont, Virginia.

REASONS FOR CURRENT STATUS

Regarded as extirpated in the United States in 1899 (USFWS 1973) due to large habitat losses and disruption, excessive hunting and persecution, and decline in deer population, its major food (Laycock 1969; IUCN 1972; USFWS 1973; Lowman 1975).

PRIORITY INDEX

Not assigned.

DESCRIPTION

A large (1.5-3.1 m), unspotted, long-tailed cat. Coloration is generally a uniform fulvous or tawny. Males are larger than females. Underparts, inner ears, lower cheeks, chin and lips are white. Tip of tail and base of whiskers are dark. Young are light-brown and irregularly spotted until about 6 months old (Dekay 1842; Young and Goldman 1946).

Eastern cougars are similar in appearance to the southern and western subspecies (*Felis concolor coryi* and *F. c. hippolestes*, respectively). Photographs of *Felis concolor* subsp. are in Wright (1972).

RANGE

Former range was the entire eastern United States and Canada as far north as Maine, New Brunswick, southern Ontario and Quebec; southward through the Appalachian Mountains to northern Georgia and Alabama where it integrated with *F. c. coryi* (Young and Goldman 1946; Hall and Kelson 1959).

Recently alleged sightings (by reliable observers) and unconfirmed reports (tracks, hair, scat) are scattered throughout the cougar's former range.

States from which recent sightings have been reported include Connecticut (Dowhan and Craig 1976, L. Gray personal communication), Georgia (Odum et al. 1977, R. R. Odum personal communication), Kentucky (J. Durrel personal communication) Maine (Cram 1901, Wright 1972), Maryland (Larson 1963, Wright 1972), Massachusetts (Mugford 1976), Missouri (Schwartz and Schwartz 1959), North Carolina (Linzey and Linzey 1971, Lee 1977a, 1977b, Teulings and Cooper 1977), New Hampshire (Dearborn 1927, Wright 1972), New York (Reilly 1964, Manville 1951), Pennsylvania (Grimm and Whitehead 1950, 1952, Dout 1969), South Carolina (Lowman 1975), Tennessee (Kellog 1939), Vermont (Spargo 1950, Wright 1972), Virginia (Russ 1973), West Virginia (Handly et al. 1961), and Wisconsin (Schorger 1938).

In Canada a population is reported to exist in New Brunswick (Wright 1953, Cahalane 1964, Wright 1972).

RANGE MAP

No range map has been prepared because of the speculative nature of this subspecies' occurrence in the United States.

STATES/COUNTIES

No states or counties are given because of the speculative nature of this subspecies' occurrence in the United States.

HABITAT

The cats show no preference for specific habitat type but appear to require large areas with adequate food supply and dense vegetation for refugia (Wright 1972).

FOOD AND FORAGING BEHAVIOR

The cats principal food is white-tailed deer (*Odocoileus virginianus*) (Wright 1972). They will feed on small mammals, insects, and reptiles. They are also known to take livestock (True 1891; Hamilton 1943).

Prey is stalked until the cat is close enough to pounce and is grabbed by the throat or back of the neck (Hamilton 1943). Remains and unused portions of prey are covered (Young and Goldman 1946). Western subspecies kill every 3 to 4 days (Young and Goldman 1946).

SHELTER REQUIREMENTS

Not known.

NESTING OR BEDDING

Not known.

RITUAL REQUIREMENTS

Not known.

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

Not known.

POPULATION NUMBERS AND TRENDS

Populations in New Brunswick, Canada, are estimated from 25 to 100 (Cahalane 1964; Wright 1972). Recent sightings in the United States may be of released and/or escaped captives of western subspecies. Wright (1971, 1972) suggests that the eastern cougar still exists in the United States and populations are widely scattered and at a fraction above the limit for sustaining the population.

REPRODUCTION

Little is known about reproduction of the eastern cougar. Available information is derived from other subspecies. Breeding season in the southern race (*F. c. coryi*) is believed to be year round with peaks in February (Schwartz 1952). Others believe cougars breed in spring or fall (True 1891). Females are polyestrous and initiate the courtship and mating act (Davis 1974). Gestation period is 90 to 98 days (Young and Goldman 1946; Asdell 1964). Litter size varies

from 1 to 6 with 2 to 3 being average (Young and Goldman 1946; Hall and Kelson 1959; Asdell 1964). Cougars usually breed once every 2 years (Young and Goldman 1946; Asdell 1964). There are also cases where two litters were produced within a period of 12 to 15 months (Asdell 1964; Hornocker 1970).

MANAGEMENT AND CONSERVATION

No recovery team or plan has been initiated for the eastern cougar. There is a Recovery Team and draft plan for the southern race, Florida panther (*F. c. coryi*). Several States are conducting questionnaire type surveys and some actual field searches. Some States have created a central clearing house for sightings of eastern cougars.

There have been sightings and unconfirmed reports of cougars from several publicly owned lands in the eastern United States. These include: Georgia, Savannah River Atomic Energy Plant; North Carolina, Blue Ridge Parkway (also in Virginia), Great Smoky Mountain National Park, and Uwharrie National Forest; and Virginia, George Washington National Forest, Jefferson National Forest, and Shenandoah National Park (Linzey and Linzey 1971; Russ 1973; Lowman 1975; Teulings and Cooper 1977).

AUTHORITIES

None.

PREPARER'S COMMENTS

Most of the available literature on life history of this species is derived from findings of studies on western subspecies. The eastern cougar and Florida panther should be treated together in the Recovery Team and Plan concepts.

There is a serious question as to whether the eastern cougar exists in the United States. More effort should be concentrated in the direction of securing documented evidence of this subspecies' existence or whether released and/or escaped captive western subspecies are the animals allegedly being seen.

LITERATURE CITED/SELECTED REFERENCES

- Asdell, S. A. 1964. Patterns of mammalian reproduction. Cornell Univ. Press, Ithaca. 679 pp.
- Cahalane, V. H. 1964. A preliminary study of the distribution and numbers of cougar, grizzly, and wolf in North America. New York Zool. Soc., New York. 12 pp.

- Cram, G. 1901. Panther in Maine. For. Str. 56: 123.
- Davis, W. B. 1974. The mammals of Texas. Texas Parks Wildl. Bull. No. 41:1-294.
- Dearborn, N. 1927. An old account of the mountain lion in New Hampshire. J. Mammal. 8: 311-312.
- Dekay, J. E. 1842. Zoology of New York, or the New York Fauna. Albany. 146 pp.
- Dout, J. K. 1969. Mountain lions in Pennsylvania. Am. Midl. Natur. 82:281-285.
- Dowhan, J. J., and R. J. Craig. 1976. Rare and endangered species of Connecticut and their habitat. State Geo. Natur. Hist. Surv. Conn., Dep. Environ. Protection Rep. 6. 137 pp.
- Grimm, W. C., and R. Whitehead. 1950. Mammal survey of southwest Pennsylvania. Pa. Game Comm., Harrisburg. 99 pp.
- . 1952. Mammal survey of northeast Pennsylvania. Pa. Game Comm., Harrisburg. 82 pp.
- Hall, E. R., and K. R. Kelson. 1959. The mammals of North America. 2 vols. Ronald Press, New York. 1,083 pp.
- Hamilton, W. J. 1943. The mammals of eastern United States; an account of recent land mammals occurring east of the Mississippi. Cornell Univ. Press, Ithaca. 432 pp.
- Handly, C. O., Jr., R. Stafford, and E. H. Geil. 1961. A West Virginia puma. J. Mammal. 42:277-278.
- Hornocker, M. G. 1969. Winter territoriality in mountain lions. J. Wildl. Manage. 33:457-464.
- . 1970. An analysis of mountain lion predation upon mule deer and elk in Idaho primitive areas. Wildl. Monogr. 21. 39 pp.
- IUCN. 1972. Red data book. Vol. I, Mammalia. Compiled by H. A. Goodwin and C. W. Holloway. IUCN, Morges, Switzerland.
- Kellog, R. 1939. Annotated list of Tennessee mammals. Proc. U.S. Natl. Mus. 86:245-303.
- Larson, J. S. 1963. Panthers in Maryland. Md. Conserv. Vol. XLIII.

- Laycock, G. 1969. America's endangered wildlife. Norton, New York. 226 pp.
- Lee, D. S. 1977a. *Felis concolor* True. Pages 354-355 in J. E. Cooper, S. S. Robinson, and J. B. Funderburg, eds. Endangered and threatened plants and animals of North Carolina. North Carolina State Mus. Natur. Hist., Raleigh. 444 pp.
- . 1977b. Unscrambling rumor: the status of the panther in North Carolina. Wildl. N. C. 41:6-9.
- Linzey, A. V., and D. W. Linzey. 1971. Mammals of Great Smoky Mountains National Park. Univ. Tennessee Press, Knoxville. 114 pp.
- Lowman, G. E. 1975. A survey of endangered, threatened, rare, status undetermined, peripheral, and unique mammals of the south-western national forests and grasslands. USDA For. Serv., Atlanta. 121 pp.
- Manville, R. 1951. Reports of cougars in New York. J. Mammal. 32:227.
- Mugford, P. S. 1976. Fish and wildlife in limited numbers in Massachusetts. Mass. Fish Wildl. 10 pp.
- Odum, R. R., J. L. McCullom, M. A. Neville, and D. R. Ettman. 1977. Georgia's protected wildlife. Georgia Dep. Natur. Resour. Atlanta.
- Reilly, E. M., Jr. 1964. New York's spooky big cats. Conservationist 19:227.
- Russ, W. R. 1973. The rare and endangered vertebrates of Virginia. M.S. Thesis. Virginia Polytechnic Inst. and State Univ., Blacksburg. 338 pp.
- Schorger, A. W. 1938. A Wisconsin specimen of the cougar. J. Mammal. 19:252.
- Schwartz, A. 1952. The land mammals of southern Florida and the upper Florida Keys. Ph. D. Dissert. Univ. Michigan, Ann Arbor. 180 pp.
- Schwartz, C. W., and E. R. Schwartz. 1959. The wild mammals of Missouri. Univ. Missouri Press, Missouri Conserv. Comm. 341 pp.
- Sparto, J. 1950. The catamount in Vermont. Bennington, Vt.
- Teulings, R. P., and J. E. Cooper. 1977. Cluster areas. Pages 409-433 in J. E. Cooper, S. S. Robinson, and J. B. Funderburg, eds. Endangered and threatened plants and animals of North Carolina. North Carolina State Mus. Natur. Hist., Raleigh. 444 pp.
- True, F. W. 1891. The puma or American lion: *Felis concolor* of Linnaeus. Pages 591-608 in Ann. Rep. Natl. Mus. Year ending June 30, 1889.
- USFWS. 1973. Threatened wildlife of the United States. Compiled by Office of Endangered Species and International Activities. Bur. Sport Fish Wildl. Resour. Publ. 114. U.S. Gov. Printing Office, Washington, D.C.
- Wright, B. S. 1953. Further notes on the panther in the northeast. Canadian Field Natur. 67: 12-28.
- . 1961. The latest specimen of the eastern puma. J. Mammal. 42:278-279.
- . 1971. The recovery of the panther in eastern North America. Intl. Symp. Ecology, Behavior, Conserv. World Cats. Laguna Hills, California.
- . 1972. The eastern panther, a question of survival. Clarke, Irvin and Co., Toronto. 180 pp.
- Young, S. P., and E. A. Goldman. 1946. The puma, mysterious American cat. Am. Wildl. Inst. 358 pp.

GATEKEEPER

To be designated by the Office of Endangered Species.

ACCOUNT PREPARED/UPDATED BY:
National Fish and Wildlife Laboratory
412 N.E. 16th Avenue, Room 250
Gainesville, FL 32601

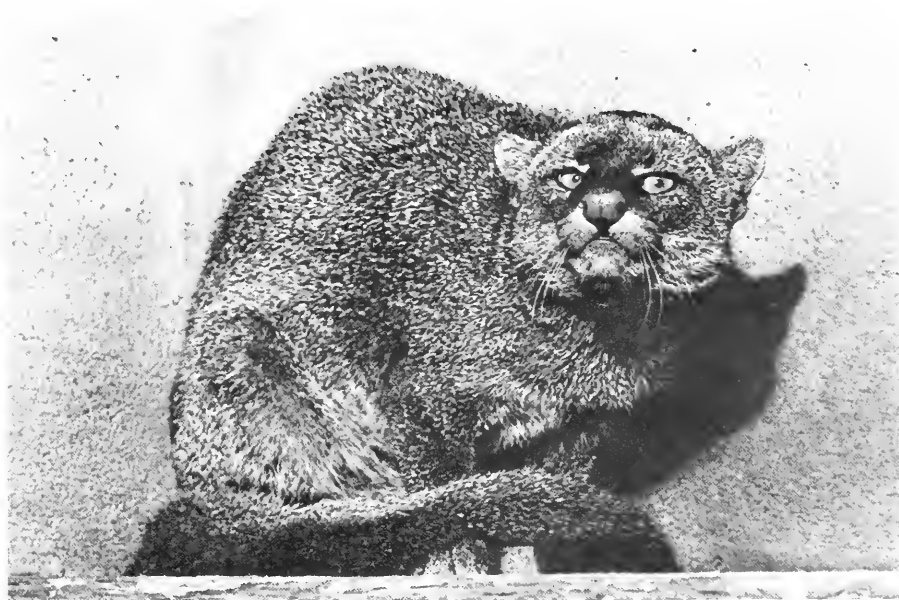
Biological Services Program

FWS/OBS-80/01.45

MARCH 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States-

THE JAGUARUNDI



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

FWS/OBS-80/01.45
March 1980

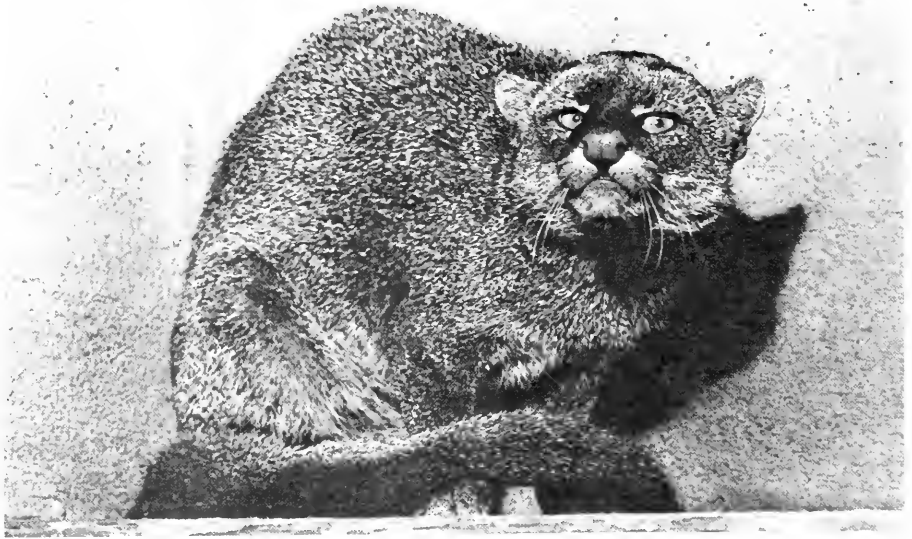
SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—

THE JAGUARUNDI

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: SAN DIEGO ZOOLOGICAL SOCIETY

JAGUARUNDI

Felis yagouarundi Geoffroy

KINGDOM Animalia
 CLASS Mammalia
 ORDER Carnivora
 FAMILY Felidae
 OTHER COMMON
 NAMES eyra, ottercat, ghost cat

DATE

Entered into SWIS. to be determined
 Updates. 31 July 1978

LEGAL STATUS

Federal: Endangered (*F. y. cacomitli*, *F. y. fossata*, *F. y. panamensis*, *F. y. tolteca*)
 (41 FR 24064; 14 June 1976).
 States: Endangered: Texas (*F. y. cacomitli*).

REASONS FOR CURRENT STATUS

Human persecution and habitat loss due to intense habitat alteration and destruction, particularly brush-clearing operations (Culbertson and Schmidly 1974, Davis 1974). However, recent data may indicate a range extension in southern Texas (Goodwyn 1970, Brownlee 1978).

PRIORITY INDEX

Not assigned.

DESCRIPTION

A small, slender-bodied, weasel-like cat 0.8 to 1.3m long, and weighing 5.6 to 7.6kg. It is somewhat larger than a housecat, with a longer tail and unusually short legs. Primarily there are two color phases - gray and red - with black animals occurring in the southern part of its range. In the gray phase, upper parts are grizzled (salt and pepper) with

underparts slightly paler, more black in winter. The red phase shows reddish upper parts intermixed with black; head and legs are more brownish while lips and throat are usually white. Fur in both phases is unspotted. Young are paler with no spots. Both phases may appear in the same litter. Photographs are in Goodwyn (1970).

RANGE

The United States distribution is restricted to extreme southern Texas and Arizona. Recent reports from Refugio and Hidalgo Counties, Texas, may indicate a possible range extension (Goodwyn 1970, Brownlee 1978). These sightings probably represent escaped and/or released captives (R. McBride personal communication). Two subspecies are recorded in the United States: *F. y. acomitli* occurs from southern Texas to central Vera Cruz, Mexico, and *F. y. tolteca* occurs in southern Arizona, south in Mexico along the Pacific coast, and inland to the Mexican Plateau. The Mexican Plateau is thought to form a barrier between the two subspecies and may explain the lack of records in New Mexico (Hock 1955). In Central and South America it occurs transcontinentally as a poorly known assemblage of subspecies and closely related species. One was reported seen at Platt National Park in Oklahoma (USFWS 1973).

RANGE MAP

Cross-hatched areas on the following map refer to presumed U.S. distribution and dots refer to sightings and/or kills (Brownlee 1978, Goodwyn 1970, R. McBride personal communication).

STATES/COUNTIES

Arizona Cochise, Pima, Santa Cruz.

Texas Cameron, Hidalgo, Starr, Willacy.

HABITAT

The jaguarundi inhabits thick, dense, thorny brushlands in the lower Rio Grande Valley (Davis 1974). Thickets need not be continuous, but may be interspersed with clear areas, as found in Mexico (Goodwyn 1970). In South America and other southern portions of the range, the jaguarundi occurs in high mountain forests (Alston 1882), tropical forests, savannas (Bourliere 1964), and forest swamps (Denis 1964). It seems to prefer areas near water (Goodwyn 1970). The most common plants in the lower Rio Grande Valley

where the jaguarundi is known to occur are black-bush acacia (*Acacia rigidula*), chillipiquin (*Caosium annuum*), lotebush (*Condalia obtusifolia*), Texas persimmon (*Diospyros texana*), coyotillo (*Karwinskia humboldtiana*), prairie baccharis (*Baccharis texana*), allthorn goatbush (*Castela texana*), commonlantana (*Lantana horrida*), berlandier wolfberry (*Lycium berlandieri*), javelinabrush (*Microrhamnus ericoides*), Texas prickly pear (*Opuntia linheimeri*), retama (*Parkinsonia aculeata*), mesquite (*Prosopis glandulosa*), cedar elm (*Ulmus crassifolia*), and lime pricklyash (*Zanthoxylum fagara*). From about 1689 to 1885, the lower Rio Grande Valley was covered with dense brush, with a relatively treeless plain to the north (Inglis 1964). The spread of mesquite north into this plain (Peacock 1968) may offer suitable habitat for the jaguarundi and a potential for range extension (Goodwyn 1970).

FOOD AND FORAGING BEHAVIOR

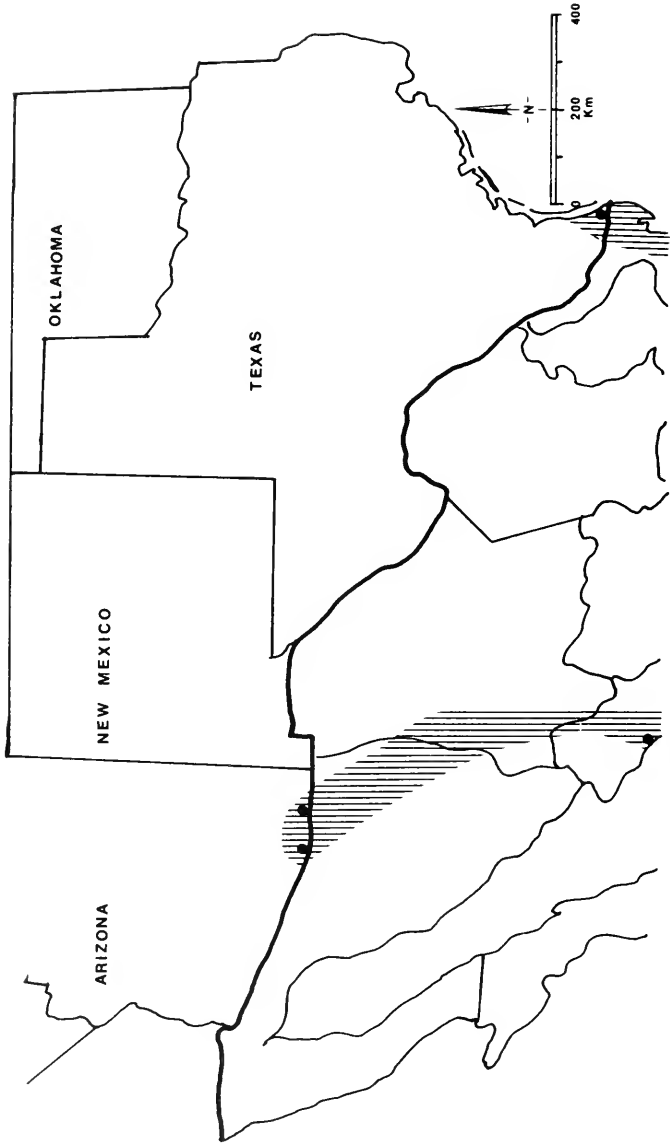
The jaguarundi stalks its prey and then pounces (Cutter 1957, Goodwyn 1970). It is an excellent tree climber and will forage in trees (Davis 1974). Primarily active at night, it will also forage during the day (Goodwyn 1970, Davis 1974). It consumes mostly birds, but will also take small mammals and some fish (Cahalane 1947, Ewer 1973, Hulley 1976). Goodwyn (1970) suggests that principal avifauna prey may be a dense-brush subtropical cohort (Wolfe 1956) consisting of Bronzed Cowbird (*Molothrus aeneus*), Chachalaca (*Ortalis vetula*), Green Jay (*Cyanocorax yncas*), Groove-billed Ani (*Crotophaga sulcirostris*), Kiskadee Flycatcher (*Pitangus sulphuratus*), Olive-backed Tropical Warbler (*Parula pitiayuma*), Red-bellied Pigcon (*Columba flavirostris*), White-fronted Dove (*Leptotila verreauxi*), and White-winged Dove (*Zenaida asiatica*).

SHELTER REQUIREMENTS

Dense thickets are used for refugia (Davis 1974).

NESTING OR BEDDING

Dense thickets, fallen logs, tree hollows, and thick, grassy clumps are used for den sites (Goodwyn 1970, Davis 1974).



Presumed distribution of the jaguarandí in southern United States and northern Mexico is represented by crosshatching. Dots indicate locations of sightings or killings.

RITUAL REQUIREMENTS

The jaguarundi will mark territory by urinating and scratching with hind feet (Hulley 1976). Thirteen distinct calls are recognized with the largest repertoire occurring during the mating season (Hulley 1976). Cutter (1957) found three calls in a captive kitten: chirp, purr, and cough. Goodwyn (1970) also found these three calls. Chirp was a high-pitched, bird-like sound, sonograph in Goodwyn (1970). Purr sounds are similar to the domestic cat's purr, but of a higher tone and more erratic. The cough is a throaty sound as of air forced from the lungs.

Jaguarundis are solitary except at mating (Denis 1964). Some captive animals show indications of gregariousness within family groups (Hulley 1976).

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

Home range size is not known, but a captive female was tracked a distance of 3.2 km in one morning (Hulley 1976).

POPULATION NUMBERS AND TRENDS

No population estimates are available for most of the range. It is extremely rare in Arizona (Cockburn 1960).

A questionnaire survey conducted by Texas Parks and Wildlife Department indicated that jaguarundi may occur on three National Wildlife Refuges in Texas: 12 on Santa Ana NWR, 8 on Laguna Atascosa NWR, and 2 on Aransas NWR (Brownlee 1978). R. McBride (personal communication) believes jaguarundis may occur on Laguna Atascosa, but not on the other two refuges.

REPRODUCTION

Mating is believed to take place in November and December (Denis 1964). Young are born in March or August and may weigh up to 22.7 g (Denis 1964, Caras 1967, Hulley 1976). The gestation period is given as 6 months (Walker 1975). There may be two litters per year with a range of one to four (average two) young per litter. Both gray and red phase may occur in the same litter (Denis 1964). There is an indication of gregariousness and tolerance of different generations by adults in captive situations (Hulley 1976), which may indicate a larger degree of socialism than once thought. Longevity records indicate a life span of 8 to 10 years (Rue 1967).

MANAGEMENT AND CONSERVATION

The jaguarundi is protected in the U.S. and some Latin American countries. Brush is no longer cleared in the national wildlife refuges in the lower Rio Grande Valley (IUCN 1972) in order to maintain brush habitat in its natural form. Santa Ana and Laguna Atascosa National Wildlife Refuges are thought to contain habitat most similar to the original brush habitat of the lower Rio Grande Valley (Goodwyn 1970).

No recovery team or plan is formalized at this time.

AUTHORITIES

William C. Brownlee
Texas Parks and Wildlife Department
4200 Smith School Road
Austin, TX 78744

W. B. Davis
Department of Wildlife and Fisheries Science
Texas A&M University
College Station, TX 77843

Roy McBride
Department of Biology
Sul Ross University
Box 725
Alpine, TX 79830

PREPARER'S COMMENTS

It is difficult to describe current population numbers and distribution based on the questionnaire survey methods used by the Texas Parks and Wildlife Department. Problems are encountered with sightings of escaped and/or released captive individuals and sightings of the same individual several times. These factors, as well as misidentification, lead to inaccurate distribution and population data.

LITERATURE CITED/SELECTED REFERENCES

- Alston, E. R. 1882. *Biologia Centralia-Americana*. Mammalia. 219 pp.
- Bourliere, F. 1964. *Mammals of the world, their life and habits*. A. A. Knopf Co., New York. 223 pp.
- Brownlee, W. C. 1978. *Feline status survey*. Performance Report, Proj. W-103-R-7. Texas Parks Wildl. Dept., Austin. 4 pp.
- Cahalane, V. H. 1947. *Mammals of North America*. MacMillan Co., New York. 682 pp.

- Caras, R. A. 1967. North American mammals; furbearing animals of the United States and Canada. Meredith Press, New York. 578 pp.
- Cockrum, E. L. 1960. The recent mammals of Arizona: their taxonomy and distribution. Univ. Arizona Press, Tucson. 276 pp.
- Culbertson, W. L. 1957. A young jaguarundi in captivity. *J. Mammal.* 38:515-516.
- Davis, W. B. 1957. The mammals of Texas. Texas Parks Wildl. Dep. Bull 41:1-294.
- Denis, A. 1964. Cats of the world. Houghton Mifflin Co., Boston. 144 pp.
- DeVos, A., R. H. Manville, and R. G. Van Gelder. 1956. Introduced mammals and their influence on the native biota. *Zoologica* 41:163-194.
- Ewer, E. F. 1973. The carnivores. Cornell Univ. Press, Ithaca. 494 pp.
- Findley, J. S., A. H. Harris, D. E. Wilson, and C. Jones. 1975. Mammals of New Mexico. Univ. New Mexico Press, Albuquerque. 360 pp.
- Goldman, E. A. 1925. Two new ocelots from Mexico. *J. Mammal.* 6:122-124.
- Goodwyn, F. 1970. Behavior, life history, and present status of the jaguarundi, *Felis yagouaroundi* (Lacepede), in south Texas. M. A. Thesis. Texas A&I University, Kingsville. 63 pp.
- Hall, E. R., and K. R. Kelson. 1959. Mammals of North America. 2 vols. Ronald Press, New York. 1,083 pp.
- Hock, R. J. 1955. Southwestern exotic felids. *Am. Midl. Natur.* 53:324-328.
- Hulley, J. T. 1976. Maintenance and breeding of captive jaguarundis (*Felis yagouaroundi*) at Chester Zoo and Toronto. *Int. Zoo. Yearb.* 16:120-122.
- Inglis, J. M. 1964. A history of vegetation on the Rio Grande plain. Texas Parks Wildl. Dep. Bull. 45:1-122.
- IUCN. 1972. Red data book. Vol. I. Mammalia. Compiled by H. A. Goodwin and C. W. Holloway. IUCN, Morges, Switzerland.
- Layne, J. N. 1974. The land mammals of Florida. In Gleason, P. J., ed. Environments of south Florida, past and present. Mem. 2 Miami Geol. Soc. 452 pp.
- Little, E. L. 1938. A record of the jaguarundi in Arizona. *J. Mammal.* 19:500-501.
- Neil, W. T. 1961. On the trail of the jaguarundi. *Fla. Wildl.* 15:10-13.
- Peacock, J. T. 1968. Historical and present status of the southern grassland, with special reference to the distribution of mesquite. Unpubl. MS. 29 pp.
- Rue, L. L. 1967. Pictorial guide to the mammals of North America. T. Y. Crowell Co., New York. 299 pp.
- Sanderson, I. T. 1959. The living mammals of the world. Hanover House, New York. 303 pp.
- USFWS. 1973. Threatened wildlife of the United States. USDI, Bureau of Sport Fisheries and Wildlife, Washington, D.C. Resource Publ. 114. 289 pp.
- Walker, E. P. 1975. Mammals of the world. 2 vols. Johns Hopkins Press, Baltimore. 1,500 pp.
- Wolfe, L. R. 1956. Checklist of birds of Texas. Intelligence Printing Co., Lancaster.

ACCOUNT PREPARED/UPDATED BY:

National Fish and Wildlife Laboratory
412 N.E. 16th Avenue, Room 250
Gainesville, FL 32601

Biological Services Program

FWS/OBS-80/01.46

MARCH 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States-

THE FLORIDA PANTHER



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

FWS/OBS-80/01.46
March 1980

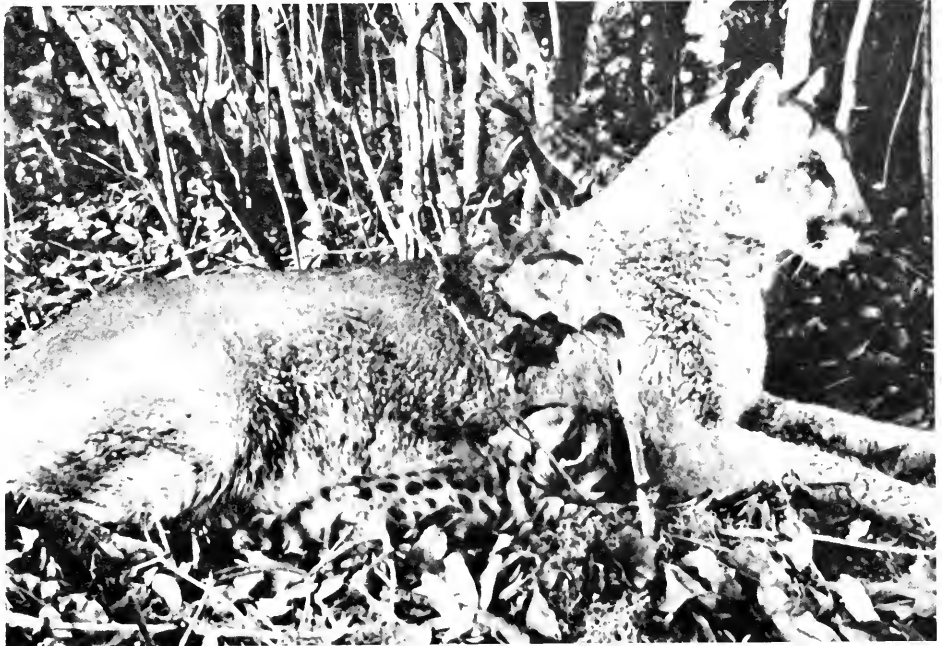
SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—

THE FLORIDA PANTHER

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: R. CHRIS BELDEN

FLORIDA PANTHER

Felis concolor coryi Bangs

KINGDOMAnimalia
 CLASSMammalia
 ORDER..... Carnivora
 FAMILY Felidae
 OTHER COMMON NAMES cougar, painter,
 mountain lion, puma

DATE

Entered into SWIS. to be determined
 Updates. 7 October 1976, 8 March 1977

LEGAL STATUS

Federal: Endangered (32 FR 4001, 11 March 1967)
 State: Endangered: Florida, Georgia, Mississippi

REASONS FOR CURRENT STATUS

The primary cause for their present status is excessive hunting and habitat disruption (Laycock 1969, Anon. 1973, Nowak and McBride 1973). Although legally protected since 1958, illegal kills, highway mortality, and habitat loss probably continue to depress the population below potential carrying capacity (Layne and McCauley 1976).

PRIORITY INDEX

Not assigned.

DESCRIPTION

The panther is a large (1.5 to 3.1 m), long-tailed cat, usually rusty on the back, fulvous on the sides, and buff underneath. The sides of the nose, tip of the tail, and backs of the ears are dark brown or blackish. Young panthers, until 6 months old, are buff colored with black spots (Audubon and Backman 1851, Merriam 1901, Hamilton

1943, Hall and Kelson 1959, Hughes 1965). Photographs are in Allen (1950), Tinsley (1970), and Lowery (1974).

RANGE

The species formerly ranged throughout Florida, Georgia, Alabama, Mississippi, Louisiana, and Arkansas (Hall and Kelson 1959). Its present distribution is uncertain. Tinsley (1970) and Layne (1974) state that remaining major concentrations seem to be in Florida — in Big Cypress Swamp and the Everglades National Park — while the extent of the population throughout the remainder of its range is unknown.

Although it is questionable that the panther survives outside of Florida (Williams 1979), recent reports suggest that they do. R. Nowak (personal communication) in 1975 examined what may have been a Florida panther in Logan County, Arkansas. Lowman (1975) lists sightings near Valdosta, Georgia; Bankhead National Forest, Baldwin, and Clarke Counties in Alabama; the Pascagoula Swamp region of George and Jackson Counties, and Amite and Claiborne Counties in Mississippi; Catahoula, Concordia, East Baton Rouge, Madison, Natchitoches, St. Tammany, and Webster Parishes in Louisiana; the Ouachita River bottomlands, Ouachita Mountains, and the White River National Wildlife Refuge in Arkansas. Also, the Mississippi Game and Fish Commission (personal communication) has a recent report of a sighting in Hancock County, Mississippi.

RANGE MAP

The estimated range in eastern United States is represented by shading, and confirmed reports are represented on the following map by stars (kills, live captures, plaster track casts, photographs) (Goertz and Abegg 1966, Noble 1971, Sealander and Gipson 1973, Lowery 1974, Belden and Williams 1976, R. C. Belden personal communication, R. Nowak personal communication).

The Florida map shows the locations of confirmed reports by stars, and unconfirmed reports by dots (Belden and Williams 1976).

STATES/COUNTIES

Alabama Baldwin, Clarke, Greene, Mobile, Tuscaloosa, Winston.
Arkansas Arkansas, Ashley, Carroll, Dallas, Drew, Franklin, Jefferson, Logan, Newton, Nevada, Pope, Saline, Scott, Stone, Washington, White.

Florida Alachua, Baker, Brevard, Broward, Citrus, Collier, Columbia, Dade, Dixie, Duval, Glades, Hendry, Highlands, Lake, Lafayette, Levy, Manatee, Marion, Martin, Okeechobee, Osceola, Palm Beach, Pinellas, Polk, Santa Rosa, Sarasota, St. Lucie, Taylor, Union, Wakulla, Walton.

Georgia Charlton, Clinch, Lowndes, Ware.

Louisiana Caddo, Catahoula, Concordia, East (Parishes) Baton Rouge, Madison, Natchitoches, St. Tammany, Webster.

Mississippi Amite, Claiborne, George, Hancock, Jackson.

South Carolina Aiken, Barnwell.

HABITAT

The panther has been reported in every habitat type. No preference or nonpreference for a specific habitat type has been noted. A large area is required, with adequate food supply and dense vegetation for cover (Bangs 1899).

FOOD AND FORAGING BEHAVIOR

Its principal food is white-tailed deer (True 1891). They also eat small mammals, insects, and reptiles (Hughes 1965, Smith 1968, Tinsley 1970) and livestock (True 1891, Hamilton 1943, Rodgers and Crowder 1974).

They stalk their prey until close enough to pounce on it, grabbing the throat or back of the neck (Hamilton 1943, Lowery 1974). If prey can not be entirely consumed at one time, a panther will cover it with brush and leaves, and return as long as it is palatable (Goin 1948, Allen 1950, Young and Goldman 1964, Lowery 1974). The frequency of meals is not known, although hunters in western United States report that mountain lions (*Felis concolor* ssp.) kill every 3 to 4 days (Young and Goldman 1964).

SHELTER REQUIREMENTS

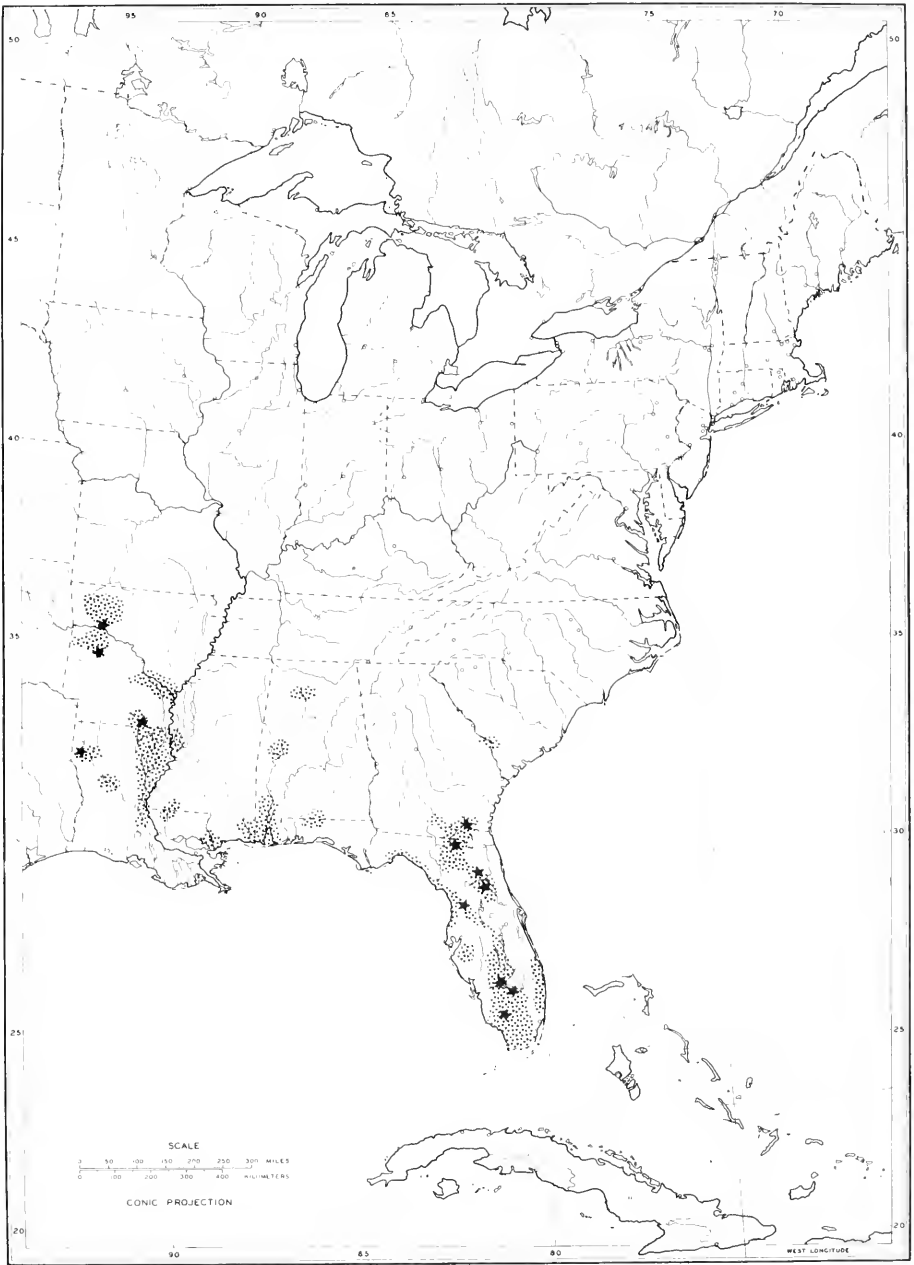
Not known

NESTING OR BEDDING

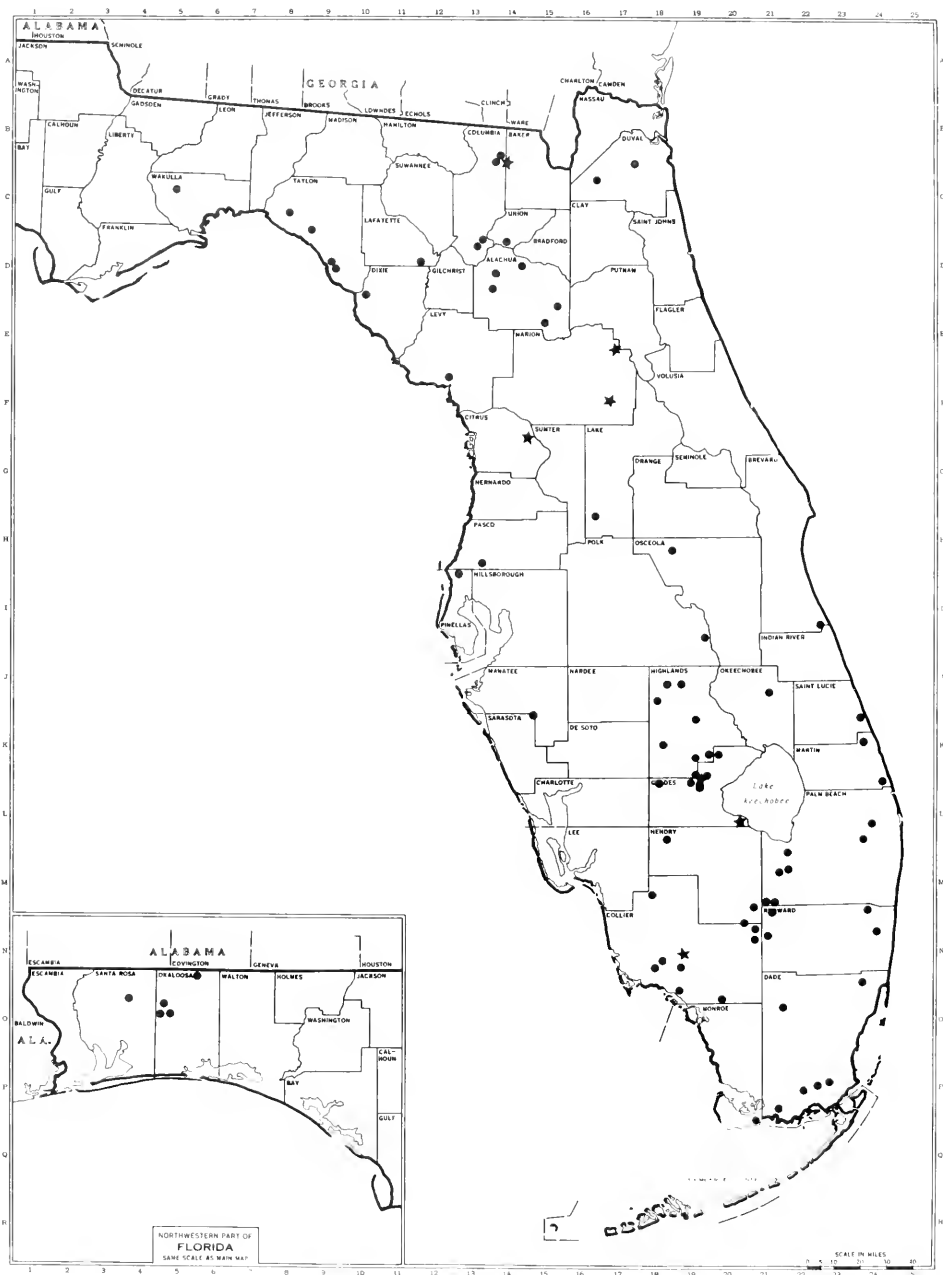
Not known.

RITUAL REQUIREMENTS

Not known.



The range of the Florida panther is depicted by shading. Stars represent sites of kills, live captures, plaster track casts or photographs.



Confirmed reports of Florida panthers in Florida are indicated by stars on this map; unconfirmed reports of panthers are depicted by dots.

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

Because of its scarcity and secretive nature, almost nothing is known of the behavioral and environmental requirements of this species. It is believed to require large expanses of undisturbed habitat without human interference (Layne 1970).

The panther's home range is unknown, but speculations vary from 150km² (Layne 1971) to 1,000 to 2,000km² (Leposky 1975a).

POPULATION NUMBERS AND TRENDS

Specific information on population trends are not available, but Sealander and Gipson (1973) and Layne and McCauley (1976) feel that the population has been on the increase in recent years. Current estimates of the population in Florida are between 30 and 300 (Williams (1979).

REPRODUCTION

Little is known about the reproduction of the Florida panther. Most of the information available is from the western subspecies. Panthers begin to breed at 2 to 3 years of age (Hall and Kelson 1959, Young and Goldman 1964). Breeding is believed to occur year-round with births peaking in February (Schwartz 1952, Frye et al. no date). Other sources indicate that panthers breed in the spring or fall (Maynard 1883, True 1891).

Davis (1966) states that females start the courtship and mating act. Males will fight for first breeding privileges. Copulation is followed by subsequent unions with other males (Lowery 1974). The gestation period is 90 to 98 days (True 1891, Asdell 1964, Young and Goldman 1964). Litter size varies from 1 to 6 (Hall and Kelson 1959) with 2 or 3 being typical (Asdell 1964, Young and Goldman 1964).

Panthers usually breed every 2 years (Asdell 1964, Young and Goldman 1964, Rogers and Crowder 1974). There are a few reports of two litters being born within a 12- or 15-month period (Asdell 1964, Hornocker 1970).

MANAGEMENT AND CONSERVATION

The Florida Panther Recovery Team was organized in July 1976, with the main objective to develop a recovery plan "... that delineates and schedules those actions required for securing or restoring..." the Florida panther "... as a viable, self-sustaining member of its ecosystem." A rough draft has been developed which calls for four major efforts (R. C. Belden personal com-

munication):

1. Find and delineate present populations.
2. Develop a captive breeding program for possible restocking in the future.
3. Develop a public education program.
4. Develop a program to evaluate present rules and regulations regarding panthers, and formulate new ones where necessary.

The Florida Game and Fresh Water Fish Commission (R. C. Belden personal communication). has outlined an investigation to locate and delineate the present population, and if found, to determine important habitat and management needs to assure continued survival. To locate and delineate the present population, a central "Florida Panther Record Clearinghouse" will be set up to receive panther records. The public will be advised whom to contact and what to report. These records will then be analyzed and collated into a list of priority areas to be searched for panther sign. Intensive field searches will be conducted in areas with positive sign of a panther population. Efforts will be made to determine habitat utilization and population dynamics. All information will then be analyzed to determine panther habitat needs and to develop appropriate management strategies.

AUTHORITIES

Ken C. Alvarez (Recovery Team)
Division of Recreation and Parks
Florida Department of Natural Resources
P.O. Box 398
Osprey, FL 33559

Robert E. Baudy (Recovery Team)
Rare Feline Breeding Compound
P.O. Box 132
Center Hill, FL 33514

Robert C. Belden (Recovery Team Leader)
Florida Game and Fresh Water Fish Commission
4005 South Main Street
Gainesville, FL 32601

James N. Layne (Recovery Team)
Archbold Biological Station
Route 2, Box 180
Lake Placid, FL 33852

Brian Noles (Recovery Team)
Appalachicola Ranger District
P.O. Box 578
Bristol, FL 32321

Peter C. H. Pritchard (Recovery Team)
Florida Audubon Society
P.O. Drawer 7
Maitland, FL 32751

Lovett Williams
Florida Game and Fresh Water Fish Commission
4005 South Main Street
Gainesville, FL 32601

PREPARER'S COMMENTS

Current status, life history, and ecology of the Florida panther are poorly known. Most biological data are limited to general accounts or brief notes from early Florida explorers and naturalists. The majority of publications since the turn of the century rehash the limited original data and information extracted from general studies done on other subspecies. More research to determine status, distribution, and ecological requirements is needed for making sound conservation and management decisions.

LITERATURE CITED/SELECTED REFERENCES

- Addor, E. F., J. K. Stoll, and V. E. LaGarde. 1974. A user-accessed computer information system for environmentally sensitive Wildlife. Vol. 2. U.S. Army Eng. Waterways Exp. Stn. Mob. Environ. Systems Lab. Vicksburg, Mississippi.
- Allen, E. R. 1950. Notes on the Florida panther, *Felis concolor coryi* Bangs. J. Mammal. 31: 279-280.
- Allen, E. R., and W. T. Neill. 1954. The raccoon preyed upon by panther and rattlesnake. Everglades Natur. Hist. 2:46.
- Anon. 1971. Wildlife popular in state parks. Florida Natur. 44(3A):9.
- . 1973. Florida panther in imminent danger. World Wildl. News 1(3):3-4.
- Asdell, S. A. 1964. Patterns of mammalian reproduction. 2nd ed. Comstock Publ. Assoc., Cornell Univ. Press, Ithaca, New York. 670 pp.
- Audubon, J. J. and J. Bachman. 1846, 1851, 1854. The viviparous quadrupeds of North America. 3 vols. George R. Lockwood, New York.
- Bangs, O. 1898. The land mammals of peninsular Florida and the coast region of Georgia. Proc. Boston Soc. Natur. Hist. 28(7):157-235.
- . 1899. The Florida puma. Proc. Biol. Soc. Washington, D.C. 13:15-17.
- Barbour, T. 1943. Naturalist at large. Little, Brown, and Co., Boston. 314 pp.
- Belden, R.C., and L.E. Williams, Jr. 1976. Survival status of the Florida panther. In Proc. of a Florida panther conference and workshop. March 1976. Florida Audubon Soc. In Press.
- Blair, W. F., A. P. Blair, P. Brodtkorb, F. R. Cagle, and G. A. Moore. 1968. Vertebrates of the United States. 2nd ed. McGraw-Hill, New York. 616 pp.
- Cahalane, V. W. 1964. A preliminary study of distribution and numbers of cougar, grizzly and wolf in North America. New York Zool. Soc. 12 pp.
- Carr, A. F. 1973. The Everglades. Time-Life Books, New York. 184 pp.
- Cory, C. B. 1896. Hunting and Fishing in Florida. Estes and Lauriat, Boston. 304 pp.
- Davis, W. B. 1966. The mammals of Texas. Rev. ed. Texas Parks and Wildl. Dept. Bull. 41: 1-267.
- Dodson, P. 1973. Journey through the old Everglades, the log of Minnehaha. Trend House, Tampa, Florida. 75 pp.
- Eaton, R. L. 1970. Pilot study on ecology of Florida panther. Unpubl. M.S. Thesis.
- . 1973. The status, conservation, and management of the cougar in the United States. Pages 68-86 in R. L. Eaton, ed. The world's cats. World Wildlife Safari, Winston, Oregon. 349 pp.
- Elliott, D. G. 1905. A check list of mammals of the North American continent, the West Indies, and the neighboring seas. Publ. Field Col. Mus., Zool. Ser. 6:1-761.
- Florida Game and Fresh Water Fish Commission. 1976. Cross Florida barge canal restudy report; endangered, threatened, rare, special concern, status undetermined and biologically sensitive species. Submitted to Fish Wildl. Ser. 267 pp.
- Frye, O.E., B. Piper, and L. Piper. No date. The disappearing panther. Mimeogr. 4 pp.
- Goertz, J. W., and R. Abegg. 1966. Pumas in Louisiana. J. Mammal. 47:727.

- Goin, O. B. 1948. Cat of a dozen names. *Fauna* 10(4):101-105.
- Hall, E. R., and K. R. Kelson. 1959. The mammals of North America. 2 vols. Ronald Press, New York. 1,083 pp.
- Hamilton, W. J. 1943. The mammals of eastern United States: an account of recent land mammals occurring east of the Mississippi. Comstock Publ. Assoc., Cornell Univ. Press, Ithaca, New York. 432 pp.
- Harper, F. 1927. The mammals of the Okefenokee Swamp region in Georgia. *Proc. Boston Soc. Natur. Hist.* 38:191-396.
- Heilprin, A. 1887. Explorations on the west coast of Florida and in the Okeechobee wilderness with special reference to the geology and zoology of the Floridian peninsula. *Wagner Free Inst. Sci. Trans.* 134 pp.
- Hornocker, M. G. 1969. Winter territoriality in mountain lions. *J. Wildl. Manage.* 33:457-464.
- . 1970. An analysis of mountain lion predation upon mule deer and elk in Idaho primitive area. *Wildl. Monogr.* 21. 39 pp.
- Howell, A. H. No date. Xerox copy of unpublished manuscript on Florida mammals. Contained in the files of U.S. Fish Wildl. Serv. Washington, D.C. 114 pp.
- Hughes, W. 1965. Florida's wild cats. *Florida Wildl.* 18(9):16-17.
- IUCN. 1972. Red data book. Vol. 1. Mammalia. Compiled by H. A. Goodwin and C. W. Holloway. IUCN, Morges, Switzerland.
- Jenkins, J. H. 1971. The status and management of the bobcat and cougar in the southeastern states. Pages 87-91 in S. E. Jorgensen and L. D. Mech, eds. *Proc. of a symposium on the native cats of North America; their status and management.* U.S. Dept. Inter., Fish Wildl. Serv., Bur. Sport Fish. Wildl. Region 3. 139 pp.
- Lahart, D. 1973. Florida's endangered dozen. *Florida Wildl.* Feb:15-22.
- Laycock, G. 1969. America's endangered wildlife. Norton, New York. 226 pp.
- Layne, J. N. 1970. Terrestrial wildlife of the Oklawaha regional ecosystem, effects of Cross-Florida Barge Canal construction on terrestrial wildlife of the area. Pages 33-41 and 88-91 in *Environmental impact of the Cross-Florida Barge Canal with special emphasis on the Oklawaha Regional Ecosystem.* Florida Def. Environ. 115 pp.
- . 1971. Mammals of Amelia Island. Pages 237-261 and 338-359 in J. McCormick, ed. *A preliminary ecological inventory.* Wallace, McHarg, Roberts, and Todd, Inc., Philadelphia. 359 pp.
- . 1974. The land mammals of south Florida. Pages 386-413 in P. J. Gleason, ed. *Environments of South Florida: present and past.* *Memoir 2 Miami Geol. Soc.* 452 pp.
- Layne, J. N. and M. N. McCauley. 1976. Biological overview of the Florida panther. In *Proc. of a Florida panther conference and workshop.* March 1976. Florida Audubon Soc.
- Leposky, G. 1975a. Panther's progress. *Florida Wildl.* (20)8:2-5.
- . 1975b. Have you seen this cat? *Petersburg Times Floridian Mag.* 8 June:14-16.
- Lewis, J. C. 1969. Evidence of mountain lions in the Ozarks and adjacent areas. 1948-1969. *J. Mammal.* 50:371-372.
- Linzey, A. V., and D. W. Linzey. 1971. *Mammals of the Great Smoky Mountains National Park.* Univ. of Tennessee Press, Knoxville. 114 pp.
- Loveless, C. M. 1959. The Everglades deer herd life history and management. *Florida Game Fresh Water Fish Comm. Tech. Bull.* 6. 104 pp.
- Lowery, G. H., Jr. 1974. The mammals of Louisiana and its adjacent waters. Louisiana State Univ. Press, Baton Rouge. 565 pp.
- Lowman, G. E. 1975. A survey of endangered, threatened, rare, status undetermined, peripheral, and unique mammals of the southeastern National Forest and Grasslands. U.S. Dep. Agric., Forest Serv., Atlanta, Georgia. 121 pp.
- Maynard, C. J. 1872. Catalogue of the mammals of Florida, with notes on their habits, distribution, etc. *Bull. Essex Inst.* 4:135-150.
- . 1883. The mammals of Florida. *Q. J. Boston Zool. Soc.* 2(1):1-8, (2):17-24, (3):38-43, (4):49-50.
- Merriam, C. H. 1901. Preliminary revision of the pumas (*Felis concolor* group). *Proc. Washington Acad. Sci.* 3:577-600.

- Miller, G. S., and R. Kellogg. 1955. List of North American recent mammals. U.S. Natl. Mus. Bull. 205. 954 pp.
- Moore, J. C. 1946. Mammals of Welaka, Putnam County, Florida. J. Mammal. 27:49-59.
- Noble, R. E. 1971. A recent record of the puma (*Felis concolor*) in Arkansas. Southwestern Natur. 16:209.
- Nowak, R. M., and R. McBride. 1973. Feasibility of a study on the Florida panther. Rep. to World Wildl. Fund. Xerox. 13 pp.
- Pearson, P. G. 1951. Mammals of Gulf Hammock, Levy County, Florida. M.S. Thesis. Univ. of Florida, Gainesville. 155 pp.
- Pritchard, P. C. H. 1976. Endangered species: Florida panther. Florida Natur. 49(4):15-22.
- Rabb, G. R. 1959. Reproductive and vocal behavior in captive pumas. J. Mammal. 40:616-617.
- Ray, C. E. 1958. Additions to the Pleistocene mammalian fauna from Melbourne, Florida. Bull. Mus. Comp. Zool. 119:421-449.
- Robertson, W. B., Jr. 1959. Everglades—the park story. Univ. of Miami Press, Coral Gables. 88 pp.
- Robinette, W. L., J. S. Gashwiler, and O. W. Morris. 1961. Notes on cougar productivity and life history. J. Mammal. 42:204-217.
- Rodgers, D. P., and J. P. Crowder. 1974. Threatened wildlife of south Florida. South Florida Environ. Proj. Ecol. Rep. DI-SFEP-74-25. 34 pp.
- Rogers, A. J. 1953. A study of the exodid ticks of northern Florida, including the biology and life history of *Ixodes scapularis* Say (Ixodidae: Acarina). Ph. D. Dissert. Univ. Maryland, College Park. 176 pp.
- Russ, W. P., 1973. The rare and endangered vertebrates of Virginia. M.S. Thesis. Virginia Polytechnic Inst. and State Univ., Blacksburg. 338 pp.
- St. Amant, L. S. 1959. Louisiana wildlife inventory and management plan. Louisiana Wildl. Fish Comm. 329 pp.
- Schemnitz, S. D. 1974. Populations of bear, panther, alligator, and deer in the Florida Everglades. Q. J. Fla. Acad. Sci. 37:157-167.
- Schwartz, A. 1952. The land mammals of southern Florida and the upper Florida Keys. Ph. D. Dissert. Univ. of Michigan, Ann Arbor. 180 pp.
- Sealander, J. A., Jr. 1951. Mountain lion in Arkansas. J. Mammal. 32:364.
- . 1956. Provisional checklist and key to the mammals of Arkansas (with annotations). Am. Midl. Natur. 56:257-296.
- Sealander, J. A., Jr., and P. S. Gipson. 1973. Status of the mountain lion in Arkansas. Proc. Arkansas Acad. Sci. 27:38-41.
- Seidensticker, J. C., IV., M. G. Hornocker, W. V. Wiles, and J. P. Messick. 1973. Mountain lion social organization in the Idaho Primitive Area. Wildl. Monogr. 35:1-61.
- Smith, G. 1968. The Florida panther. Florida Wildl. 21(8):30-31.
- . 1970. Mystery cat. Florida Wildl. 24(3): 4-6.
- Tinsley, J. B. 1970. The Florida panther. Great Outdoors Publ. Co., St. Petersburg, Florida. 60 pp.
- True, F. W. 1891. The puma, or American lion: *Felis concolor* of Linnaeus. Pages 591-609 in Ann. Rep. U.S. Natl. Mus. Year ending June 30, 1889.
- U.S. Department of the Interior. 1969. Environmental impact of the Big Cypress Swamp Jetport. 155 pp.
- . 1973. Threatened wildlife of the United States. Compiled by Office of Endangered Species and International Activities. Bur. Sport Fish. Wildl. Res. Publ. 114. U.S. Gov. Printing Office, Washington, D. C. 289 pp.
- Webb, S. D. 1974. Chronology of Florida Pleistocene mammals. Pages 5-31 in S. D. Webb, ed. Pleistocene mammals of Florida. Univ. of Florida Press, Gainesville. 270 pp.
- Wolfe, J. L. 1971. Mississippi land mammals. Mississippi Game Fish Comm. 44 pp.
- Young, S. P., and E. A. Goldman. 1964. The puma, mysterious American cat. Dover Publ., Inc. New York. 358 pp.

ACCOUNT PREPARED/UPDATED BY:

National Fish and Wildlife Laboratory
412 N.E. 16th Avenue, Room 250
Gainesville, FL 32601

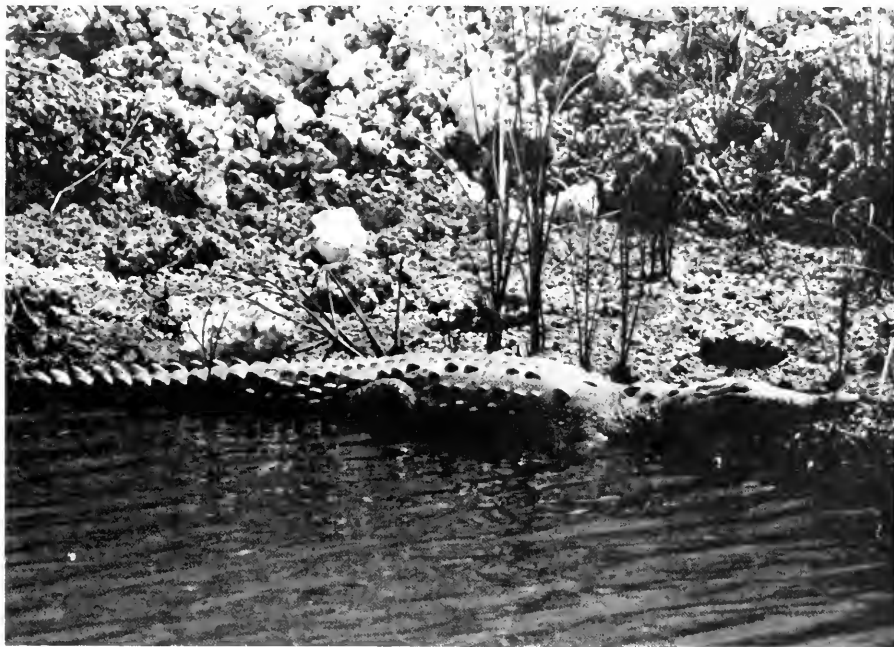
Biological Services Program

FWS/OBS-80/01.47

MARCH 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States-

THE AMERICAN CROCODILE



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—

THE AMERICAN CROCODILE

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: J. ROSS WILCOX

AMERICAN CROCODILE

(Crocodylus acutus Cuvier)

KINGDOMAnimalia
 CLASS Reptilia
 ORDER Crocodylia
 FAMILY Crocodylidae
 OTHER COMMON
 NAMES Florida crocodile

DATES

Entered into SWIS..... to be determined
 Updates..... 20 September 1976; 8 March 1977

LEGAL STATUS

Federal: Endangered (Florida populations only)
 (40 FR 44149, 25 September 1975).
 States: Endangered: Florida.

REASONS FOR CURRENT STATUS

Loss of habitat due to urbanization of south Florida; habitat loss is not all physical alteration, but includes reduction in suitability of remaining habitats through increased human recreational and other uses (Ogden 1979).

Excessive mortality occurs through malicious and ill-advised killing by humans and through accidental deaths in commercial fishing nets and on highways (Lang 1975).

Heavy predation on hatchlings in Florida Bay, primarily by raccoons, is believed to be hampering recruitment (Lang 1975).

PRIORITY INDEX

Not assigned.

DESCRIPTION

The crocodile is a large, lizard-shaped reptile. Its back is covered with regular series of keeled, bony scales and the belly with smooth white scales. It is dorsally greenish or gray-brown with irregular black mottling. Young are more contrastingly colored than adults. Hatchlings are about 23 cm in length; adults may grow to 4.5 m or larger.

The characteristics that distinguished the crocodile from the alligator are the crocodile's generally more slender build and its snout, which tapers noticeably forward of the eyes, while the alligator's snout is untapered and rounded at the end. The fourth tooth in the crocodile's lower jaw is exposed when the mouth is closed; this tooth is concealed in the alligator. Coloration of the alligator is dark gray or black with yellow markings.

Illustrations of the crocodile appear in Ditmars (1953), Carr and Goin (1955), Pope (1955), Bothwell (1963), Neill (1971), Conant (1975), Lang (1975), and Perrero (1975), among other technical, semitechnical, and popular works.

RANGE

In the United States, the American crocodile is known to breed currently only in southern parts of the Everglades National Park, chiefly Florida Bay, and outside the park on adjacent Key Largo and Turkey Point. Another population is reported in the Lower Florida Keys on Big Pine, Little Pine, and Howe Keys, with breeding rumored on Little Pine Key (Powell 1973, Ogden 1979).

Individuals are still occasionally reported north of Key Largo into Biscayne Bay on the east coast of Florida, and as far north as Marco Island and Charlotte Harbor on the west coast. Breeding in these areas has not been documented.

Historically, the crocodile ranged north at least to Lake Worth, Palm Beach County, on the east coast (Dimock and Dimock 1908). Breeding is suspected but undocumented for these northern populations. On the west coast of Florida, no historic records exist for sightings outside the areas that still occasionally report crocodiles, although a record does exist for Mobile Bay, Alabama (Loding 1922).

The largest segment of the known population in Florida is found in the Everglades National Park. The lower Keys population, if a viable breeding unit, lives primarily in the National Key Deer Refuge. Crocodiles occasionally use the cooling canals of the Florida Power and Light

Corporation's Turkey Point power plant. Individuals are also occasionally seen in Homestead Bay-front Park.

RANGE MAP

Shading indicates the known range in Florida.

STATES/COUNTIES

Florida Collier (?), Dade, Monroe.

HABITAT

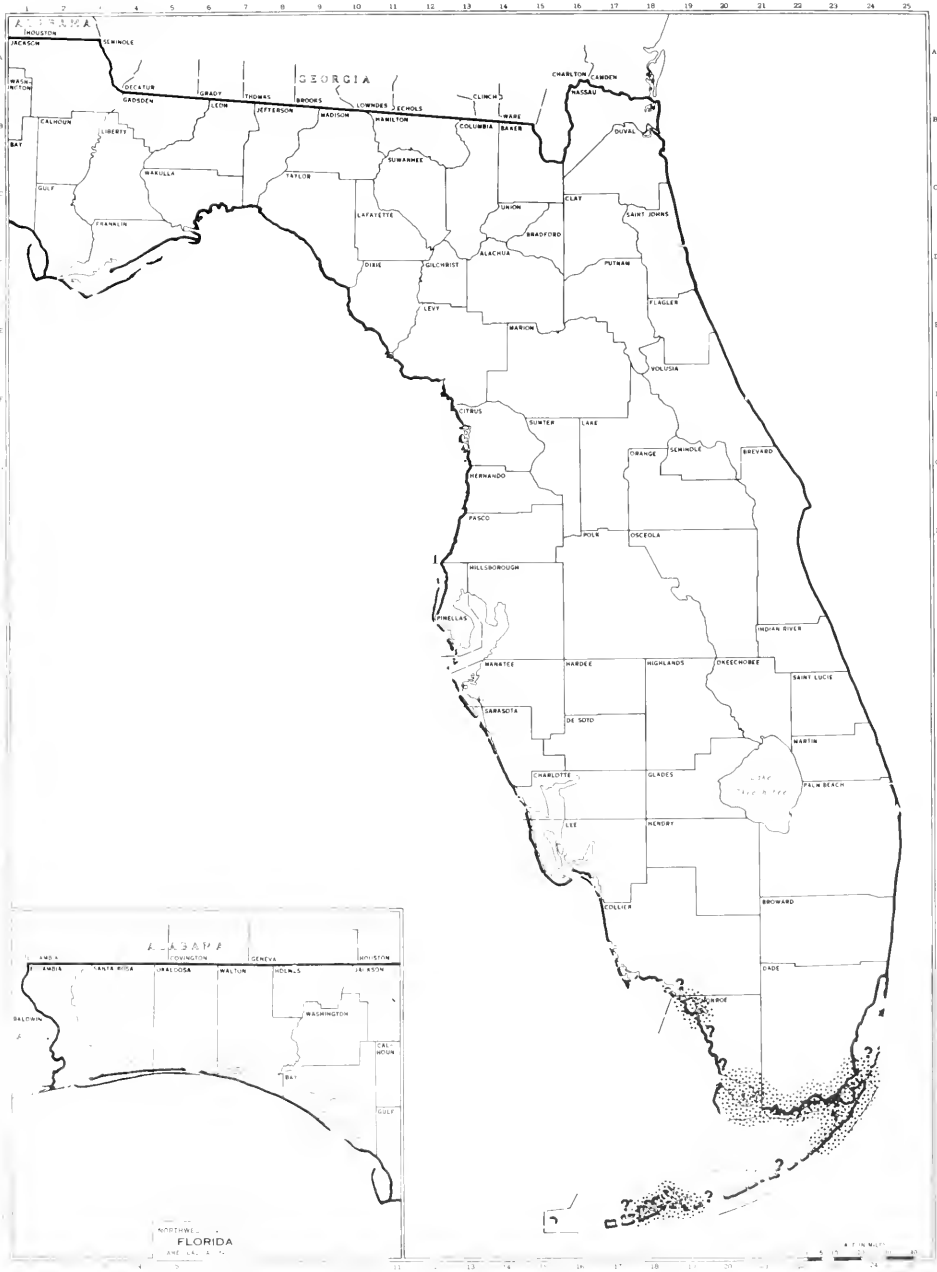
Primarily coastal, crocodiles use mangrove swamps, salt and brackish bays, and brackish creeks. They also enter coastal canals and borrow pits. Nesting occurs primarily in hardwood thickets at the heads of small sand beaches and on marl banks along narrow coastal creeks (Ogden 1979).

Present data indicate that hatchlings cannot tolerate seawater salinities, but must have brackish or freshwater for the early development period (Neill 1971, T. Ellis and W. E. Evans personal communication), but this has been questioned (Lang 1975). Adults are able to withstand full seawater salinity and may wander widely in coastal areas (Neill 1971).

Critical habitat for the American crocodile in Florida has been designated (41 FR 41915, 24 September 1976). All land and water (excluding man-made structures or settlements not necessary to the normal needs or survival of the species) within the following boundaries are included: beginning at the easternmost tip of Turkey Point, Dade County, on the coast of Biscayne Bay; thence southeastward along a straight line to Christmas Point at the southernmost tip of Elliott Key; thence southwestward along a line following the shores of the Atlantic Ocean side of Old Rhodes Key, Palo Alto Key, Angelfish Key, Key Largo, Plantation Key, Windley Key, Upper Matecumbe Key, Lower Matecumbe Key, and Long Key, to the westernmost tip of Long Key; thence northwestward along a straight line to the westernmost tip of Middle Cape; thence northward along the shore of the Gulf of Mexico to the north of the mouth of Little Sable Creek; thence eastward along a straight line to the northernmost point of Nine Mile Pond; thence northeastward along a straight line to the point of beginning.

FOOD AND FORAGING BEHAVIOR

No detailed information on foraging behavior is known, but the food of adults is believed to consist primarily of fish (Fernandez 1971, Ogden



Shading on the map depicts the present range of the American crocodile in Florida.

1979). Young feed chiefly on aquatic invertebrates (Martin de Lucenay 1942, Alvarez del Toro 1974, Ogden 1979). In general, crocodylians feed on any prey items that can be caught and overpowered (Cott 1961, Neill 1971).

SHELTER REQUIREMENTS

Not known.

NESTING OR BEDDING

Nesting site preferences appear to be hardwood thickets at the edge of small sand beaches or the banks of narrow coastal creeks (Ogden 1979). Loose soil that can be scraped into mounds appears to be a general requirement, although the Florida Bay population appears variable in this regard (Campbell 1972, Ogden 1979). Fifty meters between nests may be required for successful nesting (Alvarez del Toro 1974).

Dens consisting of burrows dug into creek banks are often constructed, but the relation of these dens to nesting areas or hibernation/estivation needs is unknown (Alvarez del Toro 1974, Ogden 1979).

RITUAL REQUIREMENTS

Crocodylians exhibit the most elaborate nest-protection behavior of any reptile, including assistance to the young during the hatching process and posthatching protection of young (Alvarez del Toro 1969, 1974; Neill 1971; Kushlan 1973; Ogden and Singletary 1973; Pooley and Gans 1976). Ogden and Singletary (1973) document this behavior for the Florida Bay population.

Requirements for this ritualistic behavior are unstudied, but Dixon and Staton (1976) have evidence that disturbance of the female while guarding the nest will disrupt her behavior and may lead to higher egg mortality. Freedom from human disturbance during the period of incubation and hatching may thus be a critical factor.

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

Hatchling crocodiles may require access to freshwater during their early lives (Neill 1971, T. Ellis and W. E. Evans personal communication); Lang (1975) differs from this view.

Home range/territoriality requirements are unknown, but crocodiles wander over considerable areas at times (Neill 1971). Local or seasonal variation in food supply may prompt these moves (Ogden 1979).

POPULATION NUMBERS AND TRENDS

Present population structure in Florida may be slanted toward larger individuals with no evidence of recruitment of young into the population. No data are available on the structure of natural, healthy populations of American crocodiles.

Population trends in Florida are clearly downward. The estimated population in Florida is between 200 and 400 individuals with fewer than 25 known breeding females (Ogden 1979). Loss of several breeding females on Key Largo has been documented over the past 5 years.

REPRODUCTION

Courtship and mating are described by Lang (1975). Females in south Florida begin construction of nests in April and eggs are laid in April or May. Twenty to 80 eggs may be laid in a clutch (Ogden 1979). Hatching occurs in July and August.

An adult crocodile, presumably the female parent, opens the nest and assists the young in hatching (Ogden and Singletary 1973, Alvarez del Toro 1974). A close early protective relationship between the parents and young is known for several crocodile species (Kushlan 1973, Alvarez del Toro 1974, Pooley and Gans 1976) and has been postulated for the Florida population (Ogden 1979), although its duration and extent are unknown.

The survival rate of young is unknown under natural conditions but is very low for the Florida population (Lang 1975).

MANAGEMENT AND CONSERVATION

Crocodylians in general, with their high reproductive potential, usually respond well to effective management/conservation programs, as the rapid recovery of the American alligator in the United States indicates. However, no population of the American crocodile has as yet received such protection and thus its potential for response to specific programs cannot be evaluated. The State of Florida and the Everglades National Park have given legal protection to crocodile populations for some time, yet the population has continued to decline. These data indicate that enforcement or protective legislation alone is inadequate to rebuild the Florida crocodile population. An active program to decrease accidental mortality and increase recruitment in conjunction with a public information

program to increase the public's tolerance to large breeding-sized individuals would appear mandatory.

The Recovery Plan for the American crocodile has been approved (12 Feb 1979) and outlines steps to be taken to assure a self-sustaining population throughout suitable habitat in the United States. The plan calls for research to determine habitat needs, habitat distribution, crocodile distribution, habitat ownership, and availability of crocodile habitat. The plan also outlines action steps that may be necessary pending research findings, including controlling man-related mortality, educating the public, increasing recruitment by captive propagation and release, reducing natural mortality, and protecting nesting sites.

AUTHORITIES

Howard W. Campbell (Recovery Team Leader)
National Fish and Wildlife Laboratory
412 N.E. 16th Ave, Room 250
Gainesville, FL 32601

Tommy Hines (Recovery Team)
Research Biologist
Florida Game and Fresh Water Fish
Commission
4005 South Main Street
Gainesville, FL 32601

Richard Klukas (Recovery Team)
Resource Management Specialist
National Park Service
Southeast Regional Office
1895 Phoenix Blvd.
Atlanta, GA 30349

James A. Kushlan (Recovery Team)
Research Biologist
Everglades National Park
P.O. Box 279
Homestead, FL 33030

Paul Moler
Florida Game and Fresh Water Fish
Commission
4005 South Main Street
Gainesville, FL 32601

John C. Ogden (Recovery Team)
Research Biologist
National Audubon Society
115 Indian Mound Trail
Tavernier, FL 33070

PREPARER'S COMMENTS

Although no subspecies of the American crocodile have been described, unpublished data indicate that geographic variation in several characters exists and studies are required to determine the relationships of the Florida crocodile population to other populations. It appears, on the basis of available data, to be distinct on an average subspecies level of difference from at least the Jamaica and Pacific coast of Mexico populations. Its isolated and peripheral status suggests that genetic differentiation from other populations is a strong possibility.

LITERATURE CITED/SELECTED REFERENCES

- Alvarez del Toro, M. 1969. Breeding the spectacled caiman at Tuxtla Gutierrez Zoo. *Internat. Zoo Yearb.* 9:35-36.
- . 1974. *Los Crocodylia de Mexico (Estudio Comparativo)*. Ediciones de Inst. Mex. Recursos Natur. Renovables, A.C. Mexico, D.F. 70 pp.
- Bothwell, D. 1962. The great outdoors book of alligators and other crocodilia. Great Outdoors Publ. Co. St. Petersburg. 88 pp.
- Campbell, H. W. 1972. Ecological or phylogenetic interpretations of crocodilian nesting habits. *Nature* 238 (5364):404-405.
- Carr, A. F. and C. J. Goin. 1955. Guide to the reptiles, amphibians, and fresh-water fishes of Florida. Univ. of Florida Press. Gainesville. 341 pp.
- Conant, R. 1975. A field guide to reptiles and amphibians of eastern and central North America. Houghton Mifflin Co., Boston. 429 pp.
- Cott, H. B. 1961. Scientific results of an inquiry into the ecology and economic status of the Nile crocodile (*Crocodylus niloticus*) in Uganda and northern Rhodesia. *Trans. Zool. Soc. London* 29(4):211-357.
- Craighead, F. C. 1968. The role of the alligator in shaping plant communities and maintaining wildlife in the southern Everglades. *Florida Natur.* 41(8):2-7, 69-74.

- Dimock, A. W. and J. A. Dimock. 1908. Florida enchantments. Outing Publ. Co., New York. 289 pp.
- Ditmars, R. L. 1953. The reptiles of North America. Doubleday and Co., Inc. New York. 476 pp.
- Dixon, J. and M. Staton. 1976. Breeding biology of *Caiman crocodilus crocodilus* from the Venezuelan Llanos. U.S. Fish Wildl. Res. Rep. 5:1-21.
- Fernandez, W. 1971. The American crocodile. Mus. News, Miami. 1(9):209-211.
- Fittkau, E. J. 1970. Role of caimans in the nutrient regime of mouth-lakes of Amazon effluents. Biotropica 2(2):138-142.
- . 1973. Crocodiles and the nutrient metabolism of Amazon waters. Amazonia 4(1): 103-133.
- Kushlan, J. A. 1973. Observations on maternal behavior in the American alligator, *Alligator mississippiensis*. Herpetologica 29(3):256-257.
- . 1974. Observations on the role of the American alligator (*Alligator mississippiensis*) in the south Florida wetlands. Copeia 1974 (4):993-996.
- Lang, J. W. 1975. The Florida crocodile: will it survive. Bull Field Mus. Natur Hist. 46(8): 5-9.
- Loding, H. P. 1922. A preliminary catalog of Alabama reptiles and amphibians. Alabama Geol. Surv. Natur. Hist. Mus., Pap. 5:1-59.
- Martin de Lucenay, A. 1942. El crocodrilo mexicano II, el desarrollo y la alimentacion. Rev. Gral. de Marina. Mexico.
- Neill, W. T. 1971. The last of the ruling reptiles. Columbia Univ. Press, New York and London 486 pp.
- Ogden, J. 1979. Florida crocodile. in R. W. McDiarmid ed. Rare and endangered biota of Florida, Vol 3, Amphibians and reptiles. Univ. Presses of Florida, Gainesville. Pages 21-22.
- Ogden, J. and C. Singletary. 1973. Night of the crocodile. Audubon 75(3):32-37.
- Perrero, L. 1975. Alligators and crocodiles of the world. Windward Publ. Co. Miami. 64 pp.
- Pooley, A. C. and C. Gans. 1976. The Nile crocodile. Science 234(4):114-124.
- Pope, C. H. 1955. The reptile world. Alfred A. Knopf, New York. 325 pp.
- Powell, J.A. 1973. The status of *Crocodylus acutus* in southern Florida. In Proc. 2nd working meet. of crocodile specialists. IUCN Pub. New Ser., Suppl. Pap. 41:1-115.

ACCOUNT PREPARED BY:

National Fish and Wildlife Laboratory
412 N.E. 16th Ave., Room 250
Gainesville, FL 32601

Biological Services Program

FWS/OBS-80/01.48

MARCH 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States-

THE KEY DEER



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

FWS/OBS-80/01.48
March 1980

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—

THE KEY DEER

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: W. H. JULIAN

KEY DEER

Odocoileus virginianus clavium Barbour and Allen

KINGDOM Animalia
 CLASS Mammalia
 ORDER Artiodactyla
 FAMILY Cervidae
 OTHER COMMON NAMES toy deer

DATE

Entered into SWIS. to be determined
 Updates. 15 October 1976, 4 March 1977

LEGAL STATUS

Federal: Endangered (32 FR 4000, 11 March 1977)

States: Endangered: Florida.

REASONS FOR CURRENT STATUS

Loss of habitat to development of Lower Keys is the primary reason for the deer's current status. Big Pine Key supports some two-thirds of the total population, and 37% of this island had been cleared for development as of 1973 (Klimstra et al. 1974). The human population of the keys is projected to increase by 48% by 1990, implying even more loss of deer habitat.

Other factors include mortality of young falling into drainage ditches and being killed by automobiles. Overhunting with dogs and jacklights (U.S. Department of the Interior 1973) was probably an important factor in the 1940's and 1950's, and reports of poaching are still rather frequent (Klimstra et al. 1974).

PRIORITY INDEX

Not assigned.

DESCRIPTION

The smallest race of North American deer, the adult key deer is 63 to 76 cm high at the shoulder with an average weight of 36 kg for males and 29 kg for females. The body is stockier, the legs shorter, and the skull wider than other races of white-tailed deer. The coat varies from a deep reddish brown to a grizzled gray color. Bucks usually develop antlers by their second year, and eight points by the fifth year (Klimstra 1979).

RANGE

The key deer's range is restricted to the islands of the lower Florida Keys: Annette, Big Munson, Big Pine, Big Torch, Cudjoe, Howe, Johnson, Knockemdown, Little Pine, Little Torch, Mayo, Middle Torch, No Name, Porpoise, Ramrod, Sugarloaf, Summerland, Treetree Hammock, Wahoo, and Water Key (Dickson 1955, Klimstra et al. 1974). The deer are resident only on keys with permanent freshwater: Big Pine, Big Torch, Cudjoe, Howe, Little Pine, Little Torch, Middle Torch, No Name, Sugarloaf, and Summerland Keys.

RANGE MAP

Present distribution is indicated by shading on the following page.

STATES/COUNTIES

Florida: Monroe

HABITAT

Only islands having permanent freshwater are used consistently by key deer. Other islands are used temporarily during the rainy season (Klimstra 1979). Big Pine Key (2,428 ha) and No Name Key (404 ha) support the largest deer population. Both have permanent freshwater and extensive pineland habitat. Klimstra et al. (1974) noted use of five habitat types in descending order of preference: pinelands, hardwood hammock, buttonwood-scrub mangrove, mangrove swamp, and developed areas. Habitat selection varies with season, time of day, and sex and age of the animal. Pinelands, hardwood hammocks, recent clearings, roadsides, and grassy areas are used for feeding. Hammocks and mangrove swamps are used for cool retreats during the day (Klimstra 1979).

The pineland community on Big Pine Key is open as a result of fire, with abundant plant species including Dade County Pine (*Pinus elliottii*

var. *densa*), silver palm (*Coccothrinax argentata*), stopper (*Myrtus verrucosa*), devil's claw (*Pisonia rotundata*), and grasses.

Dominant species in the hammocks include Spanish stopper (*Eugenia foetida*), maiden bush (*Savia bahamensis*), poisonwood (*Metopium toxiferum*), white indigo berry (*Randia aculeata*), and darling plum (*Reynosa septentrionalis*).

FOOD AND FORAGING BEHAVIOR

Red mangrove (*Rhizophora mangle*) is an important food source, with 63% occurrence in pellet analysis (Dickson 1955). Klimstra et al. (1974) list the following food plants: joeweed (*Jacquinia keyensis*); white indigo berry; devil's claw; poison ivy (*Toxicodendron radicans*); morinda (*Morinda royoc*); cathrier (*Smilax havanensis*); blolly (*Pisonia discolor*); ground cherry (*Physalis augustifolia*); blazing star (*Liatris tenuifolia*); beggarticks (*Bidens pilosa*); capweed (*Lippia nodiflora*); hempsvine (*Mikania batatifolia*); false foxglove (*Agalinis* spp.); borreria (*Borreria*); snowberry (*Chiococca pinetorum*); saffron plum (*Bumelia celastrina*); Christmas berry (*Crossopetalum ilicifolium*); nightshade (*Solanum blodgettii*); vine milkweed (*Cynanchum blodgettii*); white vine (*Sarcostemma clausa*); mallow (*Eustoma exaltatum*); and saw palmetto (*Serenoa repens*). Dickson (1955) adds silver palm, acacia (*Acacia pinetorum*), wild dilly (*Manilkara bahamensis*), and brittle thatch palm (*Thrinax microcarpa*).

Klimstra et al. (1974) determined caloric values of food plants used by key deer and noted that many are equivalent in energy content to commercial animal feeds, alfalfa, corn, wheat, and barley.

Food plants change seasonally, probably reflecting availability and nutritional needs (Klimstra et al. 1974). Some plants are regularly browsed, resulting in stunting and near-extirpation. Following fire in the pinelands, new growth immediately attracted deer and extensive browsing occurred for 6 to 9 months.

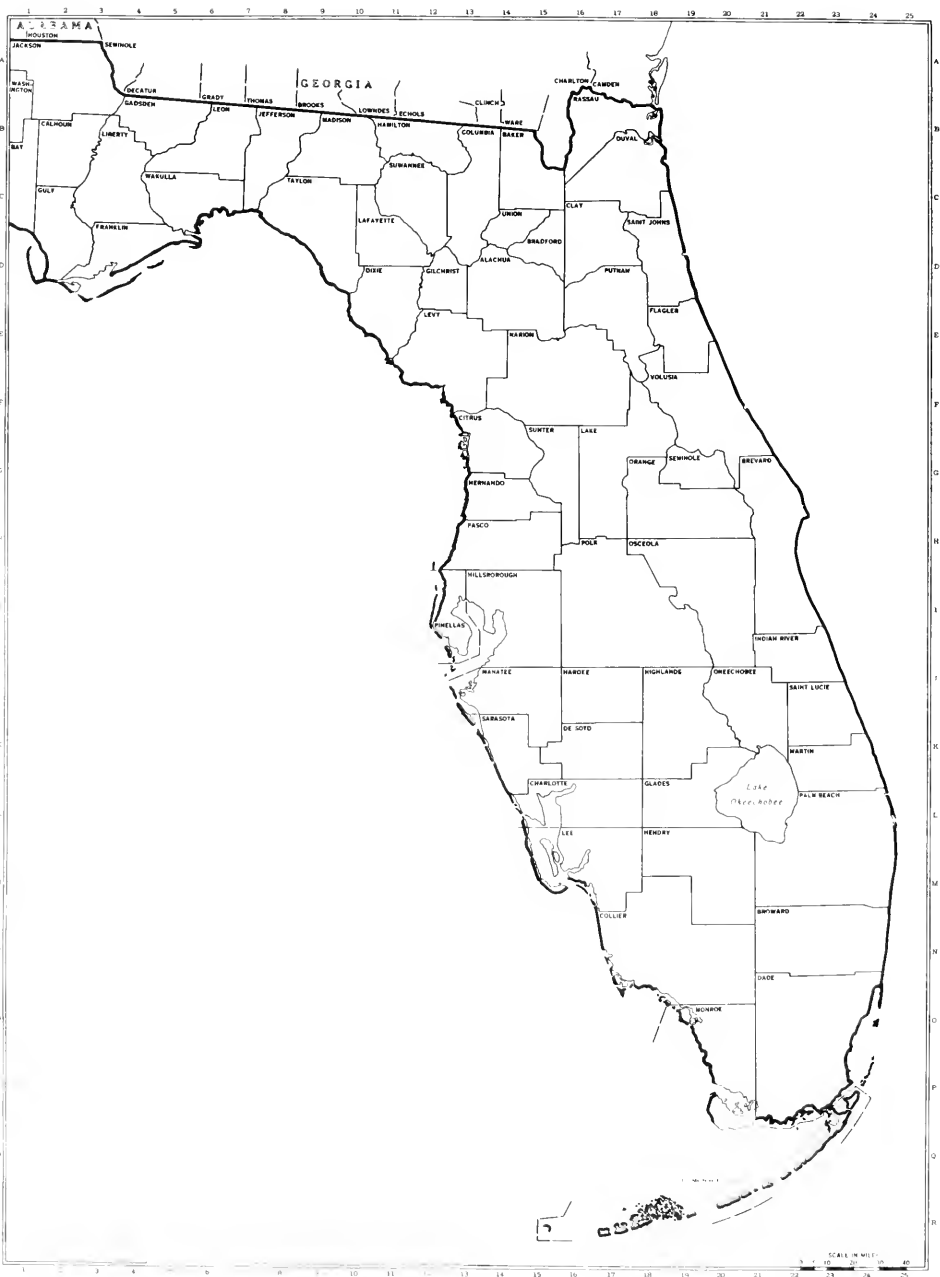
Virtually no plant species is immune from deer use at one time or another (Klimstra et al. 1974).

SHELTER REQUIREMENTS

Open areas and subdivisions are favored bedding sites at night, and mangrove swamps provide cool retreats during the day (Klimstra 1979).

NESTING OR BEDDING

Not known.



The present-day distribution of key deer is depicted on this map by shading.

RITUAL REQUIREMENTS

Not known.

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

Adult males maintain home ranges of about 120 ha (and larger during the breeding season), and adult females range over about 50 ha (Klimstra 1979).

POPULATION NUMBERS AND TRENDS

Dickson (1955) estimated the population at 25 to 80 individuals. Numbers have increased since then to between 300 and 400 animals, and the population is now believed stable (Klimstra 1979).

The official estimate of the National Key Deer Wildlife Refuge is 600 animals, but this may be revised downward as monthly census data are analyzed (D. Kosin personal communication).

REPRODUCTION

Dickson (1955) stated that there was no special breeding season, although Klimstra (1979) observed a breeding peak in September and October. Territorial activity seems limited to defending a receptive doe from other bucks (Klimstra et al. 1974). Dickson (1955) observed evidence of fighting between adult bucks in February. Bucks with full racks are generally the earliest breeders, and exclude yearling males and those with lesser racks.

The gestation period is 204 days, with peak of fawning coinciding with the rainy season in April and May (Dickson 1955, Klimstra 1979). Birth of fawns occurs in all habitat types, but usually in areas of open understory.

Key deer have a relatively low reproductive rate, with an average of 1.08 fawns per adult doe annually (Klimstra et al. 1974). Male fawns outnumber females, but the sex ratio changes until adult females outnumber males by 2.38 to 1. Fifty percent of male fawns survive 1.5 years, and 50% of female fawns survive 2.1 years (Klimstra et al. 1974). Longevity records are 8 years for males and 9 years for females.

Adult females form loose matriarchal groups with one or two generations of offspring, while bucks feed and bed together during the nonbreeding season only (Klimstra 1979).

MANAGEMENT AND CONSERVATION

In 1954, the National Key Deer Wildlife Refuge was established and now includes 1,764 ha, of which 300 ha are leased. Since 1954, the deer population has increased by more than 600%, and is now considered to be stable.

Recommendations for management include continuation of closed season, acquisition of additional habitat on Big Pine, No Name, and Cudjoe Keys, controlled burning in pinelands, maintenance of existing waterholes, fencing of islands where refuge lands and subdivisions adjoin, population and habitat monitoring, visitor management, and additional research on all aspects of key deer biology (Klimstra et al. 1974, Klimstra 1979).

AUTHORITIES

Donald J. Kosin, Refuge Manager
National Key Deer Wildlife Refuge
P.O. Box 510
Big Pine Key, FL 33043

W. D. Klimstra, Director
Cooperative Wildlife Research Laboratory
Southern Illinois University
Carbondale, IL 62901

PREPARER'S COMMENTS

Klimstra et al. (1974) noted that key deer appear to be growing to a larger size in the last few years, perhaps due to improved nutrition. The taxonomic status of the key deer has been questioned and is now under investigation by Klimstra and others.

LITERATURE CITED/SELECTED REFERENCES

- Alexander, T. R., and J. H. Dickson. 1970. Vegetational changes in the National Key Deer Refuge. *Q. J. Florida Acad. Sci.* 33(2):81-89.
- . 1972. Vegetational changes in the National Key Deer Refuge-II. *Q. J. Florida Acad. Sci.* 35(2):85-96.
- Barbour, T., and G. M. Allen. 1922. The white-tailed deer of eastern United States. *J. Mammal.* 3(2):65-78.
- Dickson, J. D., III. 1955. An ecological study of the Key deer. *Florida Game Fresh Water Fish Comm., Tech. Bull.* 3. 104 pp.

- Dooley, A. 1975. Foods of the Florida key deer. M. A. Thesis. So. Illinois Univ., Carbondale. 80 pp.
- Hardin, J. W. 1974. Behavior, socio-biology, and reproductive life history of the Florida key deer, *Odocoileus virginianus clavium*. Ph. D. Dissert. So. Illinois Univ., Carbondale. 226 pp.
- Harlow, R. F., and F. K. Jones, Jr. 1965. The white-tailed deer in Florida. Florida Game Fresh Water Fish Comm., Tech. Bull. 9. 240 pp.
- Klimstra, W. D. 1968-1972. Key deer investigations annual progress reports to the U.S. Dept. of Interior., Bur. Sport Fish. Wildl., Coop. Wildl. Res. Lab., So. Illinois Univ., Carbondale. Unpubl.
- . 1979. Key deer. Pages 15-17 in J. N. Layne, ed. Rare and endangered biota of Florida, Vol. I, Mammals. Univ. Presses of Florida, Gainesville.
- Klimstra, W. D., J. W. Hardin, N. J. Silvy, B. W. Jacobson, and V. A. Terpening. 1974. Key deer investigations final report to the U.S. Dept. of Interior, Bur. Sports Fish. Wildl., Coop. Wildl. Res. Lab., So. Illinois Univ., Carbondale. 184 pp. Unpubl.
- Sokoloff, B., J. B. Reed, and R. Dutcher. 1949 (1950). Nutritive value of mangrove leaves (*Rhizophora mangle*). Q. J. Florida Acad. Sci. 12(3):191-194.
- U.S. Department of the Interior. 1973. Threatened wildlife of the United States. Compiled by Office of Endangered Species and International Activities, Bur. Sports Fish. Wildl. Resour. Publ. 114. U.S. Govt. Printing Office, Washington, D.C. 289 pp.

GATEKEEPER

To be designated by the Office of Endangered Species.

ACCOUNT PREPARED/UPDATED BY:

National Fish and Wildlife Laboratory
412 N.E. 16th Avenue, Room 250
Gainesville, FL 32601

Biological Services Program

FWS/OBS-80/01.49

MARCH 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States- **LAYSAN DUCK**



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES

LAYSAN DUCK

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: DAVID B. MARSHALL

LAYSAN DUCK

Anas laysanensis Rothschild

KINGDOM Animalia
CLASS Aves
ORDER Anseriformes
FAMILY Anatidae
OTHER COMMON NAMES Laysan teal, Laysan Island duck

DATE

Entered into SWIS. To be determined
 Update To be determined

LEGAL STATUS

Federal: Endangered (42 FR 36425, 14 July 1977; 42 FR 10476, 22 Feb 1977).
States: Endangered: Hawaii

REASONS FOR CURRENT STATUS

Palmer found these ducks exceedingly tame (Rothschild 1900). Other observers since have commented on their tame behavior (Ely and Clapp 1973). Weak flight allows capture by hand after a flight of 125 yards (Wetmore in Delacour 1956). Their dependence on the lagoon increased their vulnerability (Warner 1963). They are now rare, after recovering from near extinction due to denudation of vegetation by European rabbits (*Oryctolagus caniculus*) introduced about 1903. The last rabbits were eliminated in 1923, and vegetation recovered. The duck population also recovered, but has fluctuated considerably since. By 1957, it was thought to be near its saturation point; it then declined from unknown causes to the point where it was close to extinction again (King in press, Fish and Wildlife Service 1973).

Ely and Clapp 1973, Berger 1972, Warner 1963, Ripley 1960). More recent counts have varied from 69 in July 1974 to 287 in August 1976. The last count was 240 in August 1977, so the present status is relatively good (Eugene Kridler personal communication).

Reasons for the rapid and extreme population fluctuation in recent years are evidently unknown, but the main one is probability inability to count all birds present (Eugene Kridler pers. comm.). Ely and Clapp (1973) say adults have no known enemies on the island and destruction of eggs by Laysan finches and young by frigatebirds is probably negligible. The limiting factor in the past and now must have been the environment.

PRIORITY INDEX

33

DESCRIPTION

The Laysan Duck is a small, dark brown duck similar to the Hawaiian duck, but smaller and redder; head and neck are blackish, often speckled irregularly with white almost around the bill and on the face and chin; there is always a white ring around the eyes. The speculum is green and black, bordered with white posteriorly. The bill is narrow. Females are more boldly marked than males; the speculum is sooty brown, sometimes with a little green (Delacour 1956).

Size — Male: wingspan 192-210 mm, tail 100-105 mm; culmen 39-40 mm; tarsus 37-39 mm; Female: wingspan 190-196 mm; tail 90 mm, culmen 38-39 mm; tarsus 35-38 mm (Delacour 1956).

The downy young are like those of the common mallard, but smaller and redder above and cinnamon below; markings on upper parts are indistinct (Delacour 1956).

Eggs are greenish white, 55 by 38 mm (Fisher 1903).

RANGE

Laysan Island (4 km²), in the northwestern or leeward Hawaiian Islands, is the only known range. According to von Kittlitz *in* Phillips (1923), it also occurred on adjoining Lisianski Island in 1928, but this statement has never been verified and is considered almost certainly er-

roneous (King in press, Ely and Clapp 1973, Berger 1972). Although 525 individuals have been banded since 1958, no natural occurrences away from Laysan Island have been recorded (Ely and Clapp 1973). The details of published records of Laysan ducks on Laysan Island from 28 March 1928 to 9 September 1960 are given by Ely and Clapp (1973).

RANGE MAP

Total Range (Ely and Clapp 1973).

STATES/COUNTIES

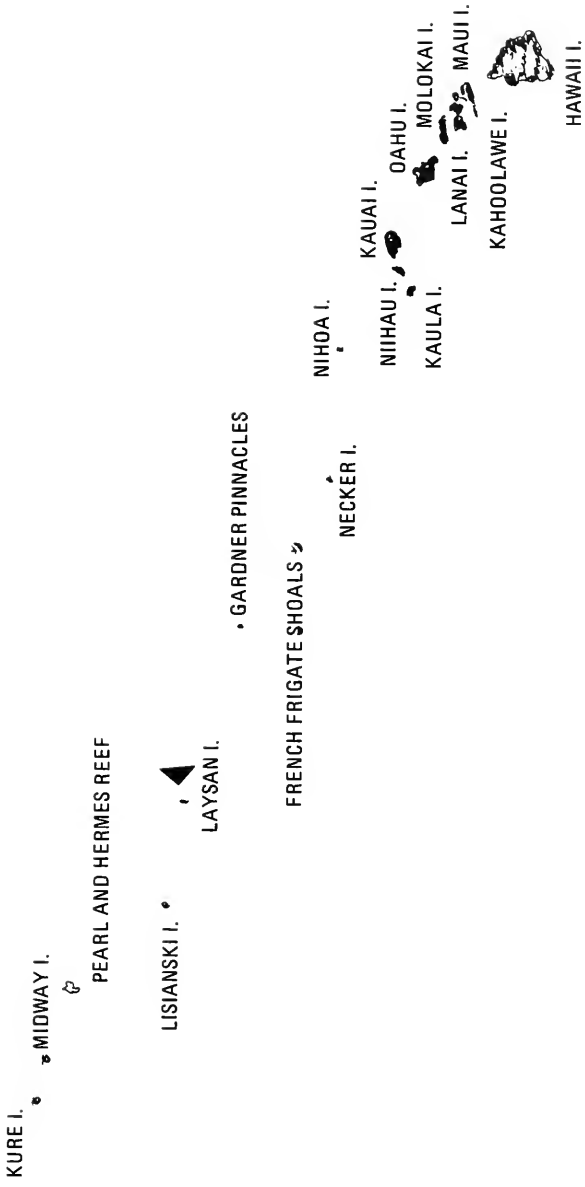
Hawaii Leeward Islands

HABITAT

All plant associations on Laysan Island are used, but concentrations are found in low sedges and vines around the central lagoon (Ely and Clapp 1973, Warner 1963, E. Kridler *in* King in press). Fisher (1903) and Bailey (1956) found birds concentrated at a small brackish or freshwater pond near the southwest corner of the lagoon, always a favorite spot until its disappearance in the 1920's. They rarely occur on the hypersaline and almost lifeless main lagoon and almost never on the ocean (Warner 1963, Ely and Clapp 1973). A. Wetmore *in* Ely and Clapp (1973) noted that birds rested among rocks during the day, and at night walked inland to the lagoon margin and patches of vegetation which probably provided food. More recently, ducks have concentrated around slightly brackish water available at several points following heavy rains. They apparently survive long periods when neither fresh nor slightly brackish water is available. The home range of each pair usually contains a strip of lagoon shore (Woodside and Kramer *in* Ely and Clapp 1973). Ducks occur throughout the island, but most of them are found in the beach morning glory near the lagoon during the day (Ely and Clapp 1973).

They formerly used permanent freshwater areas that are now filled with sand as a result of the rabbits' destruction of the vegetation cover (Warner 1963), complete except for three patches of sesuvium that may have enabled the remnant population of ducks to survive (Warner 1963). Now that vegetation has recovered, the sesuvium

Laysan Duck



The total range (ARROW) of the Laysan duck.

is completely ignored. Present vegetation is distributed in zones away from the lagoon. The lagoon flat at the water's edge is covered with alternating strands of sedge (*Sicyos* sp.), heliotrope (*Heliotropium currasavicum*), and sesuvium (*Sesuvium portulacastrum*). The next zone is a knee-deep mat of beach morning glory (*Ipomoea pes-caprae*), which almost surrounds the lagoon. Farther up the gradual slope above the water table, morning glory is replaced by a dense belt of bunch grass (*Eragrostis variabilis*), often mixed with puncture vine (*Tribulus cistoides*) and boerhaavia (*Boerhaavia diffusa*). Still farther up the slope, the plant cover thins to scattered mats of prostrate succulent boerhaavia interspersed with bunch grass. Occasional clumps of scaevola (*Scaevola frutescens*) are scattered about the higher ridges of the island. Ducks use all of these vegetation zones for feeding, although they are restricted to the morning glory and bunch grass interphase and boerhaavia zones when molting and flightless (Warner 1963). Fresh or slightly brackish water seeps are used for bathing when available, but there are long periods when these are not available. There is some evidence of salt secretion by the nasal glands, and also that rain water on bushes is used for bathing (Warner 1963).

FOOD AND FORAGING BEHAVIOR

The stomach of a male collected near a pond was gorged with small flies resembling the common housefly (Fisher 1903). Warner (1963) noted that sesuvium, so heavily utilized when it was the major remaining vegetation on Laysan during rabbit infestation, is now completely ignored as food. Most feeding and other activity begins at dusk and continues to about midnight (Ely and Clapp 1973. Warner 1963). These ducks are primarily insectivorous, at least during the summer months (Ely and Clapp 1973). Warner (1963) describes nocturnal feeding on cutworms, which are larvae of a nocturnal moth (*Agrostis* sp.), both from vegetation and the sand beneath, and pursuit of brine flies along the lagoon edge. He observed feeding on littoral invertebrates in tide pools as well as on larvae and pupae of flies and beetles in the sand around seabird carcasses. He believed that plant materials were eaten, if at

all, only incidentally to the animal food which was actively sought. He noted that ducks follow favored routes for feeding activities. He determined the home range to be about 0.81 ha, and much smaller during the summer flightless period while molting.

SHELTER REQUIREMENTS

When approached, the birds usually walk into vegetation, and less often, paddle into the lagoon or take flight (Ely and Clapp 1973).

NESTING OR BEDDING

The nest is a down-lined depression under vegetation (Ely and Clapp 1973). One nest was placed under a thick chenopodium bush close to a pond. The shallow bowl was a little over 12.7 cm in diameter, formed of long, dry sedge stems (Fisher 1903).

RITUAL REQUIREMENTS

None described.

OTHER CRITICAL REQUIREMENTS

None known.

POPULATION NUMBERS AND TRENDS

Fisher (1903) estimated their numbers at less than 100 in 1903. Dill and Bryan (1912) could not be sure of more than 6 individuals in 1911. Munter (1915) counted 13 on the freshwater pond in 1915. J. S. Palmer (*in* Phillips 1923) reported about 35 in 1918. A. Wetmore (*in* Phillips 1923) left 14 in 1923. Brock (1951) found 33 in 1950.

Never very common, they declined to minimum between 1920 and 1930. A thorough search in 1930 discovered only 1 female (Ely and Clapp 1973). By 1957, the population had recovered to an estimated 600 (Warner 1963). Estimates fluctuated between 200 and 300 until 1969, then declined to only 75 birds in 1970 (Fish and Wildlife Service, Ely and Clapp, Berger 1972; King *in press*). In 1972, the estimated number was 175, but in 1973, they were down to less than 40 (E. Kridler 1974 *in* King *in press*). More recent counts are: July 1974—69, August 1975—251, May 1976—100, August 1976—287, August 1977—240, (Eugene Kridler pers. comm.).

The extreme variation in counts even during the same year shows the difficulty of observing all birds present, probably due to the secretiveness and nocturnal habits of the species noted by Warner (1963).

There is a captive population of over 150 in zoos and private collections (King in press).

REPRODUCTION

H. M. Smith found 7 downy young in broods of 3 and 4 in 1950 (Brock 1951). Fisher (1903) found 6 eggs in a nest. The species breeds readily in captivity (Ripley 1960).

The nesting cycle is evidently an extended one. Pairing is first observed in early March and continues until mid-summer. There seems to be no published report of courtship behavior (Ely and Clapp 1973), Warner 1963). Usual clutch size is 5 or 6. The earliest recorded hatching date is 19 May (Fisher 1903). Most eggs are laid in May, but the season extends through July. Incubation takes 27 to 28 days. The drake guards the incubating female. The chicks remain in the nest with the female for 2 days. In the wild, males sometimes tend the brood (Warner 1963, Ely and Clapp 1973).

High chick mortality, which reduced brood size from an average of 3 at hatching to about 1 or less at 1 month, strongly suggests that this may be a limit on population growth (Warner 1963).

Warner (1963) considered destruction of eggs by Laysan finches and young by frigatebirds a possible but unproved limiting factor on population; Ely and Clapp (1973) thought it to be probably negligible.

MANAGEMENT AND CONSERVATION

The entire range (Laysan Island) is within the Hawaiian Islands National Wildlife Refuge. Landings on the island are restricted by permit. The species is protected by Federal and State law, and Listed in Appendix 1 of the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora. A census is conducted periodically by the U.S. Fish and Wildlife Service. Conservation measures proposed by King (in press) are:

1. Increase patrols of Laysan Island to prevent unauthorized landings and to prevent

introduction of additional pest plants, insects, and predators such as dogs, cats, and rats.

2. Introduce captive-reared Laysan ducks to another Pacific island with suitable habitat (Fish and Wildlife Service, King in press).

Introduction attempts include a release of 24 or 25 in the Kewalo marsh on the outskirts of Honolulu in 1894 by a Mr. Whitney, but none have been taken since (Ely and Clapp 1973). In March 1968, 12 were transported from Laysan to Southeast Island, Pearl and Hermes Reef, by Fish and Wildlife Service personnel. All disappeared soon after introduction (Ely and Clapp 1973, E. Kridler 1974 in King in press, Fish and Wildlife Service 1973). Beginning with 44 captured birds, rearing in captivity has been very successful in the Hawaii zoo and numerous mainland aviaries (Warner 1963, Ripley 1960). A recovery team has been appointed and a recovery plan for the Laysan duck is now in progress.

AUTHORITIES

Eugene Kridler
835 Akumu Street
Kailua, Hawaii 96743

Richard Warner
Building 737 IFAS
University of Florida
Gainesville, Florida 32611

PREPARER'S COMMENTS

The great variation in population estimates at different times, even during the same year, is evidence of the inadequacy of present inventory methods. Also, the almost complete lack of information on the factors that limit the population indicates a definite need for additional research on both of these problems in particular.

Introduction of predatory or competing animals, particularly rats, on Laysan Island as a result of unauthorized or unknown landings remains the greatest threat to the continued survival of the duck, so the sooner another population can be established on another island, the safer it will be from such accidents.—John W. Aldrich.

LITERATURE CITED/SELECTED
REFERENCES

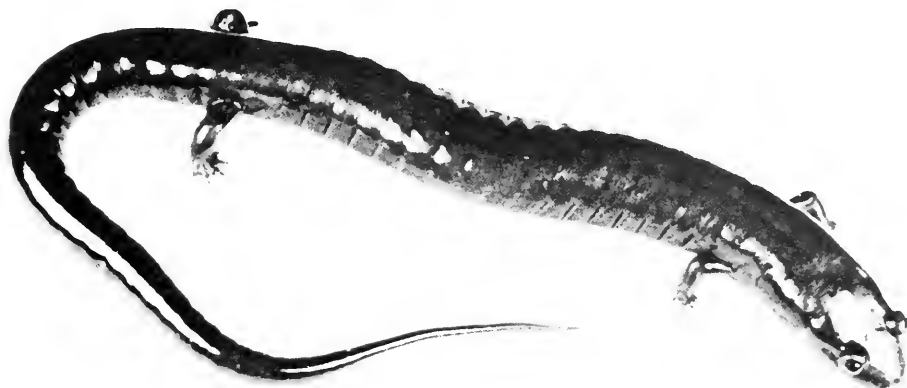
- Bailey, A. M. 1942. The portulaca flats of Laysan. Audubon Mag. 44:150-161.
- . 1956. Birds of Midway and Laysan Islands. Denver Mus. Nat. His., Mus. Pictorial 12:1-130 (80-38).
- Berger, A. J. 1972. Hawaiian birdlife. Univ. Press of Hawaii, Honolulu.
- Brock, V. E. 1951. Some observations of the Laysan Duck, *Anas wyvilliana laysensis*. Auk 68:371-372.
- Delacour, J. 1956. The waterfowl of the World, Vol. 2., Country Life Ltd., London. p.49.
- Dill, H. R., and W. A. Bryan. 1912. Report of an expedition to Laysan Island in 1911. U.S. Dep. Agric. Biol. Surv. Bull. 42. 30 pp.
- Ely, C. A., and R. B. Clapp. 1973. The natural history of Laysan Island, northwestern Hawaiian Islands. Atoll Res. Bull. 177. pp.
- Fish and Wildlife Service. 1973. Threatened wildlife of the United States. U.S. Bur. Sport Fish. Wildl. Resource Publ. 114. pp.
- Fisher, W. K. 1903. Notes on the birds peculiar to Laysan Island, Hawaiian group. Auk 20: 384-397.
- Greenway, J. C., Jr. 1958. Extinct and vanishing birds of the World. Spec. Pub. 13, Amer. Commit. for Internat. Wildl. Protect. New York. pp. 167-168.
- King, W. in press. (Revised). Red data book, Aves. Survival Service, IUCN, Morges, Switzerland.
- Lint, K. D. 1960. Preserving the Laysan Teal. Zoonooz 33(8):6-7.
- Munter, W. H. 1915. Report of destruction of bird life on Laysan Island. Ann. Rep. Coast Guard for 1915:130-140.
- Phillips, J. C. 1923. Natural history of the ducks, Vol. 2. Houghton Mifflin Co., New York. pp. 51-52.
- Ripley, S. D. 1960. Laysan Teal in captivity. Wilson Bull. 72:244-247.
- Rothschild, W. 1900. The avifauna of Laysan and neighboring islands; with a complete history to date of the birds of the Hawaiian possessions. Pt. 3. R. H. Porter, London.
- Warner, R. E. 1963. Recent history and ecology of the Laysan Duck. Condor 65:3-23.
- Wetmore, A. 1925. Bird life among lava rock and coral sand. Nat. Geog. Mag. 48:77-108.

Biological Services Program

FWS/OBS-80/01.50

MARCH 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States- **RED HILLS SALAMANDER**



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

FWS/OBS-80/01.50
March 1980

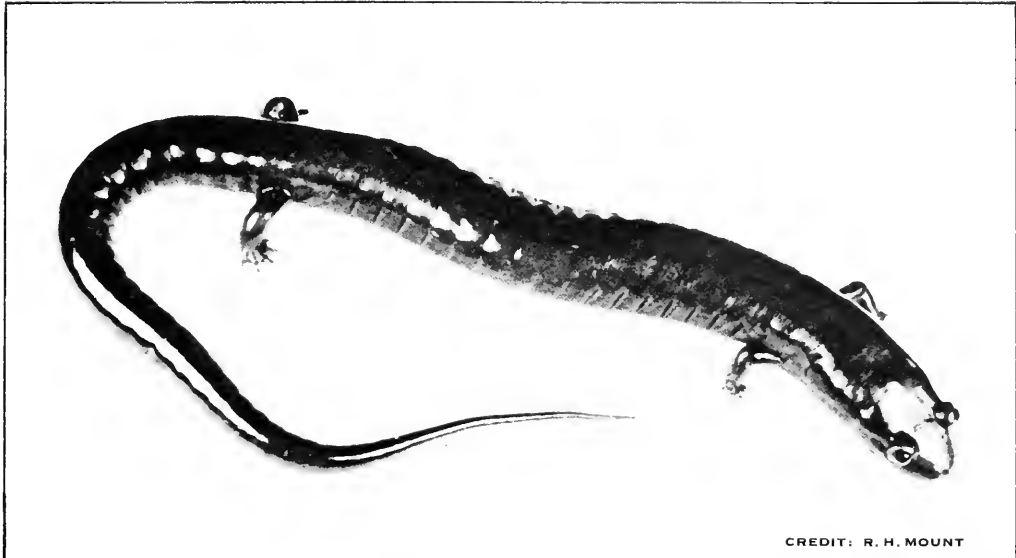
SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES

RED HILLS SALAMANDER

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: R. H. MOUNT

RED HILLS SALAMANDER
Phaeognathus hubrichti Highton

KINGDOMAnimalia
CLASSAmphibia
ORDERCaudata
FAMILYPlethodontidae
OTHER COMMON NAMES
 NAMES.....Hubricht's salamander,
 Alabama red hills salamander.

DATE
 Entered into SWIS. to be determined
 Updates..... 23 July 1977, 31 March 1978

LEGAL STATUS
 Federal: Threatened (41 FR 53032-53034,
 3 December 1976).
 States: None.

REASONS FOR CURRENT STATUS
 Timber harvesting by clearcutting, site preparation, and conversion of mixed hardwood stands to pine plantations have been shown to cause localized extermination of red hills salamanders (French 1976). The amount of suitable habitat is

steadily shrinking due to these timber management practices (Jordan and Mount 1975).
 Overcollection by amateur and professional herpetologists has reduced populations in some areas (41 FR 53032-53034, 3 December 1976).
 Natural low fertility (Brandon 1965) inhibits recovery of decimated populations.

PRIORITY INDEX
 Not assigned.

DESCRIPTION
 The red hills salamander is solid dark brown to black, with no pattern. Palms, soles, and snout are somewhat paler. Adults are 80 to 119 mm in snout-to-vent length (total length up to 256 mm); the body is elongate with 20 to 22 costal grooves and proportionately small limbs. The eyes are protuberant.

RANGE
 The salamander is known only from south central Alabama between the Conecuh and Alabama Rivers, where it is restricted to the Tallahatta and Hatchetigbee geological formations. Its known distribution includes 22,213 ha (French 1976). An additional 1,485 ha contiguous with

the present range are believed to have supported red hills salamanders prior to timber harvesting and conversion to pine within the last decade (French 1976).

RANGE MAP

The total known distribution is indicated by shading.

STATES/COUNTIES

Alabama Butler, Conecuh, Covington, Crenshaw, Monroe.

HABITAT

The species lives in burrows on the slopes of cool, moist ravines shaded by an overstory of mixed hardwood trees. It does not occur in pine forests.

FOOD AND FORAGING BEHAVIOR

The salamander feeds at or very near the mouth of its burrow at night, especially for the first hour or two after sunset. Prey items include spiders and small insects that are caught with its sticky tongue.

SHELTER REQUIREMENTS

This species requires shaded, moist ravines with ground litter and a friable soil for burrowing. Displaced individuals apparently do not make (or find) new burrows, and are thus permanently eliminated from the population (R. Jordan personal communication). Burrows are apparently not started from the surface, but only by sub-surface branching off from other burrows.

NESTING OR BEDDING

Nesting requirements are unknown. A captive female laid a clutch of infertile eggs, attached to the underside of a piece of bark (R. Mount personal communication).

RITUAL REQUIREMENTS

Not known.

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

The very specific habitat of this species may be its only environmental requirement.

POPULATION NUMBERS AND TRENDS

The species was discovered in 1960. No population estimates are available. Most of the suitable habitat is owned by timber companies who have been harvesting, preparing sites, and converting the mixed hardwood forests to pine plantations. French (1976) estimates that at least 6% of its range has been made unsuitable by these practices within the past 10 years.

REPRODUCTION

Little is known, but the presence of only a few large ovarian ova in adult females suggests that direct development occurs within the egg, without a free-living larval stage (Brandon 1965).

MANAGEMENT AND CONSERVATION

Within the range of the red hills salamander, most timber companies are now 'marking out' the ravines and steep slopes and harvesting only the largest trees (French 1976). One company has issued a policy statement indicating its intention to protect salamander habitat (R. Mount personal communication).

AUTHORITIES

Thomas W. French
Department of Life Sciences
Indiana State University
Terre Haute, IN 47809

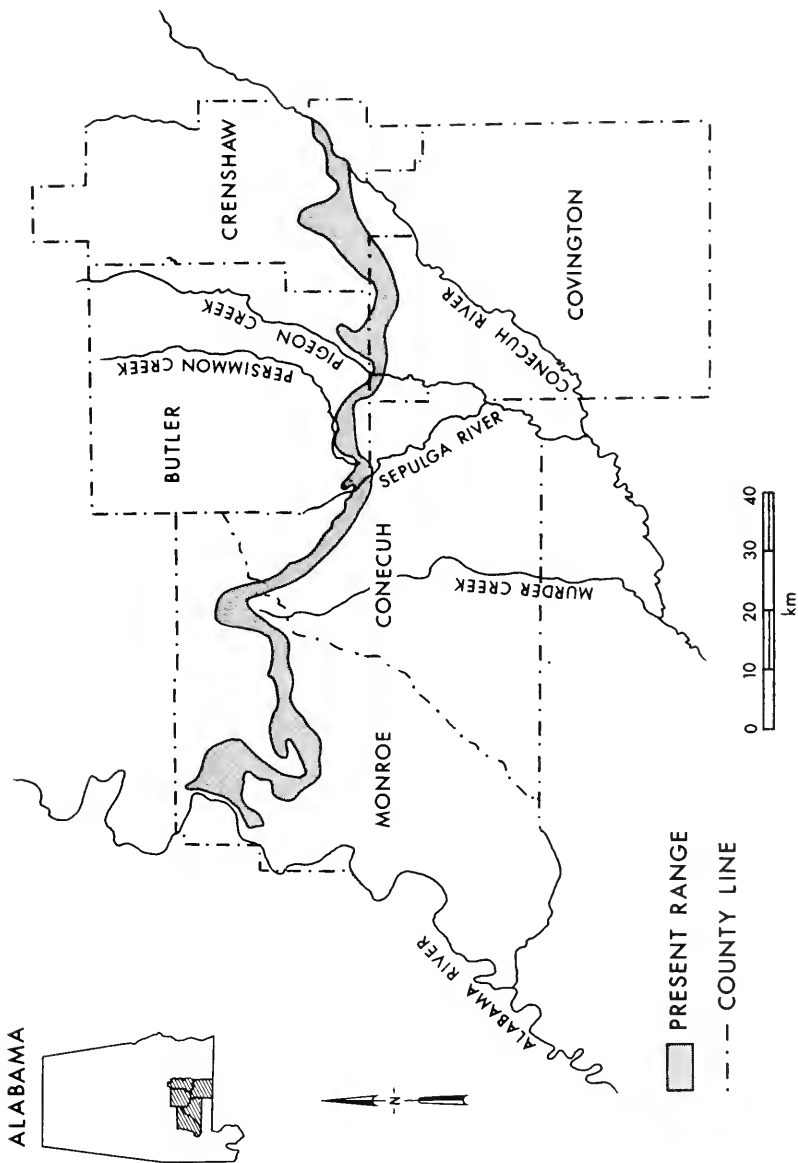
Ralph Jordan, Jr.
Tennessee Valley Authority
Regional Heritage Program
Division of Forestry
Fisheries and Wildlife Development
Norris, TN 37828

Robert H. Mount
Department of Zoology-Entomology
Auburn University
Auburn, AL 36830

Terry D. Schwaner
Museum of Natural History
University of Kansas
Lawrence, KS 66044

PREPARER'S COMMENTS

Although much remains to be learned about this salamander, the knowledge required to prevent threats to its existence is apparently available.



Range of the Red Hills salamander.

LITERATURE CITED/SELECTED
REFERENCES

- Brandon, R. A. 1965. Morphological variation and ecology of the salamander *Phaeognathus hubrichti*. *Copeia* 1965(1):67-71.
- . 1966. *Phaeognathus* and *P. hubrichti*. Pages 26.1-26.2 in *Cat. Am. Amphib. Reptiles*. Am. Soc. Ichtyol. Herpetol.
- French, T. W. 1976. Report on the status and future of the red hills salamander, *Phaeognathus hubrichti*. Office of Endangered Species, U.S. Fish Wildl. Serv., Washington, D.C.
- French, T. W., and R. H. Mount. 1978. Current status of the red hills salamander, *Phaeognathus hubrichti* Highton, and factors affecting its distribution. *J. Ala. Acad. Sci.* 49:172-179.
- Highton, R. 1961. A new genus of lungless salamander from the Coastal Plain of Alabama. *Copeia* 1962(1):65-58.
- Jordan, J. R. 1973. Sexual dimorphism in the red hills salamander, *Phaeognathus hubrichti* Highton (Amphibia: caudata: plethodontidae), with comments on its phylogenetic assignment. *Assoc. S. E. Biol. Bull.* 20(2):62.
- . 1975. Observations on the natural history and ecology of the red hills salamander, *Phaeognathus hubrichti* Highton (caudata: plethodontidae). M.S. Thesis, Auburn Univ., Auburn, Ala. 53 pp.
- Jordan, J. R., and R. H. Mount. 1975. The status of the red hills salamander, *Phaeognathus hubrichti*. *J. Herpetol.* 9:211-215.
- Mount, R. H. 1975. The reptiles and amphibians of Alabama. Auburn Printing Co., Auburn, Ala. 347 pp.
- Mount, R. H., and T. D. Schwaner. 1970. A technique for collecting the plethodontid salamander *Phaeognathus hubrichti*. *Copeia* (1):205-206.
- Schwaner, T. C. 1970. The Alabama red hills salamander. *Alabama Conserv.* 1970:7.
- Schwaner, T. D., and R. H. Mount. 1970. Notes on the distribution, habits, and ecology of the salamander *Phaeognathus hubrichti* Highton. *Copeia* 1970(3):571-573.
- Valentine, B. D. 1963a. The plethodontid salamander *Phaeognathus*: external morphology and zoogeography. *Proc. Biol. Soc. Washington* 76:153-158.
- . 1963b. The plethodontid salamander *Phaeognathus*: collecting techniques and habits. *J. Ohio Herpetol. Soc.* 4:49-54.

Biological Services Program

FWS/OBS-80/01.51

MARCH 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States- **ARCTIC PEREGRINE FALCON**



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—

ARCTIC PEREGRINE FALCON

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



PHOTO OF CLOSELY RELATED SUBSPECIES CREDIT: KENNETH FINK

ARCTIC PEREGRINE FALCON

Falco peregrinus tundrius White (1968)

KINGDOMAnimalia
 CLASSAves
 ORDERFalconiformes
 FAMILYFalconidae

OTHER COMMON

NAMESDuck Hawk (AOU 1931);
 Beach Peregrine, Blond Peregrine (fal-
 coner's names, White 1968); Tundra Pere-
 grine (Ruos 1970 and numerous authors).

DATE

Entered into SWIS.....To be determined
 Updates.....To be determined

LEGAL STATUS

Federal: Endangered: (42 FR 36425, 14 July 1977 p. 36425). Protected, Migratory Bird Treaty Act of 3 July 1918 (40 Stat. 755; 16 U.S.C. 703-711) as amended 3 Dec. 1969. Public Law 91-135. Listed, Appendix I, Convention on International Trade in Endangered Species of Wild Fauna and Flora (42 FR 10476, 22 Feb. 1977).

States: Endangered: Alaska, South Carolina, Texas - Listed: Florida.

REASONS FOR CURRENT STATUS

Up to 1960, no long-term data are available by which to detect either an increase or decrease

in the total population of peregrines of northern Canada. In general, up to that time, it had been observed as a common breeding bird in an extensive area (Fyfe 1969).

In 1969, J. L. Ruos (pers. comm.) estimated the annual harvest of tundra-breeding peregrines (taken by falconers, mostly during migration) at between 60 and 120 individuals, over 90% of which were first-year birds. The effect of this former harvest on the population is unknown, but it has been prohibited under present migratory bird regulations in the United States, where most of it occurred.

Earlier investigation of the Alaskan population (Enderson et al. 1968; Cade et al. 1968) and the Canadian population (Enderson and Berger 1968) indicated that members of this subspecies were reproducing normally. However, Cade et al. (1968) found that residues of organochlorines in tissues and eggs appeared to be near the threshold at which abnormal reproductive effects begin. More recent studies by Cade and Fyfe (1970), Berger et al. (1970), and Cade et al. (1971) indicated that shell thinning was pronounced in peregrines from the northwest territories, the Ungava region, and Alaska. The thinning approached or exceeded 20%, the level at which reproductive failures seem to begin. In addition, there was evidence that *F. p. tundrius* populations of arctic Canada and Alaska had declined suddenly. No other reason for this decline than the effect of pesticide poisoning on reproduction is suggested (Cade and Fyfe 1970:235).

PRIORITY INDEX

10

DESCRIPTION

The Arctic peregrine falcon is a medium-sized, pointed winged, swift flying bird of prey with prominent black and white facial markings; adults have slate gray back and white underparts streaked and barred with black. Immatures are brownish above and more heavily streaked below than adults. They are similar to American peregrine falcons (*anatum*), but smaller and in all plumages more lightly marked with paler browns or bluish grays and less ventral rufous wash. Black facial markings are more restricted (White 1968).

Distinction between *tundris* and *anatum* in adult plumage is best made by facial markings

(width of black between eye and white auricular, and width of malar stripe at base) and white forehead. The rufous basal portion of nape feathers, which is whiter ventrally and somewhat paler dorsally, are also useful characters. Immature plumaged *tundrius* is distinguished from *anatum* by facial characters, including a complete white superciliary stripe, with darker stripe running posterior to the eye usually present; also a median pair of tail feathers conspicuously barred with "vinaceous buff" (M. Ralph Browning ms. 1972).

Measurements (all in mm unless otherwise indicated; values in parentheses are averages).-Adult male (64 specimens): wing (chord) 292-330; tail, 134-154 (140.5); tarsus 40-50 (44.3); bill without cere 15-20 (18.7); bill with cere 22-25 (24.0); weight (12 breeding specimens), 550-647 (610.9) g. Adult female (62 specimens); wing 331-368 (351.8); tail 138-180 (167.8); tarsus 42-57 (49.8); bill without cere 21-24 (22.7); bill with cere 26-30 (27.8); weight (19 breeding specimens) 825-1094 g (952.9 g). Immature male (27 specimens): wing 295-319 (311.1); tail 135-162 (151.8); tarsus 38-50 (44.0); bill without cere 17-19 (18.3); bill with cere 22-25 (22.7); weight (4 specimens, fully fledged) 477-662 (570.0). Immature female (30 specimens): wing 320-367 (349.6); tail, 155-189 (175.6); tarsus 44-(?)55 (49.1); bill without cere 19-24 (21.4); bill with cere 23-28 (26.4); weight (3 specimens, fully fledged) 844-925 g (889.0 g) (White 1968).

RANGE

F. p. tundrius breeds in tundra areas throughout Arctic Alaska, Canada, and western Greenland, from the northern tip of the Mackenzie District south and east across the Arctic tundra to Hudson Bay, along the north coast of Ungava and north into the Arctic islands as far as northern Baffin Island and Melville Island; westward as far as Cape Prince of Wales, Alaska, and eastward to the western coast of Greenland. The subspecies intergrades morphologically with *anatum* in open boreal forest or taiga areas of Alaska and Canada (Fyfe 1969; White 1968).

These peregrines migrate largely along the Atlantic coast and to some extent through the interior of the continent. The Atlantic coastal flight includes some birds from western Greenland. They winter north (sparingly) from at least Cape Sable, Florida and Cameron Bayou Louisiana

(probably along entire gulf coast) and Baja California (occasionally); south through West Indies, Central and South America to 40° S in Chile and 35° S in Argentina (White 1968; Rice in Hickey *ed* 1969; Shor 1970a; Mueller and Berger 1961; Hofslud 1966; Enderson 1965, 1969).

Ward and Berry (1972), analyzing records of sightings and bandings of fall migrants on the outer beaches of Assateague Island, Maryland, from 1939-1971, determined that the proportion of immatures in different years was 81% to 91%. Of birds trapped for banding in those years, only 8% of the adults and 30% of the immatures were males. A decline in total numbers during the study period was indicated (Ward and Berry 1972). Shor (1970) points out that data on production indicate that this great preponderance of immatures is impossible unless we assume that about 90% of adult birds are not seen in migration. It was assumed that most of the birds recorded were Arctic Peregrines, the majority possibly from Greenland breeding localities, as indicated by Shore (1970).

Migrants appear in numbers on an island off Kenai Peninsula, Alaska around 1 September. It is not known where they go from there. Some individuals, almost certainly from the Arctic migrant population, have been taken in July and August in mid-latitudes of the United States (White 1969).

Mueller and Berger (1961) recorded 150 peregrines in fall migration along the west shore of Lake Michigan from 1952 to 1957. They were seen with concentrations of hawks of various species along that migration route, and their abundance at any one time was correlated with weather conditions that caused updrafts of air.

RANGE MAP

The Breeding range (Fyfe et al. 1976) and migration range are shown on the following map.

STATES/COUNTIES (within main migration routes):

Massachusetts:	Barnstable, Nantucket, Dukes
Rhode Island:	Washington
New York:	Suffolk, Nassau
New Jersey:	Monmouth, Ocean, Atlantic, Cape May
Delaware:	Sussex

Maryland:	Worcester
Virginia:	Accomack, Northampton
North Carolina:	Currituck, Dane, Hyde, Carteret, Onslow, Pender, Hanover, Brunswick
South Carolina:	Horry, Georgetown, Charleston, Colleton, Beaufort
Georgia:	Chatham, Liberty, McIntosh, Glynn, Camden
Florida:	Nassau, Duval, St. Johns, Flagler, Volusia, Brevard, Indian River, St. Lucie, Martin, Palm Beach, Broward, Dade, Collier
Minnesota:	St. Louis
Wisconsin:	Douglas, Door, Kewaunee, Manitowoc, Sheboygan, Ozaukee, Milwaukee, Racine, Kenosha
Illinois:	Lake
Texas:	Jefferson, Chambers, Galveston, Brazoria, Matagorda, Calhoun, Aransas, Nueces, Kleberg, Kenedy, Willacy, Cameron

HABITAT

Peregrines prefer cliff ledges for nesting sites, but in the absence of these, will nest on cutbanks along rivers or coastal areas, on elevated landforms known as dykes, and occasionally on low mounds or even boulders. In nearly all instances, nests are located in the immediate vicinity of a body of water, either salt or fresh. If cliffs are not close to water or if no food species are available, nesting peregrines will be scarce or absent (Fyfe 1969). In the case of joint occupancy of bluffs by peregrines and gyrfalcons along the Colville River in Alaska, peregrine nests were usually at the brink of a slope or on a bluff to which a person could walk, whereas gyrfalcon nests were on ledges on vertical faces of cliffs, usually under an overhang, and accessible only by rope (White 1969).

In arctic Canada, these falcons nest on cliffs and cut banks of rivers if food is available nearby. In the central Canadian barrens near Cotwoyot Lake, the landforms known as dykes provide rocky formations elevated over the surrounding countryside that are suitable for nesting. Where land relief is slight in the central barrens (tundra) of Canada, peregrines nest on boulders and hummocks as little as 1 m above the surrounding area.



Breeding range and migration routes of the Arctic peregrine falcon

Rivers are important in the falcon's environment; they create the nesting cliffs by erosion and provide bathing facilities, especially on gravel bars; rivers also provide habitat for shorebirds and waterfowl for the falcon's food. Peregrines also hunt extensively over the surrounding country, particularly taking ptarmigan and longspurs (Cade 1960).

They seldom nest on the cliffs along the Bering Sea coast of mainland Alaska or in the mountains above 800 m. A cliff of some sort is the most important feature of the nesting habitat (Cade 1960).

FOOD AND FORAGING

Food would not be a limiting factor in most of northern Canada. Throughout that area, passerines, shorebirds and waterfowl are abundant in summer, with the exception of the Arctic desert areas or relatively barren mountain tops on Baffin Island (Fyfe 1969; Cade 1954).

Burnham and Maddox (*in* Fyfe et al. 1976) reported that four species of small passerine birds made up over 90% of the food of peregrines in western Greenland. J. N. Rice and R. B. Berry (*ms.* 1970) also found that, with the exception of a single ptarmigan, the peregrines nesting at Ungava Bay in 1970 fed entirely on small passerines, primarily horned larks, snow buntings, and water pipits. Cade (1960), however, reported that Arctic peregrines take a wide variety of avian prey (waterfowl, shorebirds, and passerines), with no single species predominating except possibly ptarmigan. In his opinion, peregrines probably feed heavily on lemmings during their cyclical abundance, but that the availability of lemming does not affect the peregrine population.

SHELTER REQUIREMENTS

None

NESTING OR BEDDING

In Arctic Alaska and Canada, nests are scrapes in either earth or gravel, on bare grass, rocky cliffs, cutbanks, dykes, boulders, or hummocks. Three nests in old rough-legged hawk nests had eggs laid on bare sticks with no soft material. Five nests in old rough-legged hawk nests had eggs and other plant material (Hohn 1955, McEwen 1957; Cade (1960); Fyfe 1969).

Cliff nests are typical for the species and are situated on a ledge or in a hole, often under a pro-

tecting overhang. Nests on boulders and hummocks have little or no protection from above (Fyfe 1969). All nesting sites known in Alaska were on cliffs on islands or along the coast or river bluffs (Cade 1960). Of 57 eyries along the Colville River, height of the nests above the river ranged from 3.2 m to 96 m (average 35 m); the distance below the brink of the cliff was 0 to 90 (average 14) m. Fifteen of 57 eyries were located on shale formations, 17 on sandstone or conglomerate, and 27 on earth or talus banks. Eleven were in old rough-legged hawk nests. The brinks of the cliffs are usually overgrown with dense thickets of alder and willow scrub (Cade 1960). All nests found by Burnham and Mattox (*in* Fyfe et al. 1976) in western Greenland were located on rocky cliffs varying in height from 25 to 120 m. All nests found in Alaska were on cliffs, mostly along rivers (Cade 1960).

RITUAL REQUIREMENTS

The complex courtship and mating ritual is described under Reproduction. A strong pair bond is essential to the reproductive success of the species (Cade 1960).

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

Suitable nesting sites near an adequate food supply and freedom from organochlorine chemicals in the environment are the most critical requirements.

POPULATION NUMBERS AND TRENDS

White (1969) said the number of breeding adults on the Arctic Slope of Alaska seems to be maintaining itself and there was no evidence of a decrease in reproductive capacity.

Population density was approximately one pair per 52 km² of suitable habitat in the Bathurst Inlet area, Canada, and about one pair per 259 km² in areas of limited nesting habitat. In estimating 7,500 breeding pairs in northern Canada (Fyfe 1969, J. H. Enderson and D. D. Berger *in* Fyfe 1969), a sharp decline of nesting peregrines was found along the Mackenzie River and at Campbell Lake in 1966.

Enderson (1969) calculated the mortality rate of peregrines on the basis of band recovery (presumably mostly *tundrius*) as 70% for immatures and an annual rate of 25% for adults. He assumed

that the 70% immature mortality rate is indicative of a declining population.

Rice (1969) calculated from peregrines trapped for banding on the beaches of the Maryland-Virginia coast that immatures constituted 83% of the population in the 1954-1959 period and 84% in the 1960-65 period. The 1954-59 sample included 2 adult males, 37 adult females, 50 immature males and 144 immature females. The 1960-65 sample included 4 adult males, 26 adult females, 56 immature males and 116 immature females. Cade (1960) estimated 200 to 250 breeding pairs in Arctic Alaska.

Cade (1960) suggests that gyrfalcons can successfully prevent peregrines from occupying the larger river cliffs and thus affect their density and distribution.

In the Colville River area of about 36,800 km² on the Arctic slope of Alaska, the population of peregrines appears to have held rather constant in the number of breeding pairs until about 1970-71, and then started a severe drop. It may now have leveled off at about 30% to 35% of its former numbers, as suggested by data from 1973 and 1975. Total numbers of pairs or single adults were as follows: 1952-1959, 32-36; 1967, 27; 1968, 32; 1969, 33; 1971, 25; 1973, 14; 1975, 13. Based on early 1950 studies by Cade, the total population of the Colville drainage may have been between 120 and 160 pairs (White and Cade 1975; Peakall et al. 1976).

In the Sagavanirktok River area of about 2400 km² on the Arctic Slope of Alaska, the population followed a similar pattern, but appears to have started to decrease earlier and declined slightly more. Total numbers of pairs or single adults were as follows: pre-1950, 11; 1958, 5; 1963, 5; 1970, 3; 1972, 2; 1973, 2; 1974, 5; 1975, 3 (White and Cade 1975).

Fyfe et al. (1976) note that limited data for other parts of Arctic Alaska indicate a population decline similar to the well-documented decline for the Colville drainage, and that it is doubtful that as many as 50 pairs are still producing young in northern Alaska where Cade (1960) estimated the breeding population at 200 to 300 pairs in the late 1950's.

In the Canadian Arctic, most populations have declined to 50% or less of their historically known size. On Ungave Bay, the Interior Barrens, Central Arctic Coast, Banks Island, and the North Slope of Canada where historical records exist,

only 41% of known nesting sites were occupied in 1975. Occupancy of newly found nests declined 60% from 20 in 1973 to 8 in 1975, indicating an accelerated decline of Canadian Arctic populations since 1973.

In western Greenland, the observations of Burnham and Mattox (*in* Fyfe et al. 1975) revealed a substantial density of one peregrine per 200 km².

REPRODUCTION

In the Colville River area (36,800 km²) on the Arctic Slope of Alaska, production of young may have started to fall off as early as 1965 or 1966. The numbers of young produced in 1952-1959 was 40 to 50; in 1967, 34; in 1968, 34; in 1969, 26; in 1971, 14; and in 1973, 9 (White and Cade 1975; Peakall et al. 1975). The DDE residue in eggs in that area through 1971 averaged about 190 parts per million dry weight (Peakall et al. 1975) and egg shells had thinned to about 23% (White and Cade 1975).

Burnham and Mattox (*in* Fyfe et al. 1976), in an approximately 1800 km² area of western Greenland, found a productivity of peregrines averaging nearly 2.5 young per pair over a 4-year period. DDE residues of 332 parts per million found in added eggs and egg-shell thinning of 14% indicate incipient problems for that population. Eleven peregrine egg shells taken from Arctic Ungava in 1967 ranged in thickness between 0.25 and 0.33 mm (mean thickness 0.291 mm), representing a 24.4% drop from the 0.385 mean of 30 eggshells measured by Dan Anderson from "eastern Arctic" eggs collected during the first third of the century. In ten eggs checked, DDE ranged from 137 to 498 ppm on a fat basis (D. D. Berger pers. comm. 1970).

Cade (1960) suggests that when peregrines and gyrfalcons are in direct competition, the gyrfalcon is the dominant competitor. On the Anderson River, Fyfe (1969) found the gyrfalcon to be dominant and believed that where the two species nest during the same season, the gyrfalcon may displace the peregrine from the better nesting sites such as cliff locations, relegating the peregrine to dirt cutbanks. Natural hazards to nesting are late spring storms or excessive erosion. Because of the short nesting season, renesting is usually not possible (Fyfe 1969). A significant correlation of immature peregrine migration counts along Atlan-

tic coastal beaches in October with mean daily minimum July temperatures in eastern Arctic Canada indicate that minimum temperature on the breeding grounds will cause a 31.6% (1-bird) change in numbers of migrant immature birds identified along the Atlantic coast per party-day (Ruos 1970).

The Arctic peregrine is, in effect, reproductively isolated from the more southern taiga population by its gonad cycle. The entire courtship cycle of *tundrus* and thus the factors regulating pair bonding is at variance with more southern breeding peregrines (Cade 1960; White 1968).

Peregrines apparently become established along the lower Colville river between 4 and 10 May, with peak arrivals after the middle of May. Falcon arrival is synchronized with the arrival of their chief prey species. The incubation period probably averages about 29 days for each egg. Since there are intervals of 2 days between egg layings and incubation begins with laying of the first egg in the Arctic, there may be as much as a week's difference in the ages of the youngest and oldest nestlings. On the Colville, there was one instance of laying in the last week of May, 12 instances in the first week of June, and 6 instances in the second week of June. The total range for any given event in the breeding cycle is barely more than 3 weeks. Since the total period of the breeding cycle from laying to the beginning of independent existence of the young is not less than 95 days in Arctic, peregrines must begin to lay eggs not later than the third week in June to ensure successful rearing of young before the food is gone. The average clutch of Arctic birds is 3 eggs (54 samples), whereas the mean for the U.S. is 3.74 (299 samples) showing a decreasing size of clutch northward. Average fledging success on the Colville River, Alaska was 1.4 young per nest. Predators on eggs and young, in addition to man, are a negligible factor in the Arctic. Fairly certain predators are the timber wolf, red fox, arctic ground squirrel, and golden eagle (Cade 1960).

Preincubation or courtship behavior divided into 8 parts: (1) attraction of mates to each other, (2) mutual roosting on cliffs, (3) cooperative hunting excursions, (4) courtship flights, (5) "familiarities" on cliff, (6) courtship feeding, (7) copulation, (8) nest scraping. Females are dominant over males and successful mating depends

on the males' ability to adjust to that situation. Incubation and brooding is done mostly by the female, who sits more closely than females in more southern latitudes. Food is brought by the male, and even during the early fledging period, the male continues to transfer food to the female for feeding young. When young are about 3 weeks old, the female begins to hunt actively again (Cade 1960). Peregrines are definitely territorial during the breeding season and defense of territory, which is roughly 3.22 km in diameter, has a graded intensity from less intense at the outer limits, where defense is only over food, to most intense near the nesting cliff, which is always defended against all other predatory birds, although rough-legged hawks are sometimes allowed to nest on the same cliffs within 100 yards (Cade 1960).

First-year falcons not engaged in breeding may pass their first summer within or at the periphery of their breeding range, but are not obvious because they are not associated with nesting sites. In 1967 one first-year female was seen on the Colville River (White 1969).

Tradition is important in the occupancy of a particular cliff. Once vacant, it may take a long time for another pair to reoccupy it and establish a new tradition. New occupancy is probably the result of population pressure as well as attractiveness of the site (Cade 1960).

MANAGEMENT AND CONSERVATION

The most important actions that might be taken in behalf of the Arctic peregrine would probably be to designate for special protection against land-use exploitation the areas where eyries are concentrated in Arctic Alaska, Canada, and western Greenland; as well as major migration concentration areas along the Atlantic and Gulf coasts and the shores of the western Great Lakes; and to conduct an intensive educational and law-enforcement program to reduce the use of chlorinated hydrocarbon pesticides in areas along the major migration pathways and wintering grounds in the eastern United States, West Indies, and Central and South American countries.

AUTHORITIES

Thomas J. Cade
Laboratory of Ornithology
Cornell University
Ithaca, New York 14850

Clayton M. White
Department of Zoology
575 Widtsoe Bldg.
Brigham Young University
Provo, Utah 84601

Richard Fyfe
Room 1110
10025 Jasper Avenue
Edmonton, Alta. Canada
T5J 1S6

James H. Enderson
Dept. of Biology
Colorado College
Colorado Springs, Colorado 80903

David B. Peakall
Laboratory of Ornithology
Cornell University
Ithaca, New York 14850

Daniel D. Berger
1328 N. Jefferson, Apt. 313
Milwaukee, Wisconsin 53202

William H. Burnham
Dept. of Zoology
Brigham Young University
Provo, Utah 84601

Joseph J. Hickey
226 Russell Laboratories
University of Wisconsin
Madison, Wisconsin 53706

James L. Ruos
7145 Deer Valley Road
Highland, Maryland 20772

Walter R. Spofford, II
Aguila-Rancho
Portal, Arizona 85632

F. Prescott Ward
302 Belfast Court
Joppa, Maryland 21085

Wilston Shor
6614 32nd Street
Washington, D.C. 20015

James N. Rice
Contention Lane
Berwyn, Pennsylvania 19312

PREPARER'S COMMENTS

It seems obvious that by far the most important factor contributing to the reproductive

difficulties and population decline of the Arctic peregrine, as in the case of the now-extinct eastern United States population of the American peregrine, is high levels of chlorinated hydrocarbon chemicals in the environment. Correction of this situation should receive the highest priority in all efforts in behalf of this species—J. W. Aldrich.

LITERATURE CITED/SELECTED REFERENCES

- A. O. U. 1931. Check-list of North American birds. American Ornithologists' Union, Lancaster, PA.
- Berger, D. C., D. W. Anderson, J. D. Weaver, R. W. Risebrough and J. A. Keith. 1970. Shell-thinning in eggs of Ungava Peregrines. *Canad. Field-Nat.* 84:256-267.
- Berry, R. B. 1971. Peregrine Falcon population survey, Assateague Island, Maryland, fall 1960. *Raptor Research News* 5(11):31-43.
- Burnham, W. H. 1975. Breeding biology and ecology of the Peregrine Falcon in West Greenland. MSc. thesis. Brigham Young Univ. Provo, Utah.
- Burnham, W. H., M. A. Jenkins, F. P. Ward, W. G. Mattox, D. M. Clement, and J. T. Harris. 1974. Falcon research in Greenland. 1973. *Arctic* 27:71-74.
- Cade, T. J. 1954. On the biology of falcons and the ethics of falconers. *Falconry News and Notes* 1:12-19.
- . 1960. Ecology of the Peregrine and Gyrfalcon populations in Alaska. *Univ. Calif. Publ. Zool.* 63:151-290.
- Cade, T. S., and R. Fyfe. 1970. The North American Peregrine survey, 1970. *Canad. Field-Nat.* 84:231-245.
- Cade, T. J., C. M. White and J. R. Haugh. 1968. Peregrines and pesticides in Alaska. *Condor* 70:170-178.
- Cade, T. S., J. L. Lincer, C. M. White, D. G. Roseneau, and L. G. Schwartz. 1971. DDE residues and eggshell changes in Alaskan falcons and hawks. *Science* 172(3986):955-957.
- Campbell, R. W. and B. Davies. 1973. Nesting raptor survey in western Canadian Arctic. Environmental Protection Board Report; 1973, Sect. 1.

- Enderson, J. 1965. A breeding and migration survey of the Peregrine Falcon. *Wilson Bull.* 77: 327-339.
- . 1969. Coastal Migration data as population indices for the Peregrine Falcon. Chapt. 23 in J. J. Hickey ed. *Peregrine Falcon populations: their biology and decline*. Univ. Wisconsin Press, Madison.
- Enderson, J., and D. Berger. 1968. Chlorinated hydrocarbon residues in Peregrines and their prey species from northern Canada. *Condor* 70:149-153.
- Enderson, J. J., D. G. Rosenau, and L. G. Schwartz. 1968. Nesting performance and pesticide residues in Alaska and Yukon Peregrines in 1967. *Auk* 85:683.
- Fyfe, R. 1969. The Peregrine Falcon in the Canadian Arctic and eastern North America. Chapt. 8. in Hickey ed. *Peregrine Falcon populations, their biology and decline*. Univ. Wisconsin Press Madison.
- . 1977. Status of Canadian raptor populations, ICBP World Conf. *Birds of Prey Proc.*: 34-39.
- Fyfe, R., S. A. Temple, and T. J. Cade. 1976. The 1975 North American Peregrine Falcon survey. *Canad. Field-Nat.* 90:228-273.
- Hickey, J. J. (ed). 1969. *Peregrine Falcon populations: their biology and decline*. Univ. Wisconsin Press, Madison.
- Hofslund, P. B. 1966. Hawk Migration over the western tip of Lake Superior. *Wilson Bull.*, 78:79-87.
- Hohn, E. O. 1955. Birds and Mammals observed on a cruise in Amundsen Gulf, N.W.T. July 29-August 16. 1953. *Canad. Field-Nat.* 69: 41-44.
- Kessel, B. and T. J. Cade. 1958. Birds of the Colville River, northern Alaska. *Biol. Papers Univ. Alaska* no. 2.
- Mattox, W. G., R. A. Graham, W. A. Burnham, D. M. Clement. 1972. Peregrine Falcon survey, west Greenland, 1972. *Arctic* 25:308-311.
- McEwen, E. G. 1957. Birds observed at Bathurst Inlet, Northwest Territories, *Canad. Field-Nat.* 71:109-115.
- Mueller, H. C. and D. D. Berger. 1961. Weather and fall migration of hawks at Cedar Grove, Wisconsin. *Wilson Bull.* 73:171-192.
- Peakall, D. B., T. J. Cade. C. M. White and J. R. Haugh. 1975. Organochlorine residues in Alaskan Peregrines. *Pesticide Monitoring Journ.* 8:255-260.
- Rice, J. N. 1969. A peregrine population index on the Maryland-Virginia coast. pp. 279-280, in J. J. Hickey ed, *Peregrine Falcon populations: their biology and decline*. Univ. Wisconsin Press, Madison.
- Ruos, J. L. 1970. Correlation of Arctic temperatures in July with numbers of Tundra Peregrines (*F. p. tundrius*) seen per partyday in October along the Mid-Atlantic coast. Special study Report prepared for Rare and Endangered Species Committee, U.S. Fish and Wildlife Service, 15 Feb. 1970.
- Shor, W. 1970. Peregrine Falcon population dynamics deduced from band recovery data. *Raptor Research News* 4(2):49-59.
- . 1970a. Banding recoveries of Arctic migrant Peregrines of the Atlantic Coast and Greenland population. *Raptor Research News* 4(4):125-131.
- Spofford, W. R. 1969. Hawk Mountain counts as population indices in northwestern America, pp. 323-332, in J. J. Hickey ed. *Peregrine Falcon populations: their biology and decline*. Univ. Wisconsin Press, Madison.
- Walker, W., W. G. Mattox, and R. W. Risebrough. 1973. Pollutant and shell thickness determination of Peregrine eggs from west Greenland. *Arctic* 26:256-158.
- Ward, F. P. and R. B. Berry. 1972. Autumn migrations of Peregrine Falcons on Assateague Island, 1970-72. *Journ. Wildl. Mngmt.* 36:484-492.
- White, C. M. 1968. Diagnosis and relationships of the North American tundra inhabiting Peregrine Falcons. *Auk* 85:179-191.
- . 1969. Breeding Alaskan and Arctic migrant populations of Peregrines. Chap. 2 in Hickey, J. J. ed. *Peregrine Falcon populations their biology and decline*. Univ. Wisconsin Press, Madison.
- White, C. M., and T. J. Cade. 1971. Cliff-nesting raptors and ravens along the Colville River in Arctic Alaska. *Living Bird* 10:107-150.
- . 1975. Long term trends of Peregrine populations in Alaska. ICBP World Conf. *Birds of Prey Proc.*

Biological Services Program

FWS/OBS-80/01.52

MARCH 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States-

MISSISSIPPI SANDHILL CRANE



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

FWS/OBS-80/01.52
March 1980

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—

MISSISSIPPI SANDHILL CRANE

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



(PHOTO OF CLOSELY RELATED SUBSPECIES)

CREDIT: LUTHER C. GOLDMAN

MISSISSIPPI SANDHILL CRANE

Grus canadensis pulla Aldrich

KINGDOMAnimalia
 CLASSAves
 ORDER.....Gruiformes
 FAMILY..... Gruidae
 OTHER COMMON

NAMES. . . Florida Crane (McIlhenny 1938);
 Florida Sandhill Crane (Valentine 1963).

DATE

Entered into SWIS.To be determined
 Updates.....To be determined

LEGAL STATUS

Federal: Endangered: (42FR36425, 14 July 1977). Protected (Migratory Bird Treaty Act of July 3, 1918. (40 Stat. 755; 16 U.S.C. 703-711) as amended 3 Dec. 1969. Public Law 91-135.

States: Endangered: Mississippi (protected under the Nongame and Endangered Species Act of 1974; Listed: Alabama.

PRIORITY INDEX

50

DESCRIPTION

REASONS FOR CURRENT STATUS:

The Mississippi Sandhill Crane is nearing extinction because of its very small and restricted population and the deterioration of its habitat, semiopen wet pine savanna, because of drainage, planting of trees for timber, urban and suburban development, and highway construction (U.S. Fish and Wildlife Service 1973; Morine 1975; Recovery Team for the Mississippi Sandhill Crane 1976).

Since the mid-1950's, timber companies have acquired or leased thousands of hectares, which have been planted to slash pine (*Pinus elliottii*). Drainage ditches dug through savannas and watercourses speed run-off. Fire, the natural agent in maintaining even wet prairies, has been controlled or eliminated, encouraging pine plantation survival and also permitting natural reproduction of pine and brush in unplanted savannas. Many access roads, trails, and fire lanes have been built, giving people easier access to crane habitat. Timber management has made thousands of hectares of former crane habitat unsuitable for these birds (Valentine and Noble 1970; Morine 1975; Recovery Team for the Mississippi Sandhill Crane 1976).

Housing developments and small farms are expanding into crane habitat from Ocean Springs, Fontainebleau, and Gautier communities. Recent release of St. Regis timber land holdings allowed the sale of about 2,000 hectares of crane environment for development.

U.S. Highway 90, a four-lane east-west avenue through crane range, now a "strip city" extends the entire distance between Ocean Springs and Pascagoula. Other highways through crane habitat are being built or improved. The adverse effects of highways on cranes are: (1) direct loss of land to right-of-way and borrow areas; (2) disturbance by noise, vibration, and visual factors; (3) pollution of surrounding air and soil; (4) facilitation of public access to crane environment; and (5) stimulation of residential and commercial developments along highway route (Recovery Team for the Mississippi Sandhill Crane 1976).

This species is similar in size to the Florida sandhill crane, *Grus canadensis pratensis*, but colored portions of plumage are much darker throughout. It differs from the greater sandhill crane, *Grus canadensis tabida*, in smaller size (except tarsus) and darker color; and from the lesser sandhill crane, *Grus canadensis canadensis*, in larger size in all dimensions and darker color. It can be distinguished from the Canadian sandhill crane, *Grus canadensis rowani*, by longer tarsi and darker color (Aldrich 1972).

Measurements. (8 live adult birds hatched from Mississippi-taken eggs, sex undetermined): wind (chord), 470-493 mm; bill (from posterior end of nostril), 82-91; tarsus, 216-258 (Aldrich 1972).

Eggs. Light buffy background with splotches of reddish brown and lavender, particularly around the large end (McIlhenny 1938; Walkinshaw 1960). Average measurements of 16 eggs was 95.9 (89-104) x 58.55 (56.2-59.0) (Walkinshaw 1973).

RANGE

Sandhill cranes are permanent residents in Jackson County Mississippi near Ocean Springs and at Fontainebleau, between the Pascagoula River on the east and Jackson-Harrison county line on the west, Graveline Bayou on the south and on the north the 30°37' latitude line (Valentine 1978, pers. comm.).

Their former distribution is poorly known, but presumed to have been more extensive than at present with populations in widely separated areas of suitable habitat in southern Louisiana (Cook 1914; Figgins 1923; McIlhenny 1943; Lowery 1960), southern Mississippi (McIlhenny 1938; Turcotte 1947; Walkinshaw 1949; Valentine 1963; Valentine and Noble 1970), and southern Alabama (Howell 1928; Imhof 1962). No specimens of the populations outside southern Mississippi are extant, so their identification as *pulla* must be assumed. In a more detailed statement by the Recovery Team of the Mississippi Sandhill Crane (1976), the range is said to be confined to southern Jackson County, Mississippi, from the Pascagoula River to about the Harrison County

Line. The northern limit is the east-west line (lat. 30° 35'), about 6.4 km north of Vancleave. The southern limit is Simmons Bayou and Graveline Bay. Eleven nesting areas were located within those limits during 1965 through 1978. It is not known where unpaired birds go when paired adults are nesting.

Although this subspecies leaves its breeding range to feed and roost, it probably does not migrate far. One individual was seen as far as 11 miles from the nesting area. However, some individuals of other populations of sandhill cranes may winter within the range of the Mississippi birds, as evidenced by the fact that two cranes found dead in 1974 within the range of *G. c. pulla* neither clearly fit the original description of that subspecies nor matched the specimens of cranes reared from eggs taken in Mississippi (Aldrich in Recovery Team for the Mississippi Sandhill Crane 1976). Also, migrant sandhill cranes have been found wintering at Gulf Shores in Baldwin County, Alabama, about 80 km from the range of the Mississippi subspecies (Hamilton 1971; James 1972).

RANGE MAP

Breeding range (from Valentine and Noble 1970:763; Recovery Team for the Mississippi Sandhill Crane 1976) is shown on the following map. Hatched areas are recent (1965-70) nesting grounds. Numbers indicate active nests found.

STATES/COUNTIES

Mississippi: Jackson.

HABITAT

Nesting habitat was described by Walkinshaw (1949), Valentine (1963) and Valentine and Noble (1970) as wet areas in semiopen pine flats. It would appear that, although savanna-like in aspect, breeding areas have more trees than is usually the case with sandhill cranes of other subspecies (Walkinshaw 1949, 1960, 1973). However, the area immediately surrounding the nest is fairly open. In the larger savannas, there are scattered long-leaf pines (*Pinus palustris*), slash pine (*Pinus elliottii*), baldcypress (*Taxodium distichum*), and shrubs, but the view is quite open. Grassland openings in the swamps, forests and pine plantations used for nesting may be less than 0.4 hectares in area. Of 55 nests, 24 (44%) were in open savannas;

24 (44%), in swamp edges and openings; 4 (7%), in pine plantations; and 3 (5%), along pine forest edges (Valentine and Noble 1970; Valentine in Recovery Team for the Mississippi Sandhill Crane 1976).

Habitat in the winter roost in the Pascagoula River marsh is mainly sawgrass (*Cladium*) with minor components of other marsh plants. The creek and bayou banks are lined with baldcypress and several brush species. The roost marsh is fresh to slightly brackish, but fairly salty water may run up the bayous during droughts and high tides (Recovery Team for the Mississippi Sandhill Crane 1976).

Factors in the natural environment that can cause mortality are severe storms with flooding, droughts, and fires. Despite some losses of nests from fire, it is essential to the ecology of cranes because it checks encroachment of woody vegetation on open savannas (Recovery Team for the Mississippi Sandhill Crane 1976; Aldrich pers. comm.).

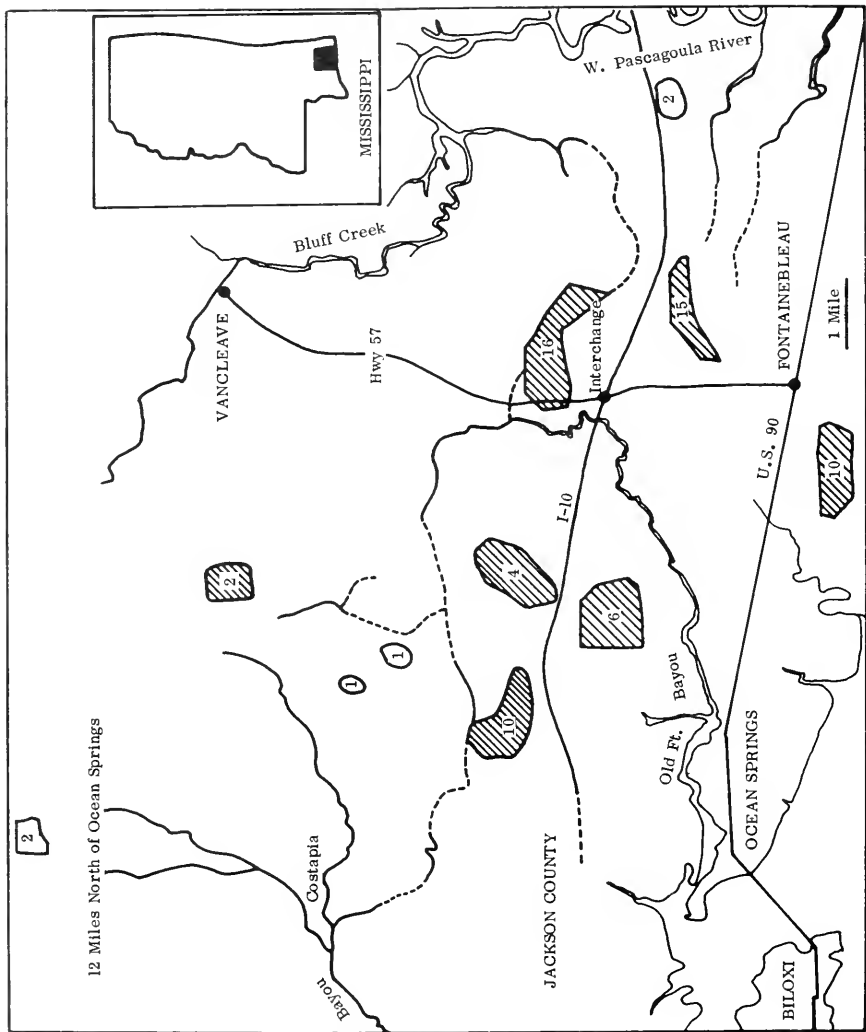
The most serious threat to the success of crane breeding is probably habitat destruction through the current timber management practices, draining marshes and planting pine (Valentine and Noble 1970).

FOOD AND FORAGING BEHAVIOR

During the summer, cranes feed on natural foods found in swamps, savannas, and open forest lands. Animal foods include adult and larval insects, earthworms, crayfish, frogs, and small rodents. Plant foods are roots, tubers, seeds, nuts, fruits and leafy parts. During the fall, winter, and early spring, most cranes feed on waste grain and invertebrates in small corn fields and pastures several kilometers north of the breeding range. Such farms are scarce in that area. There have been a few complaints of crane depredations on corn fields, but most farmers welcome the cranes (Recovery Team for the Mississippi Sandhill Crane 1976). In winter and spring, they also feed on freshly sprouted grass on burned open pine flats (McIlhenny 1938).

NESTING OR BEDDING

Nests are built in savannas, sparsely forested areas, or swamp openings that hold shallow water or may be dry. Nests placed on ground in open



Known breeding range of the Mississippi sandhill crane (Valentine and Noble 1970, Valentine pers. comm.).

areas are built of dead vegetation gathered near the nest site (Recovery Team for Mississippi Sandhill Crane 1976). Walkinshaw (1960) found nests of dried sedges that were 124 by 104 cm across and 13 cm high and were situated in water 21 cm deep. McIlhenny (1938) described a nest of dried grasses and weed stalks about 128 cm across and 20 to 36 cm above water 15 cm deep. The active nest is often within a short distance of the one used the previous year. Old or "dummy" nests are often in close proximity to active nests (Recovery Team for Mississippi Sandhill Crane 1976). Valentine found one instance of the same nest being used 3 consecutive years; two used for 2 years; and another use 1 year, deserted for one season and used again the next year (Valentine 1978, pers. comm.).

The main winter roost is in the Pascagoula River marsh, in the vicinity of Bluff Creek, Bayou Castelle, and Paige Bayou to the West Pascagoula River (Recovery Team for the Mississippi Sandhill Crane 1976). The Pascagoula River marsh roosts are used mainly from August to March. During the breeding season, most cranes roost in the nesting and feeding range. Cranes may be vulnerable to hunters as they fly into and out of the roost, generally only during brief periods at daybreak and sundown (Recovery Team for the Mississippi Sandhill Crane 1976).

RITUAL REQUIREMENTS

All subspecies of sandhill crane engage in spectacular dances. Sometimes a single member of a pair will dance, sometimes both; sometimes a group forms a circle, facing inward. The dances consist of a great variety of postures, particularly bowing low and leaping 2 or more meters into the air, accompanied by vocalizations. Walkinshaw (1949) describes these dances in detail. They seem to be related to courtship in some cases, but may take place at any time of the year.

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

None known.

POPULATION NUMBERS AND TRENDS

Leopold (1929) estimated 50 to 100 or more cranes in Mississippi. McIlhenny (1938) reported 11 nests in the Fontainebleau area and counted 34 in one flock in April 1938. Walkinshaw (1949)

estimated more than 25 pairs in 1940. Turcotte (1947) estimated 30 in 1947. Strong (1969) estimated 16 pairs and a population of 50 to 60 birds. Valentine and Noble (1970) estimated about 38 to 40. Valentine (1975) judged a minimum of 10 to a maximum of 15 breeding pairs with a population between 30 and 50 individuals. He found 20 fairly distinct nesting territories in 11 areas during 1965 through 1978, but the most nests found in any one year was 8 in 1969.

During the period 19-22 January 1977, a total of 52 cranes was counted in the wintering area of Mississippi sandhill cranes. It is not known whether they were all of that subspecies or some were migrants from elsewhere (Jacob Valentine, official trip report U.S. Fish and Wildlife Service, 27 Jan. 1977).

REPRODUCTION

Paired cranes select a breeding territory for courtship, mating, and nesting and defend it from other cranes. Territory size may depend on the density of cranes and physical attributes of the habitat. In open savannas, it appears that only one pair has possession of a territory despite the size of the savanna. The smallest savanna occupied by one pair was 36 ha, the largest, over 202 ha. In Ben Williams Swamp and other areas where openings suitable for nesting are shielded from each other by large trees and shrubs, cranes will nest close together. In 1971, three nests in a row along southern edge of Ben Williams Pond were only 0.8 km apart. The same nesting territories are often used year after year. Territories have been deserted (or searchers could not find the nest) for years and then reoccupied. Desertions may have been caused by brush or tree encroachment on the open area around the nest. Three territories apparently were not occupied after roads were built nearby. One nesting site was destroyed by excavation of a borrow pit in construction of Interstate 10. Of the 14 or 15 known nesting territories, 6 appear to be abandoned (Recovery Team for the Mississippi Sandhill Crane 1976).

The egg-laying period is 4 April to 20 May. Hatching occurs between 11 April and 20 June, with a peak during 1-20 May. Of 54 nests found between 1965 and 1975, 9 contained 1 egg and 45 held 2, a mean of 1.83 eggs per clutch. The incubation period is 30 to 31 days. Both parents incubate. The hatching success of 38 eggs in the wild was 61%, compared to 60% of 42 eggs arti-

ficially incubated for propagation. Hatching failure of 15 wild eggs was attributed to desertion (4); rotten eggs (2); eggs missing (3); crow depredation (3); chick dying in eggs (1); and eggs cracked by flushing birds (2). Human disturbance can be credited with at least 5 egg losses; crow depredations occurred during periods when cranes were off nests after being frightened by humans. Two eggs were broken by cranes flushed from nests by humans. The fate of three missing eggs is unknown; some eggs found were outside the nest after desertion. Heavy rains are known to destroy some eggs. Cranes attend nests constantly and so are not normally subject to robbing by birds or mammals. Crows have not been abundant until recently, when sanitary fill dumps along the road now attract hundreds of them. Raccoons are present but not numerous in the breeding range (Walkinshaw 1973; Valentine *in* Recovery Team for the Mississippi Sandhill Crane 1976).

Poor hatchability of eggs, weak chicks and foot and leg deformities in chicks have been noted in cases of captive chicks hatched from eggs in incubators. Relatively low hatchability and survival is thought by some to be due to genetic problems resulting from inbreeding because of the obviously small gene pool. On the other hand, J. M. Valentine has observed 10 wild chicks, all free of apparent defects (Valentine 1978 pers. comm.). Another chick died while trying to break out of the egg (Recovery Team for the Mississippi Sandhill Crane 1976). Chicks are able to scramble off the nest at 8 hours of age and can swim if necessary (Walkinshaw 1973).

MANAGEMENT AND CONSERVATION

Restoration of this population of sandhill cranes began before it was recognized as a distinct subspecies, with the rearing of young hatched from eggs taken from wild nests in Mississippi. Captive propagation has been at the Patuxent Wildlife Research Center, Laurel, Maryland. The intent was to reintroduce the propagated stock into the wild. Acquisition and restoration of habitat in the present range and adjoining areas and rerouting proposed sections of Interstate Highway 10 were proposed as essential protection measures (U.S. Fish and Wildlife Service 1973).

As of 20 September 1976, a Mississippi Sandhill Crane Recovery Team, with Jacob M. Valentine as leader, was appointed by the U.S. Fish and

Wildlife Service, and a recovery plan approved in September 1976 was revised in 1978 (Recovery Team for the Mississippi Sandhill Crane 1976).

Lands available for crane occupancy are limited. The U.S. Fish and Wildlife Service has proposed some refuge lands which are the best available that still contain either nesting cranes or potential nesting habitat. With the assistance of the Nature Conservancy, the Service acquired 3,490 ha of habitat in two units and has established the Mississippi Sandhill Crane National Wildlife Refuge. A habitat management plan for the refuge was completed by the Service on 28 March 1975 (Morine 1975; Recovery Team for the Mississippi Sandhill Crane 1976). In June 1977, 202 ha of forest and savanna within the breeding range of the Sandhill Crane refuge were burned for the purpose of opening the cover and improving nesting habitat (Jacob Valentine *in* lit 15 June 1977).

Competition with other animals for food or living space need not be a concern of management, as there are few competitors in the crane's range. Closing of the open range policy in the 1950's prohibited cattle and hog grazing on timber company holdings, and cattle are now confined to better grazing lands. Deer are scarce but are increasing as trees and brush invade the savannas (Valentine, pers. comm.). Management of the crane range should not include improvement of the habitat for deer or game birds, as this would create a demand for hunting there as well as make the habitat less suitable for cranes (Recovery Team for the Mississippi Sandhill Crane 1976).

The Fish and Wildlife Service has conducted a study and propagation program at the Patuxent Wildlife Research Center with the objective of rearing 10 captive breeding pairs to produce young cranes for transplanting to suitable habitat within the range of the Mississippi Sandhill Crane. Up to the present, 14 captive birds have been produced at Patuxent from Mississippi-taken eggs; several captive pairs reared have laid eggs and from these, 2 have been raised (Ray Erickson pers. comm. 1978).

The U.S. Forest Service, in cooperation with Fish and Wildlife Service and the Mississippi Game and Fish Commission, will clear and maintain two areas in the DeSoto National Forest in an effort to improve crane habitat. No cranes are nesting there at present.

The U.S. National Park Service has made surveys and will recommend National Landmark status for some lands included within the proposed Federal refuge boundaries.

The Jackson County, Mississippi, Board of Supervisors passed a resolution supporting purchase of a county school section by the Fish and Wildlife Service to become part of the Fountainebleau Unit of the refuge.

The Mississippi Game and Fish Commission has participated in sandhill crane studies and protection for many years. It has cooperated with the U.S. Fish and Wildlife Service in crane propagation since 1965 by approving and assisting taking of eggs. It approved establishment of a Federal crane refuge in 1971.

The National Wildlife Federation and Mississippi Wildlife Federation filed a federal court action against the Department of Transportation, Federal Highway Administration, and Mississippi Highway Department for violations of Section 7, Endangered Species Act for construction of Interstate Highway I-10 through the Mississippi Sandhill Crane National Wildlife Refuge. They asked the court for elimination of an interchange on the Gautier-Vancleave Road, the elimination of borrow pits in the sensitive area, and the acquisition of lands by the highway agencies to mitigate the loss of critical habitat by the highway.

If it is concluded that the present population of Mississippi sandhill cranes is doomed to extinction because of impaired reproduction resulting from inbreeding, it may be justified to try a genetic infusion of another strain such as that of the Florida or Georgia populations of the Florida Sandhill Crane. This would be with hope of continuing to have a crane population in the remnant habitat now occupied by the Mississippi subspecies. This might be accomplished by placing eggs of Florida Sandhills in the nests of Mississippi birds, which would act as foster parents. This action would be taken only as a last ditch option (MSCRT 1976). Critical habitat has been designated in Jackson County, Mississippi (42FR39985, 8 August 1977).

AUTHORITIES

Lawrence H. Walkinshaw
1145 Scenic Drive
Muskegon, Michigan 49445

Robert E. Noble
Department of Forestry and Wildlife Management

Louisiana State University
Baton Rouge, Louisiana 70803

William H. Turcotte
Mississippi Game and Fish Commission
P.O. Box 451
Jackson, Mississippi 39205

Jacob M. Valentine, Jr.
U.S. Fish and Wildlife Service
111 East Main St.
Lafayette, Louisiana 70501

PREPARER'S COMMENTS

The Mississippi sandhill crane has had the benefit of adequate study to show, in detail, what is necessary to prevent its extinction. However, its habitat and population have been reduced to such a small remnant by drainage and planting for pine timber production, and human population expansion and economic pressures are becoming so great in and around the crane's habitat, that only an overwhelming public sentiment to do everything possible for it can save the Mississippi sandhill crane.

LITERATURE CITED/SELECTED REFERENCES

- Aldrich, J. W. 1972. A new subspecies of sandhill crane from Mississippi. *Proc. Biol. Soc. Wash.* 85:63-70.
- Cooke, W. W. 1914. Distribution and migration of North American rails and their allies. *U.S. Dept. Agric. Bull.* 128.
- Figgins, J. D. 1923. The breeding birds of the vicinity of Black Bayou and Bird Island, Cameron Parish, Louisiana, *Auk* 40:666-667.
- Hamilton, R. S. 1971. Central Southern Region. *Amer. Birds* 25:590.
- Howell, A. H. 1928. *Birds of Alabama* (2nd Ed.) U.S. Dept. of Agric. Bur. Biol. Surv. and Ala. Dept. of Game and Fisheries.
- Imhof, T. A. 1962. *Alabama birds*. Dept. of Conservation, Game and Fish Div. Univ. Alabama Press.
- James, F. G. 1972. Central Southern Region. *Amer. Birds* 26:616.

- Valentine, J. M., Jr. 1963. The status of the Florida Sandhill Crane in Jackson County, Mississippi. Admin. Rept. U.S. Bur. Sport Fish. & Wildl., Atlanta, Ga.
- Valentine, J. M. 1975. The Mississippi Sandhill Crane *Grus canadensis pulla*). Report to Crane Working Group, I.C.B.P. ms.
- Valentine, J. M. Jr., and R. E. Noble. 1970. A colony of Sandhill Cranes in Mississippi. Journ. Wildl. Mgmt. 34:761-768.
- Valentine, J. M., Jr., and R. E. Noble. 1976. The Mississippi Sandhill Crane - Endangered or Doomed. Proc. Int. Crane Workshop 1:343-346.
- Valentine, J. M., Jr. 1978. The Mississippi Sandhill Crane - A Status Update. Presented at the crane workshop, December 7, 1978.
- Walkinshaw, L. H. 1949. The Sandhill Cranes. Cranbrook Institute of Science. Bull. 29.
- Walkinshaw, L. H. 1960. Some Mississippi Crane notes. Migrant 31:41-43.
- Walkinshaw, L. H. 1973. Cranes of the World. Winchester Press. pp. 136-140.
- Leopold, A. 1929. Report on a game survey of Mississippi. ms.
- Lowery, G. H., Jr. 1960. Louisiana birds. Louisiana Wildl. and Fisheries Comm. La. State Univ. Press.
- McIlhenny, E. A. 1938. Florida Crane a resident of Mississippi. Auk 55:598-602.
- McIlhenny, E. A. 1943. Major changes in the bird life of southern Louisiana during sixty years. Auk 60:541-549.
- Morine, D. E. 1975. Saving the Mississippi Sandhill Crane. Nature Conservancy News. Winter 1975:15-18.
- Recovery Team for the Mississippi Sandhill Crane 1976. Mississippi Sandhill Crane Recovery Plan (Draft April 1976).
- Strong, L. 1969. An investigation of the status of the Sandhill Crane in Mississippi. Miss. Game and Fish Comm. P-R Project Report W-48-R.
- Turcotte, W. H. 1947. The Sandhill Crane in Mississippi. Mississippi Game and Fish. June 1947:8-9.
- U.S. Fish and Wildlife Service. 1973. Threatened Wildlife of the United States, 1973 Edition. U.S. Dept. of Interior. Resource Publication 114, GPO.

Biological Services Program

FWS/OBS-80/01.53

MARCH 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States- **GRAY WOLF**



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

FWS/OBS-80/01.53

March 1980

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES

GRAY WOLF

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: L. DAVID MECH

GRAY WOLF

Canis lupus Linnaeus

KINGDOM Animalia
CLASS Mammalia
ORDER Carnivora
FAMILY Canidae
OTHER COMMON
NAMES Lobo, Timber Wolf

DATE

Entered into SWIS To be determined
Updates 1 Feb. 1978; 11 July 1978

LEGAL STATUS

Federal: Endangered in United States (48
conterminous States other than Min-
nesota) and Mexico (43 FR 9607; 9

Mar 1978). Threatened in Minnesota (43 FR 9607; 9 Mar 1978).

States: Endangered: Colorado, Idaho (T or E), Massachusetts (Extinct), Michigan, Montana, New Mexico, Rhode Island (Extinct), Texas, Wisconsin.

REASONS FOR CURRENT STATUS

Clearing of forests and proliferation of civilization in the eastern United States led to extirpation there. Habitat alteration caused depletion of prey such as deer, moose, and beaver; loss of natural prey probably led to predation on domestic animals (Mech 1977a). Bounties were imposed in the 1600's and wolves were essentially extirpated from this region by the 1800's (Ruther and Pimlott 1968).

In the Great Plains, wolves preyed on livestock as bison (*Bison bison*) became depleted. In the 1800's, bounties on wolves were offered by cattlemen. In 1907, the U.S. Biological Survey concluded that wolf predation caused an annual loss of several million dollars. The agency determined that destruction of young in dens, together with trapping adults, significantly reduced loss of cattle and sheep (Young and Goldman 1944). In 1915, Biological Survey was authorized to control wolf numbers, and they systematically reduced wolf numbers by trapping, poisoning, and other means (Rutter and Pimlott 1968).

Bounties are still maintained in some Canadian provinces, and unorganized but effective control continues in Mexico (Mech 1974a, McBride 1978). Minnesota (which has the last major concentration of gray wolves in the 48 contiguous states, Wisconsin, and Michigan offered bounties until 1965, 1950, and 1960, respectively (Thompson 1952, Hendrickson et al. 1975, Mech 1977a). Regulations providing bounties for wolves in Alaska were repealed for units 1-3 in 1978, and the balance of the state in 1969-1970 (R. Rausch, personal communication).

Killing by man for commercial purposes, as well as for sport, has been the major factor in the decline of the wolf in the contiguous United States and Mexico (43 FR 9611; 9 Mar. 1978). Illegal hunting continues today, largely because of wolf predation on livestock and game and, to a lesser extent, because of an age-old unsubstantiated fear of attack on human beings (not one nonrabid wolf has been known to deliberately attack a

person in North America.—Mech 1966).

PRIORITY INDEX

Not assigned.

DESCRIPTION

Canis lupus is a dog-like canid. Males are larger than females, weighing 20 to 70 kg and measuring 1.27 to 1.64 m in total length. Females weigh 18 to 55 kg and measure 1.37 to 1.52 m.

Pelage is extremely variable, usually grayish with black extending from upper side of neck over back. The head is more or less suffused with cinnamon. Underparts vary from white to pinkish buff with scattered dark hairs, becoming a clearer white in the inguinal region. Limbs range in color from a pinkish buff to a rich cinnamon, with some specimens having a prominent narrow black line on the forearms. The tail is grayish above and buff below with a black tip. Summer colors are similar to winter but somewhat paler. Other color phases include all white, or all black, and any color variation between them.

It is distinguished from the coyote (*Canis latrans*) by its larger size, broader snout, shorter ears, and proportionately smaller brain case. It resembles a German shepherd (*Canis familiaris*); however, there are subtle skull differences (Mech 1974a). Gray wolves are more massive and not as lanky as red wolves (*Canis rufus*) (Riley and McBride 1972).

Black-and-white photographs are found in Murie (1944), Young and Goldman (1944), Mech (1966), and McBride (1978); and color pictures, in Mech (1974a, 1977b), Peters and Mech (1975), and March (1977).

RANGE

The present range is essentially equal to the former range in Alaska and much of northern Canada. In the 48 conterminous United States and Mexico, however, populations are limited to Isle Royale, Michigan, the northern third of Minnesota, the northern Rocky Mountains in Montana, and the States of Chihuahua and Durango (and possibly San Luis Potosi, Sonora, and Zacatecas) in Mexico. Scattered reports of sightings occur in three other areas:

1. Southwestern Texas, southern New Mexico, and southeastern Arizona;

2. The Rocky Mountains in Wyoming and Idaho; and
3. (more commonly than the other two areas) the Upper Peninsula of Michigan and northern Wisconsin.

While formerly common in most of North America from the Polar ice cap south to middle Mexico, there were probably very few or none in California or the southeastern United States.

RANGE MAP

Present range is delineated by shading (Mech 1974a; McBride 1978). Critical habitat is taken from the official listing (43 FR 9607, 9 Mar. 1978).

STATES/COUNTIES

- Alaska: All.
- Arizona: (?)
- Idaho: Fremont, Clark, Lemhi.
- Michigan: Chippewa, Iron, Keweenaw, Mackinac, Marquette.
- Minnesota: Aitkin, Becker, Beltrami, Carlton, Cass, Clay, Clearwater, Cook, Crow Wing, Dakota, Hubbard, Itasca, Koochiching, Lake, Lake of the Woods, Mahanomen, Marshall, Norman, Pennington, Pine, Polk, Red Lake, Roseau, St. Louis, Wadena.
- Montana: Beaverhead, Flathead, Glacier, Lewis and Clark, Madison (?), Park (?), Pondera, Teton.
- New Mexico:(?)
- North Dakota:(?)
- Texas: (?)
- Washington:(?)
- Wisconsin: (?)
- Wyoming: Fremont, Park, Teton.

HABITAT

The gray wolf has no particular habitat preference except areas of relative wilderness where human habitations are scarce (Stebler 1944). Mech (1974b) suggests that wild land is not actually preferred, but is the only place to

survive human persecution.

Olson (1938) observed that wolves use a variety of habitats, depending on prey items and season of the year. De Vos (1950) studied wolf movements in Ontario and concluded that topography was also important; all topographies and habitats are utilized except deserts and high mountain tops (Mech 1974a). McBride (1978) and R. Rausch (personal communication), however, also include deserts and high mountain tops.

FOOD AND FORAGING BEHAVIOR

Predominant prey in Alaska depends on location. Sitka deer (*Odocoileus hemionus sitkensis*), moose (*Alces alces*), and caribou (*Rangifer tarandus*) are of greatest value, with numerous other species also taken (Murie 1944; Rausch 1967; R. Rausch, personal communication).

Gray wolves in the United States and Canada prey on white-tailed deer (*Odocoileus virginianus*), moose, snowshoe hare (*Lepus americanus*), cottontail rabbit (*Sylvilagus floridanus*), beaver (*Castor canadensis*), various rodents, carrion, and livestock. The white-tailed deer is the single most important food source, particularly in winter (Young and Goldman 1944; Thompson 1952; Weise et al. 1975).

In Wood Buffalo Park in Canada, bison are taken (Pimlott 1967). Tundra wolves in Canada have a winter diet almost exclusively of caribou. Summer diet varies and includes fish, small birds, and rodents (Kuyt 1972).

Wolves in Mexico prey almost exclusively on livestock, particularly weaned yearling cattle, burros, and colts. Natural prey levels are low over wolf range (McBride 1978).

Wolf predation is largely restricted to malnourished, young, old, or otherwise weakened individuals (Murie 1944, Crisler 1956, Mech 1966, Pimlott 1967, Mech and Frenzel 1971, Mech 1975, Wolfe 1977). Studies by McBride (1978) and R. Rausch (personal communication), however, indicate that wolves in Mexico and Alaska take healthy animals in preference to unhealthy ones.

Wolves use a variety of hunting techniques. Murie (1944) and Mech (1966) describe many hunts, including ambushes, chases, and stalkings. Wolves often stalk the prey until it makes a move, and then chase at 56.3 to 64.4 km/h for up to 3 km (Mech 1970).



Present range of the gray wolf

Methods of kill depend upon the size and condition of the prey. On occasion, one wolf will grab the prey by the nose while others attack from behind. They feed side by side and gorge up to 4.5 kg per day (Mech 1975). They can go several days without eating (Mech 1966). Remains of the kill are often left, but wolves seldom return (McBride 1978) unless they are in poor condition, extremely hungry, or feeding pups (Young and Goldman 1944).

Hunting success, studied by Mech (1966) on Isle Royale, Michigan, indicated that less than 8% of attacks on moose by wolf packs were successful. Kolenosky (1972) estimated that 25% and 63% of deer hunts were successful on two winters in Ontario, although these values might be inflated. Wolves in Alaska appear to take prey in proportion to its abundance, and are highly successful. When conditions such as deep snow or abundant prey are present, they kill in excess of their needs (R. Rausch, personal communication).

SHELTER REQUIREMENTS

See NESTING OR BEDDING.

NESTING OR BEDDING

Ryon (1977) describes the den-digging of a captive wolf. The work was started in April and May, with the female doing most of the work (although on one occasion, the male was observed doing most of the work). Three dens had lengths from 138 to 183 cm, widths of 36 to 41 cm, and heights of 31 to 38 cm. All had domed roofs with somewhat restricted entrances.

Wolves often occupy fox dens or make dens in hollow logs, rock caves, bases of trees, or sides of hills (Murie 1944, Young and Goldman 1944, Joslin 1967). Many dens are located in sandy soils and may be in spots where there is limited visibility or on slopes where there is a clear view of the surrounding terrain (Young and Goldman 1944, Jordan et al. 1967, Joslin 1967).

Photographs of dens appear in Murie (1944) Young and Goldman (1944), Mech (1966), and McBride (1978).

RITUAL REQUIREMENTS

Not known.

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

The wolf territories studied in Superior National Forest, Minnesota, ranged in size from 125 to 310 km² (Mech 1974b). Territories in Alaska and Canada, however, cover a greater range of areas (R. Rausch, personal communication).

A pack will travel its territory irregularly, but will cover most areas every 3 weeks or oftener in Superior National Forest. Boundaries are scent-marked (Peters and Mech 1975). Mech (1974b) found that lone wolves have a nomadic range over a large, nonterritorial area and attempt to avoid packs.

Maximum wolf densities on Isle Royale in Lake Superior, Algonquin Provincial Park, Ontario, and Superior National Forest have been estimated at one wolf per 2,590 ha. Wolf density can be much compressed in areas of very high prey density, such as parts of Canada and the eastern edge of the Superior National Forest (Kuyt 1972, Mech 1974b).

POPULATION NUMBERS AND TRENDS

On Isle Royale in Lake Superior, R. Linn (personal communication) reports that there are 40 or more wolves. Mech (1977a) estimates 1,000 to 1,200 in Minnesota. R. Ream (personal communication) reports that from 10 to 20 can be found in the extreme northern Rocky Mountains of Montana. Wisconsin is believed to have a few (Anon. 1977), and there are perhaps six in the Upper Peninsula of Michigan (Hendrickson et al. 1975).

Mech (1977b) and R. Rausch (personal communication) estimate that wolves number 10,000 to 15,000 in Alaska and 17,000 to 28,000 in Canada. Fewer than 50 adult wolves probably survive in Mexico (McBride 1978).

Murie (1944) recorded a decline in wolf numbers which he was unable to explain in Alaska from 1916 to 1925; he suggested that disease may have accounted for it.

Numbers in Minnesota increased following the prohibition of aerial hunting in 1950, curtailment of wolf control programs in 1955, and repeal of bounties in 1965. However, between 1968 and 1970, the Superior National Forest population decreased 32% based on the 1967-68 numbers, and 55% based on the 1969-70 numbers. This

appears to be a direct result of a decrease in the deer population, which is being stressed by wolf predation, inclement weather, and the decline of their habitat as cut-over forests mature (Mech 1977d, Mech and Karns 1977).

Studies on Isle Royale, Michigan, indicated that successful rearing of young is dependent on ready availability of food. Two or more pups survived rather than the usual one in years when twinning was observed in the moose population (Jordan et al. 1967).

REPRODUCTION

Courtship lasts from a few days to months, with a definite mate preference. Estrus lasts 5 to 7 days, with copulation occurring in February in Minnesota and later further north and at higher altitudes. The gestation period is 63 days; average litter size is six.

The female stays with the young for 1 to 2 months, while the male and other family members provide food. Weaning is at 5 weeks, and sexual maturity at 1 to 2 years (Medjo and Mech 1976).

In each pack, there is usually a dominant pair; the male leads attacks on prey or intruders. Young that survive the first winter may disperse before the next year's litter is born, but usually stay until after it is born (Rutter and Pimlott 1968).

An unexploited population in Ontario contained 35% pups, 40% yearlings, and 25% adults. Exploited populations in Alaska contained 42% pups, 29% yearlings, and 30% adults (Mech 1974a).

MANAGEMENT AND CONSERVATION

Cessation of wolf controls, including bounties, and prohibition of aerial hunting have had positive effects on wolf numbers in the Superior National Forest, Minnesota (Mech 1973).

Several attempts have been made to reintroduce gray wolves. In 1952, four zoo animals were released on Isle Royale, but they became a public nuisance. In 1960, four animals were released on Coronation Island, Alaska. By 1964, they numbered 11 and had learned to prey on black-tailed deer (*Odocoileus hemionus columbianus*). In 1972, five laboratory animals were unsuccessfully released near Umiat, Alaska (Weise et al. 1975).

In 1974, four live-trapped radio-tagged Minnesota animals were released in the Upper Peninsula of Michigan. All four were killed by human-related causes. However, it was demonstrated that wolves can be translocated. For a successful reintroduction program, Weise et al. (1975) recommended a strong public education campaign, abatement of all coyote bounties, and release of a larger number of animals.

U.S. Fish and Wildlife Service reclassification of *Canis lupus* (43 FR 9607, 9 Mar 1978) provides Endangered status for all gray wolves south of Canada, excluding Minnesota (where they are considered Threatened). This ruling supersedes a previous ruling which listed four subspecies as Endangered and was considered unsatisfactory because the taxonomy was outdated, wolves wander outside recognized boundaries, and unlisted subspecies may still occur in the lower 48 States (possibly in Washington and North Dakota). Reclassification of the wolf as Threatened in Minnesota was considered necessary to provide for the future well-being of both the wolves and persons living in areas inhabited by wolves. The ruling provides for establishment of five management zones in Minnesota, of which three (Zones 1, 2, and 3) are considered Critical Habitat (43 FR 9607, 9 Mar 1978). Zone 1 is in the extreme northeastern part of the State and includes parts or all of Cook, Koochiching, Lake, and St. Louis Counties. Zone 2 borders the southern part of Zone 1 and includes parts of Lake and St. Louis Counties. Zone 3 is in the north-central part of the State and includes portions of Beltrami, Itasca, Koochiching, Lake of the Woods, Marshall, and Roseau Counties. Zones 4 and 5 comprise the remainder of the State. Wolf numbers in these zones will be held below biological potential (43 FR 9607, 9 Mar 1978).

The Eastern Timber Wolf Recovery Team (1975) outlined the three major objectives it believes are necessary to remove this subspecies from Endangered status:

1. Determine the status and distribution of the population
2. Insure perpetuation in its present range
3. Reestablish populations in suitable areas within the former range where viable populations do not now exist.

Other considerations include establishing mechanisms for resolving conflicts between the interests

of the wolves and the interests of people; resolving taxonomic questions, and identifying essential habitat and species requirements. The plan outlines coordination among several Federal agencies and the States of Idaho, Montana, and Wyoming to achieve these objectives.

In the United States, there are a number of captive wolves. The species breeding potential is very good. Jack Lynch's Loboland in Gardiner, Washington, has over 100 wolves whose primary genetic origin is in the Northern Great Plains and Rocky Mountain areas (area of overlap of *C. l. nubilus* and *C. l. irremotus*). Reintroduction of some of these animals to the wild in a national park has been suggested (March 1977).

McBride (1978) believes the wolf will become extinct in Mexico in the next 20 years. The Arizona-Sonora Desert Museum in Tucson, Arizona, however, is working to establish a breeding colony of the Mexican wolf (*C. l. baileyi*) (McBride 1978).

Wolves are persecuted in Canada for their impact on caribou. Kuyt (1972) suggests that wolves be listed as a game animal, which would render some protection and help insure survival.

Estimates of 1978 wolf numbers on Federal lands, based on responses to letters of inquiry, are listed in the table below.

AUTHORITIES

Eastern Timber Wolf Recovery Team

Ralph E. Bailey, Leader
Michigan Department of Natural Resources
P.O. Box 190
Marquette, Michigan 49855

William C. Hickling
U.S. Fish and Wildlife Service
279 Federal Building
Ashville, N. Carolina 22801

Robert M. Linn
National Park Service
Biological Science Department
Michigan Technological University
Houghton, Michigan 49931

L. David Mech
U.S. Fish and Wildlife Service
North Central Forest Experiment Station
Folwell Avenue
St. Paul, Minnesota 55101

Ron Nicotera
Wisconsin Department of Natural Resources
Box 450
Madison, Wisconsin 53701

State	Location	Status	Reference
Alaska	Arctic NWR	Not surveyed	
	Chugach NF	40-50 estimated to be in Unit 7	R. Walker, pers. comm.
	Glacier Bay NM	28-55 estimated	B. Paige, pers. comm.
	Katmai NM	30-40 estimated	W. Troyer, pers. comm.
	Kenai National Moose Range	94 estimated	T. Bailey, pers. comm.
	Mt. McKinley NP	35-50 estimated	D. Kuehn, pers. comm.
	Tongass NF	No estimate, numbers increasing. 87 harvested 1975-76	W. Overdorff
Arizona	Coronado NF	Several unconfirmed reports of possible transient wolves	P. Karp, pers. comm.
Idaho	Salmon NF	5 estimated	L. Campbell, pers. comm.
	Targhee NF	Numerous unauthenticated reports	O. Johnson, pers. comm.
Michigan	Isle Royale NP	40 or more wolves known to be present	R. Linn, pers. comm.

State	Location	Status	Reference
Minnesota	Ottawa NF	5 wolf activity centers	R. Prause, pers. comm.
	Chippewa NF	40 is present estimate	J. Mathisen, pers. comm.
	Superior NF	300-400	D. Mech (1976)
	Voyageurs NF	Not surveyed	
Montana	Beaverhead NF	Some documented observation	R. Kiewit, pers. comm.
	Blackfeet Indian Reservation	Not surveyed	
	Custer NF	Not surveyed	
	Flathead NF	Sporadic reports of sign or sightings of single wolves	R. Hensler, pers. comm.
	Gallatin NF	Not available	
	Glacier NP	10-20 estimated, no persistent pack activity	C. Martinka, pers. comm.
	Kootenai NF	Not surveyed	
	Lewis and Clark NP	Scattered reports of sightings and sign — no estimate	J. Schulstad
Texas	Big Bend NP	Occasional unauthenticated reports of transient wolves	G. Balaz, pers. comm.
Wisconsin	Chequamegon NF	Not surveyed	
	Nicolet NF	No estimate — some transient visitors	A. Rinaldi, pers. comm.
	Ottawa NF	No estimate, but good evidence of wolf activity there	T. Wingle, pers. comm.
Wyoming	Bridger-Teton NF	No estimate, but sightings and sign reported	R. Jackson, pers. comm.
	Shoshone NF	No estimate, but unauthenticated sightings	R. Hall, pers. comm.
	Yellowstone NP	Unauthenticated sightings, recent search failed to confirm any wolves	Weaver (1978)

Key: NF—National Forest; NM—National Monument; NP—National Park; NWR—National Wildlife Refuge.

Robert E. Radtke
U.S. Forest Service
633 W. Wisconsin Avenue
Milwaukee, Wisconsin 53203

Leroy Rutske
Minnesota Department of Natural Resources
Centennial Building
St. Paul, Minnesota 55155

Karl Siderits
Superior National Forest

P.O. Box 338
Duluth, Minnesota 55801

Northern Rocky Mountain Wolf Recovery Team

Dennis L. Flath, Leader
Nongame Species Biologist
Montana Department of Fish and Game
Box 5, MSU Campus
Bozeman, Montana 59717

Levi Mohler
602 Michael
Boise, Idaho 83704

Roger Evans
Wildlife Biologist
Lewis and Clark National Forest
Great Falls, Montana 59401

Mary M. Meagher
Research Scientist
Yellowstone National Park, Wyoming 83020

Donald McIntosh
Bureau of Land Management
P.O. Box 30157
Billings, Montana 59101

Robert K. Turner
National Audubon Society
P.O. Box 3232
Boulder, Colorado 80303

Robert K. Ream
School of Forestry
University of Montana
Missoula, Montana 59801

Donald S. Balsler
U.S. Fish and Wildlife Service
Room 3035, Federal Building
Billings, Montana 59101

Other Authorities

Durward Allen (Eastern Timber Wolf)
Department of Wildlife Ecology
Purdue University
West Lafayette, Indiana 47907

Roy McBride (Mexican and Gray Wolves)
Department of Biology
Sul Ross State University
Box 725
Alpine, Texas 79830

Douglas H. Pimlott
Department of Zoology
University of Toronto
Toronto, Ontario, Canada

Robert Rausch (Alaskan Wolf)
Alaskan Department of Fish and Game
Division of Game
Juneau, Alaska 99801

PREPARER'S COMMENTS

There is extensive controversy concerning competition between wolves and hunters. Pimlott (1975) suggests that wolves feed on the non-breeding sector of the population and thus do not depress prey populations, although he states that in areas of heavy hunting, competition probably does exist. R. Rausch (personal communication) states that work in Alaska has shown that in many cases wolves show a preference for adults and thus can depress prey populations. A recent study by Mech and Karns (1977) indicated that, given a particular combination of factors, wolves could severely deplete deer numbers and keep them at a depressed level.

LITERATURE CITED/SELECTED REFERENCES

- Anon. 1977. Timber wolf declassification debated. *End. Species Tech. Bull.* 2(3):1, 2-4, 7.
- Crisler, L. 1956. Observations of wolves hunting caribou. *J. Mammal.* 37:337-346.
- DeVos, A. 1950. Timber wolf movements of Sibney Peninsula, Ontario. *J. Mammal.* 31(2): 167-169.
- Eastern Timber Wolf Recovery Team. 1975. Recovery plan for the eastern timber wolf. Preliminary draft. 79 pp.
- Hall, E. R., and K. R. Kelson. 1959. *The mammals of North America*. 2 vols. Ronald Press, New York.
- Hendrickson, J., W. L. Robinson, and L. D. Mech. 1975. Status of the wolf in Michigan, 1973. *Am. Midl. Nat.* 94(1):226-232.
- Ingles, L. G. 1963. Status of the wolf in California. *J. Mammal.* 44:109.
- Jordan, O. A., P. C. Shelton, and D. L. Allen. 1967. Numbers, turnovers, and social structure of the Isle Royale wolf population. *Am. Zool.* 7:233-252.
- Joslin, P. W. B. 1967. Movements and home sites of timber wolves in Algonquin Park. *Am. Zool.* 7:279-288.

- Kolenosky, G. B. 1972. Wolf predation on wintering deer in east-central Ontario. *J. Wildl. Manage.* 36:357-369.
- Kuyt, E. 1972. Food habits and ecology of wolves on barren-ground caribou range in the Northwest Territories. *Canadian Wildl. Serv. Rep. Ser.* 21. 36 pp.
- March, J. 1977. Courage and the art of wolf maintenance. *Audubon* 79(6):80-113.
- McBride, R. T. 1978. Status of the gray wolf (*Canis lupus baileyi*) in Mexico. A progress report to the U.S. Fish and Wildlife Service. Contract 14-16-0002-3728. 72 pp.
- Mech, L. D. 1966. The wolves of Isle Royale. U.S. Dep. Inter. Natl. Park Serv. Fauna Ser. 7, 240 pp.
- . 1970. The wolf: the ecology and behavior of an endangered species. Doubleday, New York. 389 pp.
- . 1973. Wolf numbers in the Superior National Forest of Minnesota. North Central For. Exp. Sta., USDA, For. Serv. Res. Pap. NC-97. 10 pp.
- . 1974a. *Canis lupus*. Mammalian Species 37. *Am. Soc. Mammal. pp.* 1-6.
- . 1974b. A new profile for the wolf. *Nat. Hist.* 83(4):26-31.
- . 1975. Hunting behavior in two similar species of social canids. Pages 363-368 in M. W. Fox, ed. *The wild canids*. Van Nostrand Reinhold Co., New York. 508 pp.
- . 1977a. A recovery plan for the eastern timber wolf. *Natl. Parks Conserv. Mag.* 1977(1):17-21.
- . 1977b. Where can the wolf survive? *Natl. Geogr. Mag.* 152(4):518-537.
- . 1977c. Wolf-pack buffer zones as prey reservoirs. *Science* 198:320-321.
- . 1977d. Productivity, mortality, and population trends of wolves in northeastern Minnesota. *J. Mammal.* 58(4):559-574.
- Mech, L. D., and L. D. Frenzel. 1971. Ecological studies of the timber wolf in northeastern Minnesota. U.S. Dep. Agric. For. Serv. Res. Pap. NC-52. 62 pp.
- Mech, L. D., and P. D. Karns. 1977. Role of the wolf in a deer decline in the Superior National Forest. USDA For. Serv. Res. Pap. NC-148. 23 pp.
- Medjo, D. C., and L. D. Mech. 1976. Reproductive activity in nine- and ten-month-old wolves. *J. Mammal.* 57(2):406-408.
- Murie, a. 1944. The wolves of Mt. McKinley. Fauna of the National Parks of the United States. U.S. Dep. Inter. Natl. Park Serv. Fauna Series 5. pp.
- Northern Rocky Mountain Wolf Recovery Team. 1978. Draft plan for the recovery of the northern Rocky Mountain wolf. 40 pp.
- Olson, S. F. 1938. A study in predatory relationship with particular reference to the wolf. *The Sci. Monthly* 46:323-336.
- Peters, R. P., and L. D. Mech. 1975. Scent-marking in wolves. *Am. Sci.* 63(6):628-637.
- Pimlott, D. H. 1967. Wolf predation and ungulate populations. *Am. Zool.* 7(2):267-278.
- . 1975. The ecology of the wolf in North America. Pages 280-285 in M. W. Fox, ed. *The wild canids*. Van Nostrand Reinhold Co., New York. 508 pp.
- Rausch, R. A. 1967. Some aspects of the population ecology of wolves, Alaska. *Am. Zool.* 7(2):253-265.
- Riley, G. A., and R. T. McBride. 1972. A survey of the red wolf (*Canis rufus*). U.S. Fish Wildl. Serv. Spec. Sci. Rep.—Wildl. 162. 15 pp.
- Rutter, R. J., and D. H. Pimlott. 1968. *The world of the wolf*. Lippincott, Philadelphia. 202 pp.

- Ryon, J. C. 1977. Den digging and related behavior in a captive timber wolf pack. *J. Mammal.* 58(1):87-89.
- Schenkel, R. 1947. Expression studies of wolves. *Behavior* 1:81-129.
- Stebler, A. M. 1944. The status of the wolf in Michigan. *J. Mammal.* 25:37-43.
- Stenlund, M. H. 1955. A field study of the timber wolf (*Canis lupus*) on the Superior National Forest, Minnesota. *Minn. Dep. Cons. Tech. Bull.* 55 pp.
- Thompson, D. Q. 1952. Travel, range, and food habits of timber wolves in Wisconsin. *J. Mammal.* 33(4):429-442.
- Weise, T. F., W. L. Robinson, R. A. Hook, and L. D. Mech. 1975. An experimental translocation of the eastern timber wolf. *Audubon Conser. Rep.* 5 in cooperation with U.S. Dep. Inter., Fish Wildl. Ser. Region 3. 28 pp.
- Wolfe, M. L. 1977. Mortality patterns in the Isle Royale Moose Population. *Am. Midl. Nat.* 97(2):267-279.
- Wolfe, M. L., and D. L. Allen. 1973. Continued studies of the status, socialization, and relationships of Isle Royale wolves, 1967 to 1970. *J. Mammal.* 54(3):611-635.
- Young, S. P., and E. A. Goldman. 1944. The wolves of North America. 2 vols. *Am. Wildl. Inst.*, Washington, D.C. 636 pp.
- Zimen, E. 1975. Social dynamics of the wolf pack. Pages 336-363 in M. W. Fox, ed. *The wild canids*. Van Nostrand Reinhold Co., New York. 508 pp.

PREPARED/UPDATED BY

National Fish and Wildlife Laboratory
412 N.E. 16th Avenue, Room 250
Gainesville, Florida 32601

**Selected Vertebrate Endangered Species
Of the Seacoast of the United States-
THICK-BILLED PARROT**



PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—

THICK-BILLED PARROT

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: SAN DIEGO ZOO

THICK-BILLED PARROT

Rhynchopsitta p. pachyrhyncha (Swainson)
Rhynchopsitta p. terrisi Moore 1947

- KINGDOM Animalia
 ORDER Psittachiiformes
 FAMILY Psittacidae
 OTHER COMMON NAMES
R.p. pachyrhyncha Cotorra serrana,
 guacamayo, guacomaja
R.p. terrisi Maroon-fronted parrot,
 cotorra fiente purpurea,
 guacamaya, papagayo

DATE

Entered into SWIS. to be determined
 Update to be determined

LEGAL STATUS

Federal: Endangered. Fed. Reg. Vol. 42, No. 135, 14 July 1977, p. 36427. Listed Appendix I, Convention on International Trade in Endangered Species of Wild Fauna and Flora (Federal Register, Vol. 42, No. 35, 22 February 1977, p. 10478).

States:

REASONS FOR CURRENT STATUS

Cutting of mature mountain pine forests, depriving the birds of food and nesting sites, is the primary cause of the decline of the thick-billed parrot (Vincent 1967, Monson 1965, Ridgley WWF Report, Crossin pers. comm., W. King 1977).

Killing of birds and taking of eggs for food, sport, or specimens is known to occur but is certainly of minor significance because of the inaccessibility of areas where these birds live and the difficulty of finding nests (Ridgley WWF Report, Crossin pers. comm., King 1977, Lusk 1900, Wetmore 1935, Thayer 1906, and Bergtold 1906).

Capture for zoos and for pets occurs but is also a minor cause of decline (Lanning and Lawson pers. comm., Crossin pers. comm., King in press, Wetmore 1935). Apparently, this species is not used much in the commercial cage bird trade, as it is not listed as imported into the U.S. in recent years (Clapp 1975).

Forest fires and logging are considered the greatest potential threats to *R. p. terrisi* at present in southeast Coahuila (Lanning and Lawson pers. comm.).

PRIORITY INDEX

Not assigned.

DESCRIPTION

R. p. pachyrhyncha is mostly dull olive green; the forehead, lores, and a stripe extending along the sides of the crown, bend of wings, and thighs are deep red; the tail is long and pointed, outer feathers graduated. In flight, the bright yellow patch on under-wing converts is conspicuous. The bill is black and notably thick. The iris is reddish. *R. p. terrisi* is larger and darker green; the forehead and superciliary stripes are brownish maroon (instead of bright red); the patch on the underwing converts is brownish gray (not bright yellow as in *R. p. pachyrhyncha*) (Blake 1953). All color characters of *pachyrhyncha* and *terrisi* are highly variable and not definitely distinguishing, except color of under primary converts, which are bright yellow in *pachyrhyncha* and olive yellow in *terrisi*; *terrisi* is also larger (Hardy and Dickerman 1955). All examples of *terrisi* seen at close range in the field have had maroon rather than scarlet foreheads, but five adults in the Uni-

versity of Kansas collection have a few scarlet feathers on forehead (Ely 1962).

Length, 16 - 16.7 in. (41 - 42 cm); wing, 8.5 - 10.5 in. (22 - 27 cm); tail, 6.3 - 7 in. (16 - 18 cm); bill length, 1.4 - 1.5 in. (3.6 - 3.8 cm); bill height, 1.6 - 1.7 in. (4 - 4.3 cm). Bill relatively very large and greatly compressed laterally (Bailey 1938). Weight: *terrisi*, SW, Coahuila, 2 males, 391.5 and 467.5 gms; female, same area, 466 gms (Urban 1959).

Whether *pachyrhyncha* and *terrisi* are considered as two distinct species or two well-marked subspecies of a single species is a matter of opinion. Prior to Dickerman and Hardy (1955) all authors who reported specimens with mixed characters considered them 2 distinct species. Since then, subspecific status has been accepted by Dickerman and Hardy (1955), Ely (1962), Forshaw (1973), Urban (1959), Vincent (1967), and King (1977). However, Hardy (1967) changed his mind on the basis of the hypothetical importance of the difference in shade of red of the forehead, which he thought might be significant in social recognition of the birds belonging to the two populations, serving as effective reproductive isolating mechanisms, thus making them two distinct species by definition.

RANGE

R. p. pachyrhyncha formerly bred in high coniferous forests in Sierra Madre Occidental of western Mexico from northwestern Chihuahua (Colonia Pacheco and Colonia Garcia, Thayer 1906) south to southern Durango (Canyon Rio San Juan, Bent 1940), from 4,000 to 10,000 ft (1,219 - 3,048 m) (Bergtold 1906). Within the area reported from Sierra Huachinera (Marshall 1957), Cumbre on Barranca Cobre, SW Chihuahua (Stager 1954), Mt. Mohinora, southwest of Verjel (Friedmann et al. 1950), mountains west of Parral (Bergtold 1906), Guadalupe y Calvo (Bent 1940), all in Chihuahua, and the mountains near Ciudad Durango (Bent 1940) in Durango. They formerly wandered extensively, chiefly in winter, or when pine cone crops failed, to mountains of southeastern Arizona and southwestern New Mexico, and, centuries ago, even to central and northern Arizona (Verde Valley and San Francisco Mountain). The chief areas visited included the Chiricahua Mountains, and occasionally nearly all the higher mountains east and south of the Santa Cruz and Gila

Rivers, Arizona, and also in Animas Mts., New Mexico (Phillips et al. 1964; Wetmore 1935; Bent 1940; Smith 1907; Vorhies 1934; Bailey 1928). The most recent U.S. record in Animas Mts. New Mexico was in the fall of 1964 (Charles Hanson, pers. comm. 1977). They also wandered eastward from the breeding area to Ciudad Chihuahua (Bent 1940), and possibly to San Antonio de las Alazanas, Coahuila (Ely 1962). Long movements from the breeding area southward and southeastward to Volcanes de Colima, Jalisco (Schnell et al. 1974), Cerro de Tancitaro, Michoacan (Blake and Hanson 1942), Mt. Popocatepetl, State of Mexico (Bent 1940), and Perote and Jalapa, Vera Cruz (Bent 1940). At present, the entire range is evidently much restricted.

R. p. terrisi is assumed to have bred formerly in high coniferous forests of the Sierra Madre Oriental, from southeastern Coahuila north to west of Saltillo (Irby Davis, pers. comm.). It now breeds east of San Antonio de las Alazanas south of Saltillo (Ely 1962), and from Sierra Zapaliname in the Guadalupe Range (Burleigh and Lowery 1942) through southern Nuevo Leon and Cerro Potosi (Moore 1947); south to Sierra de Guatemala in the Gomez Farias region, Tamaulipas (Ridgley WWF Report); and La Joya de Salas, 65 mi. (105 km) south southwest of Victoria, Tamaulipas (Robins and Heed 1951). Altitudes of observation ranged from 1,829 to 3,658 m (Moore 1947; Ely 1962; Lanning & Lawson pers. comm.). There is no evidence of *terrisi* wandering extensively, as *R. p. pachyrhyncha* did.

RANGE MAP

Shown on next page.

STATES/COUNTIES

Arizona: Cochise, Graham, Pima, Pinal, Santa Cruz, Yavapai.

New Mexico: Hidalgo.

HABITAT

Mature pine-oak, pine, and fir forests are preferred habitat, in that order with increasing altitude, 1,219 to 3,658 m in mountains. The species is found in locations varying from plateau-like tops of mountains with open pine or pine-oak woodland and large trees and grass below (Monson 1965; Marshall 1957), to pine and fir forests below high cliffs or rimrock outcrops that are

used by the parrots for roosting and nesting. They are assumed to require either large dead tree stumps or high cliffs with holes for nesting.

They have been observed most frequently in stands of mature pine at median altitudes. Chihuahua Pine (*Pinus chihuahuana*) appears to be the most common species in occupied habitats although a number of pine and oak species are utilized.

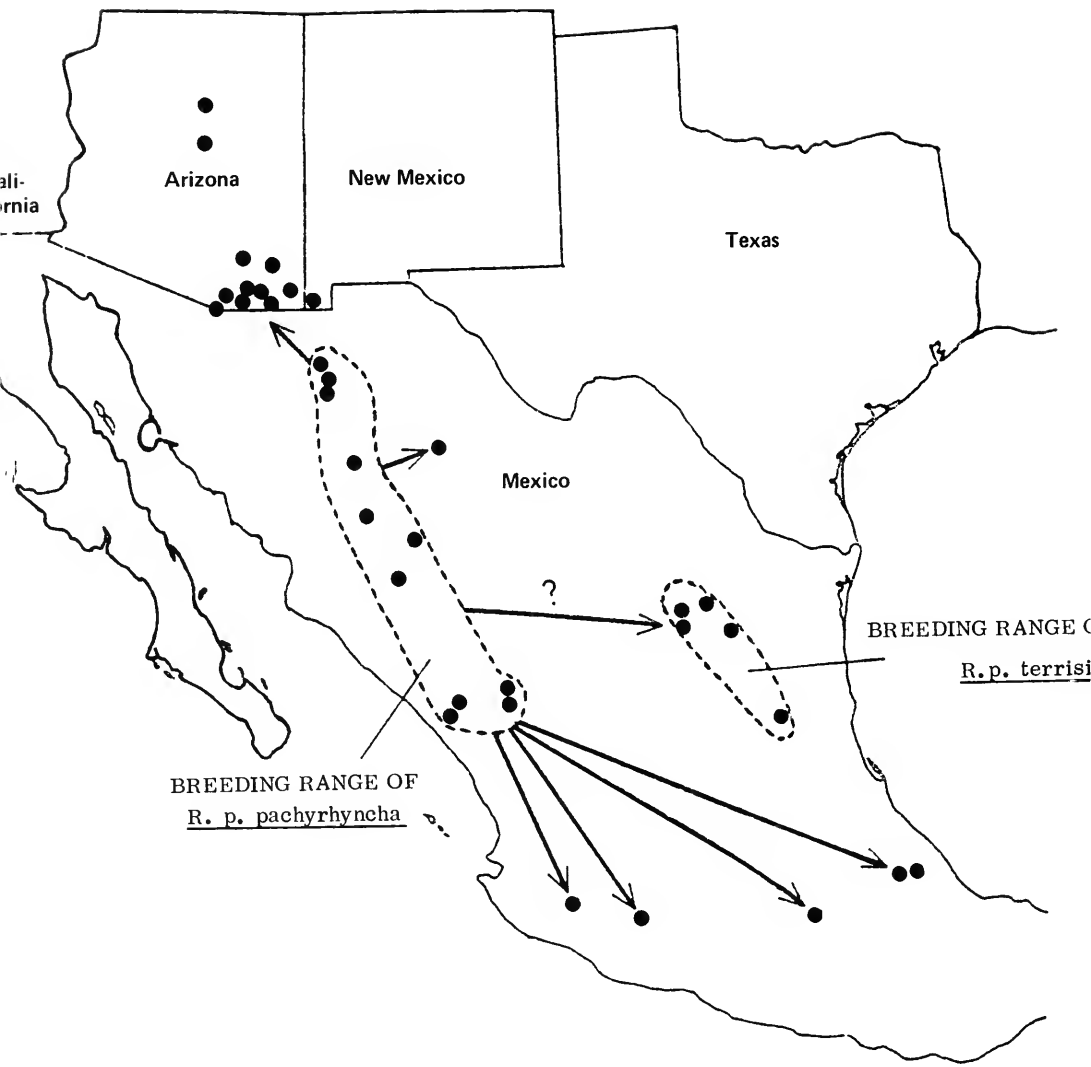
FOOD AND FORAGING

Pine seeds are by far the most important food. Seeds of both large forest pines and the smaller lower altitude pinons are eaten, along with some acorns (Ridgley WWF Report; Lanning & Lawson, pers. comm.; Ely 1962, Lusk 1900, Wetmore 1935; Leopold 1937). Other foods eaten occasionally are terminal buds of Chihuahua and Lumlholtz Pines, at 8,200 ft (2,499 m) in Barranca de Cobre, Chihuahua, 13 to 21 May (Stager 1954); fruit of a cherry (*Prunus copuli*) and seeds of an unidentified legume at Cerro de Tancitaro, Michoacan (Blake and Hanson 1942); and juice or nectar of agave flowers in southeastern Coahuila (Ely 1962, Lanning & Lawson pers. comm.). Captive birds at the Arizona-Sonora Desert Museum remained healthy on standard zoo parrot food, but did not breed unless fed pinon seeds (Charles Hanson pers. comm. 1977).

The method of feeding on pine seeds was to snip off a cone with the bill and support it with a foot while extracting individual seeds with the bill (Ridgley WWF Report), or to pull bracts from the cone and extract seeds while the cone was still on the tree (Lanning & Lawson pers. comm.). Seeds were even extracted from immature green cones. Bills and breast feathers were found smeared with pitch (Wetmore 1935, Lusk 1900). Acorns were used in the Chiricahua Mts., Arizona, through fall and winter after the pine seed crop was exhausted (Wetmore 1935, Leopold 1937). Parrots go to rivers or waterfalls to drink toward evening before going to roost (Wetmore 1935, Marshall 1957). They have been seen "eating" snow and ice on Cerro Potosi in 1977 (P. T. Moore to Lanning and Lawson pers. comm.).

SHELTER REQUIREMENT

Cavities high up either in dead trees or in cliffs are used for roosting and nesting (Thayer 1906, Bergtold 1906, Stager 1954, Lanning and



Breeding range of the thick-billed parrot.

Lawson pers. comm., Leopold 1937).

NESTING AND BEDDING

The only occupied nests reported were in cavities high up in large dead pines in the Sierra Madre Occidental of Chihuahua, at least some of which were abandoned imperial woodpecker nests (Thayer 1906, Bergtold 1906). According to residents in southeast Coahuila, they used cliffs and possibly trees for nesting. There are few suitable trees, but many cliffholes in the region (Lanning and Lawson, pers. comm., Burleigh and Lowery 1942); they slept in higher cliffs of high barranca at Palmito, Sinaloa, during May 1964 (R. Crossin pers. comm. to W. King 1977). In the morning, flocks leave the roost in the rimrocks in Sierra Madre de Chihuahua (Leopold 1937). Eggs were found (10 records) 10 May to 25 Aug. 1905 and (7 records) 11 to 25 Aug. (Thayer 1906, Bergtold 1906, Bent 1940). They are not dependent on holes made by the nearly extinct imperial woodpecker for nesting. Parrots are capable of remodeling a natural cavity or hole (Ridgley WWF Report; Charles Hanson pers. comm. 1977).

RITUAL REQUIREMENTS

The courtship display, raising the wings to expose under surfaces, may effect reproductive isolation of *pachyrhyncha* and *terrisi*, because of the marked difference in color of under primary coverts. This display is accompanied by distinctive vocalizations (Charles Hanson pers. comm. 1977). The habit of soaring in circles high in the air like a hawk has been noted in both *R. p. pachyrhyncha* and *R. p. terrisi* (Marshall 1957, Ridgley WWF Report); in *terrisi*, the purpose is to gain altitude for long flights (Lanning & Lawson pers. comm.). When flying in flocks grouped by pairs, two birds fly very close together, occasionally with a third behind. Several feet separate pairs; sometimes flocks fly in V-formation. They are very noisy and their cries carry great distances, probably facilitating communication between wide-ranging individuals (Marshall 1957).

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

None known other than those given under food, nesting and bedding, and habitat.

POPULATION NUMBERS AND TRENDS

R. p. pachyrhyncha. - Apparently is much reduced from its former population; it is seen less frequently and in smaller numbers in the heart of its range in the Sierra Madre Occidental and no flights have been observed in the southwestern U.S. since the early 1900's. Published estimates include 100 at Palmito, Sinaloa, 7 May 1964; 200, same place, 10 May (R. Crossin pers. comm.), flocks of 60 and 15, at Volcanes de Colima, Jalisco, 6 Jan. 1973 (Schnell et al. 1974); about 300 in the Chiricahua Mts., Ariz., 1 Sept. 1917; 100-1500, same place, early fall, 1917; 150, same place, middle of May through summer and early fall 1917 (Wetmore 1935); 35, Cumbre, Barranca de Cobre, Chihuahua, 13 May 1950 (Stager 1954); Flocks of 50, 60 and 8 in the Sierra Huachinera, Chihuahua, 1951 and 1952; populations shift from year to year (Marshall 1957). During an extensive survey of northern Mexico 11 Oct. to 31 Dec. 1971 and 2 Mar. to June 1972, with considerable time spent in thick-billed parrot habitats, only a few were seen high overhead (R. Crossin pers. comm. to W. King).

R. p. terrisi. - There is not much evidence of a total decline in numbers of this subspecies, since its existence has been known only since 1947 and recent estimates seem as high as earlier ones. However, because of its restricted range, it probably never had a large population and a continually decreasing habitat would certainly result in a population decline. Population estimates include 91 at La Mesa de las Tables, Coahuila; 15 and 60 at Cerro Potosi, Nuevo Leon (Ridgley WWF Report); 400 to 500, near Saltillo, Coahuila, 1977; estimate on the order of 1500 in entire Saltillo, Coahuila area (Dirk Lanning pers. comm. to W. King); count of 800 to 1000 in Southeast Coahuila, 4 April 1977, (Lanning & Lawson pers. comm.).

REPRODUCTION

Following are records of nests with eggs or young of *R. p. pachyrhyncha*: Collected by W. W. Brown at Colonia Pacheco and Colonia Garcia, Chihuahua: 9 nests, all in holes in dead pines, heights above ground 50-80 ft (15 to 24 m) av. 71 ft (22 m); depth of nest cavity 18 to 28 in (46 to 71 cm) av. 24 in (70 cm); width of cavity 6-10 in (15 to 25 cm) av. 8 in (20 cm); diameter of en-

trance (3 nests all) 6 in (15 cm); number of eggs or young 1 to 3 (av. 2 eggs or young per nest). Eggs glossy white, shell very thick for size of eggs, which averaged 1.53 x 1.19 in (3.88 x 3.02 cm) (Thayer 1906).

A single egg hatched in captivity after 28 days of incubation (Lint 1966 in Forshaw 1973). Captive young were brooded by the female for the first 11 days after hatching; young left nest 59 days after hatching (Dyson 1969 in Forshaw 1973). At the Arizona-Sonora Desert Museum, 2 pairs have bred successfully, 1 pair in 2 successive years. They began nesting in July, but may start later. A clutch is usually 2 eggs (Charles Hanson pers. comm. 1977).

No nests with eggs or young of *R. p. terrisi* have been reported. At La Mesa de las Tablas, Coahuila in a flight of 91 parrots, pairs were always in evidence, but many of the pairs seemed to be accompanied by offspring, most often 2, sometimes only 1 and once 3. The groups of 3, 4, and 5 birds were about as frequent as unaccompanied pairs, indicating that breeding success was good (Ridgley WWF Report).

MANAGEMENT AND CONSERVATION

Ideas that have been presented are: To set aside and protect adequate areas of mature evergreen mountain forest in both the Sierra Madre Occidental and Sierra Madre Oriental (Vincent 1966). Preservation of the rapidly disappearing mature high mountain forests is the only obvious method to preserve the species (Ridgley WWF Report; King 1977).

The species is listed in Appendix 1 of 1973 Convention on International Trade of Endangered Species of Wild Fauna and Flora. It is protected by law in Mexico, but the law is unenforceable in practice because of the remoteness of the areas where birds still occur. In 1976, 76 Thick-billed Parrots (*R. p. pachyrhyncha*) were in captivity in 24 collections; of these, 10 (13%) were bred in captivity (Olney 1976 in King 1977 ms.). Captive rearing might be a means of aiding the survival of the species until adequate wild populations are assured.

PREPARER'S COMMENTS

It would appear that both subspecies of the thick-billed parrot are endangered because of the

steady elimination of the high mountain coniferous forests of northern Mexico, on which the birds are completely dependent because of their specialized feeding and nesting requirements: large trees for nesting and pine seeds for nutrition adequate for reproduction. There would seem to be no remedy for this except the prompt setting aside of a number of very large tracts of such habitat where the parrots still occur, and excluding lumbering in those tracts. It is essential to have a number of different areas because of the periodic failure of pine cone crops in a particular area. Much further investigation of nesting behavior is needed, particularly to determine the importance of cliff nest sites as compared with holes in dead trees.

AUTHORITIES

Robert S. Ridgley
Department of Zoology
Duke University
Durham, North Carolina 27706

John W. Hardy
Florida State Museum
University of Florida
Gainesville, Florida 32611

Robert W. Dickerman
Department of Microbiology
Cornell University Medical College
1300 York Avenue
New York, New York 10021

L. Irby Davis
2502 Keating Lane
Austin, Texas 78703

Warren B. King
871 Dolly Madison Blvd.
McLean, Virginia 22101

Charles A. Ely
Department of Zoology
Fort Hayes Kansas State College
Hayes, Kansas 67602

Joe T. Marshall
National Fish and Wildlife Laboratory
National Museum of Natural History
Washington, D.C. 20560

Charles L. Hanson
Arizona-Sonora Desert Museum
Tucson, Arizona

Richard S. Crossin
1719 N. Huachuca
Tucson, Arizona 85705

Dirk Lanning and Peter Lawson
Chihuahuan Desert Research Institute
Box 1334
Alpine, Texas 79830

LITERATURE CITED/SELECTED REFERENCES

- Bailey, F. M. 1928. Birds of New Mexico. N. Mex. Dept. of Game and Fish, and U.S. Biol. Surv.
- Bent, A. C. 1940. Life histories of North American cuckoos, goatsuckers, hummingbirds and their allies. U.S. Nat. Mus. Bull. 176:(Thick-billed Parrot 14-18).
- Bergtold, W. H. 1906. Concerning the Thick-billed Parrot. Auk 23:425-428.
- Blake, E. R. 1953. Birds of Mexico. Univ. Chicago Press. 644 pp.
- Blake, E. R., and H. C. Hanson. 1942. Notes on a collection of birds from Michoacan, Mexico. Publ. Field Mus. Nat. Hist. Zool. Ser. 22:513-551.
- Burleigh, T. D., and G. H. Lowery. 1942. Notes on the birds of southeastern Coahuila, Occ. Pap. Mus. Zool. La. State U. 12:185-212.
- Clapp, R. B. 1975. Birds imported into the United States in 1972. Spec. Sci. Rep. Wildlife 193. U.S. Fish and Wildlife Service.
- Dyson, R. F. 1969. Captive hatching and development of a Thick-billed Parrot at Arizona-Sonora Desert Mus. Int. Zoo Yearbook No. 9:127-129 (in Forshaw 1973).
- Ely, C. A. 1962. The birds of southeastern Coahuila, Mexico. Condor 64:34-39.
- Flemming, R. L., and R. H. Baker. 1963. Notes on the birds of Durango, Mexico. Publs. Mich. St. Univ. Mus. Biol. Ser. 2:275-303 (in Forshaw 1973).
- Forshaw, J. M. 1973. Parrots of the world. Garden City: Doubleday and Co. (*Rhynchopsitta* p. 411).
- Friedmann, H., L. Griscom, and R. J. Moore. 1950. Distributional check-list of the birds of Mexico, Part I. Pacific Coast Avifauna 29, p. 127.
- Hardy, J. W. 1967. *Rhynchopsitta terrisi* is probably a valid species: a reassessment. Condor 69:527-528.
- Hardy, J. W., and R. W. Dickerman. 1955. Taxonomic status of the Maroon-fronted Parrot. Condor 57:305-306.
- King, W. 1977 (Revised) Red data book. Survival Service, International Union for the Conservation of Nature and Natural Resources, Morges.
- Leopold, A. 1937. The Thick-billed Parrot in Chihuahua. Condor 39:9-10.
- Lint, K. C. 1966. Thick-billed Parrots breed in captivity. Zoonooz 39(2):3-6 (in Forshaw 1973).
- Lusk, R. D. 1900. Parrots in the United States. Condor 2:129.
- Marshall, J. T. 1957. Birds of the pine-oak woodland in southern Arizona and adjacent Mexico. Pac. Coast Avifauna 32:1-125.
- Monson, G. 1965. A pessimistic view—the Thick-billed Parrot. Audubon Field Notes 19(3):389.
- Moore, R. T. 1947. New species of parrot and race of quail from Mexico. Proc. Biol. Soc. Wash. 60:27-28.
- Olney, P. J. S. (ed.). 1976. Census of rare animals in captivity 1975. Inter. Zoo Yearbook 16:411-446 (in King 1977 ms.).
- Phillips, A., J. Marshall, and G. Monson. 1964. The birds of Arizona. Univ. of Arizona Press, Tucson.
- Ridgley, R. Unpubl. interim report for 1976. Macaw status survey. World Wildlife Fund, U.S. App. Proj. 61.
- Robbins, C. R., and W. B. Heed. 1951. Bird notes from La Joya de Salas, Tamaulipas. Wilson Bull. 63:263-270.
- Schnell, G. D., J. S. Weske, and J. J. Hallack. 1974. Recent observations of Thick-billed Parrots in Jalisco. Wilson Bull. 86:464-465.
- Smith, A. P. 1907. The Thick-billed Parrot in Arizona. Condor 9:104.
- Stager, K. E. 1954. Birds of Barranca de Cobre region of southwestern Chihuahua, Mexico. Condor 56:21-32.

- Thayer, J. E. 1906. Eggs and nests of the Thick-billed Parrot. *Auk* 23:223-225.
- Urban, E. 1959. Birds from Coahuila, Mexico. *U. of Kansas Publs. Mus. Nat. Hist.* 11:443-516.
- Vincent, J. 1967. Red Data Book. Vol. 2. Survival Services Commission IUCN Morges, Switzerland.
- Vorhies, C. T. 1934. Arizona records of the Thick-billed Parrot. *Condor* 36:180-181.
- Wetmore, A. 1935. The Thick-billed Parrot in southern Arizona. *Condor* 37:18-21.

Biological Services Program

FWS/OBS-80/01.55

MARCH 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States- **SAN CLEMENTE SAGE SPARROW**



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—

SAN CLEMENTE SAGE SPARROW

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



PHOTO OF CLOSELY RELATED SUBSPECIES

CREDIT: HERBERT CLARKE

SAN CLEMENTE SAGE SPARROW

Amphispiza belli clementeae Ridgway (1898)

KINGDOM Animalia
 CLASS Aves
 ORDER Passeriformes
 FAMILY Fringillidae
 OTHER COMMON

NAMES Bell Finch; Bell Sparrow;
 San Clemente Sparrow

DATE

Entered into system To be determined
 Updates To be determined

LEGAL STATUS

Federal: "Threatened." Fed. Reg. Vol. 42, No. 155, 11 August 1977, p. 40685. Protected by Migratory Bird Treaty Act.

States: Protected by California state law.

REASONS FOR CURRENT STATUS

Stewart and Clow (1974) state that since 1934, sheep and goats, formerly fenced, have

roamed the island uncontrolled, practically eliminating reproduction of native shrubs. Goats eat seedlings and young plants and strip the leaves and bark from the lower portions of trees and bushes. No seedling or young bushes were found at any place visited. Reduction of ground cover has led to erosion of topsoil necessary for seedlings to develop. Feral swine have furthered erosion by rooting beneath what topsoil is left. The reduction in plant cover may have facilitated predation on sage sparrows and their nests and eggs by the island fox and feral house cats. It would also have greatly reduced the dense bush habitat the sage sparrows require for nesting and feeding.

PRIORITY INDEX

None assigned.

DESCRIPTION

A. b. clementeae is a small gray bird with black streaks on sides and single black spot on chest, dark cheeks and "moustache" streaks on sides of throat, white line over eye, and white corners on tail.

This is a weakly differentiated race. Some of the alleged characteristics are not present in series.

A longer bill and lighter juvenal plumage seem to be the only characteristics that are reasonably constant in separating it from the mainland race, *A. b. belli* (van Rossem 1932, Grinnell and Miller 1944).

RANGE

These birds are permanent residents on and confined to San Clemente Island about 80 km off southwestern California (American Ornithologists' Union 1957, Miller 1968). San Clemente is approximately 34 km long, 2.4 to 6.4 km wide, and 34 km from the nearest island, Santa Catalina, to the north. *A. b. clementae* was thought to probably occur also on San Nicholas and Santa Rosa Islands, although specimens from those islands were never critically determined (Grinnell and Miller 1944).

RANGE MAP

See map on following page.

STATES/COUNTIES

California: Los Angeles.

HABITAT

The San Clemente sage sparrow habitat consists of xeric species of scrubby brush on mesas (Howell 1917) and thorny brush growing in clumps and patches interspersed with cactus (Grinnell 1897). Frost is unknown and consequently vegetation was rank most of the year, although there was no fresh water on the island (Breninger 1904).

Topography is dominated by a plateau with steeply sloping east side and gently sloping west side, now covered with introduced grasses except where it has been completely denuded by goats. At present, trees and shrubs grow only on the bottoms and sides of canyons. On the east side, ironwood (*Lynothamus*), island oak (*Quercus tomentella*), and lemonade bush (*Rhus intergrifolia*) are the most abundant species. West side canyons are mostly denuded by livestock, but have some growth of toyon (*Heteromeles*), lemonade bush, and island cherry (*Prunus ilicifolia lyonii*) (Stewart and Clow 1974).

FOOD AND FORAGING BEHAVIOR

These birds forage on the ground or low in

bushes, presumably for small seeds and insects. Miller (1968) saw a female of *A. b. belli* on the coast of California carrying four green caterpillars obviously intended for young birds. Since freshwater is very scarce or absent on San Clemente (Breninger 1904), sage sparrows must depend primarily on dew or fog for drinking.

SHELTER REQUIREMENTS

Low scrubby brush is presumed to be the required shelter for *A. b. clementae*, by analogy to the California coast subspecies, *A. b. belli*, which prefers dense and continuous brush within which it finds all of its requirements (Miller 1968).

NESTING AND BEDDING

These birds feed and nest among the bushes of the hillsides, along with song sparrows (Breninger 1904). Nests are situated in scrubby brush a few inches above the ground (Howell 1917). A nest of *A. b. belli* was found on the mainland in the fork of a heavy bush at practically ground level. It was well made of weed stalks and lined with fine weed stems and soft weed fibers (Miller 1968).

RITUAL REQUIREMENTS

The sage sparrow presumably maintains and defends breeding territory, proclaimed by the song of the male, as in other related species of sparrows.

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

None are known other than those noted elsewhere.

POPULATION NUMBERS AND TRENDS

Grinnell (1897) wrote that these sparrows were quite common on hillsides and the lower mesa where there was low thorny bush growing in clumps and patches interspersed with cactus.

Howell (1917) considered it "common" on mesa lands back from the shore.

It is now mostly confined to the lower west terrace. On 3 May 1974, a total adult population of between 20 and 30 individuals was estimated in that area. No goats were seen in the area of observation, but feral swine were seen in two different localities (Stewart and Clow 1974).

SAN CLEMENTE SAGE SPARROW



REPRODUCTION

Nests with pipped eggs and young were found in the latter part of March 1915 (Howell 1917). If similar to the coastal race (*belli*), nests with (usually) 4 eggs would be found chiefly in April and May, and pairs would be spaced an average of about 50 yards (46 m) apart (Miller 1968).

MANAGEMENT

The obvious procedure in management of the San Clemente Sage Sparrow would be to remove all goats and swine from the island, or at least to fence them away from large enough sections of the plateau to permit regrowth of the dense low scrub necessary for the existence of this species of sparrow.

AUTHORITIES

Robert M. Stewart and William C. Clow
Point Reyes Bird Observatory
Box 321
Bolinas, California 94924

PREPARER'S COMMENTS

I agree with Stewart's and Clow's appraisal in their 1974 report that the feral goats are a menace, not only to the San Clemente Sage Sparrow, but all of the brush-inhabiting birds of the island, and that the only way to prevent the extinction of several species is to remove or drastically confine the goats and give the vegetation a chance to come back. The U.S. Navy that controls the island should be encouraged to take all steps possible to achieve such goat control.

LITERATURE CITED/SELECTED

REFERENCES

- American Ornithologists' Union. 1957. Check-list of North American Birds, 5th Ed. Baltimore, Md. Amer. Ornith. Union. 591 pp.
- Breninger, G. F. 1904. San Clemente Island and its birds. *Auk* 21:218-223.
- Grinnell, J. 1897. Report on the birds recorded during a visit to the islands of Santa Barbara, San Nicholas, and San Clemente, in the spring of 1897. *Pasadena Acad. Sci. Publ.* 1.
- Grinnell, J. and A. H. Miller. 1944. The distribution of the birds of California. *Pac. Coast Avifauna* 27.
- Howell, A. B. 1917. Birds of the islands off the coast of southern California. *Pac. Coast Avifauna* 12:79.
- Miller, A. H. *in* Bent, A. C. 1968. Life histories of North American cardinals, grosbecks, buntings, towhees, finches, sparrows and allies, part 2. *U. S. Nat. Mus. Bull.* 237:1015-1020.
- Stewart, R. M. and W. C. Clow. 1974. Part I San Clemente Island. *in* "The status of the Song Sparrow and Bewick's Wren on San Clemente Island and Santa Barbara Island, California." by R. M. Stewart, J. Smail, W. C. Clow and R. P. Henderson. Rep. to Endangered Species Off. U. S. Fish and Wildl. Ser. by Point Reyes Bird Observatory.
- van Rossem, A. J. 1932. On the validity of the San Clemente Island Bell's Sparrow. *Auk* 49:490-491.

Biological Services Program

FWS/OBS-80/01.56
March 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States- **CALIFORNIA CLAPPER RAIL**



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

FWS/OBS-80/01.56
March 1980

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—

CALIFORNIA CLAPPER RAIL

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: JACK WHITE, CALIF. FISH AND GAME COMM.

CALIFORNIA CLAPPER RAIL
Rallus longirostris obsoletus Ridgway

State: Endangered: California.

KINGDOMAnimalia
 CLASSAves
 ORDERGruiformes
 FAMILYRallidae
 OTHER COMMON

NAMES.....California King Rail,
 Red-breasted Rail, Marsh Hen (Grinnell and Miller 1944).

DATE

Entered into SWIS. to be determined
 Update to be determined

LEGAL STATUS

Federal: Endangered: (42 FR 36427, 14 July 1977). Migratory Bird Treaty Act of 3 July 1918 (40 Stat. 755; 16 U.S.C. 703-711) as amended 3 Dec. 1969. Public Law 91-135.

REASONS FOR CURRENT STATUS

Originally abundant locally within its limited range, California clapper rail numbers and the extent of its territory were much reduced before market hunting was outlawed. Under legal protection, its population increased, and by 1944, much of the former territory had been regained. Exceptions were extensive areas of San Francisco Bay marsh that had been converted to human use (Bryant 1915, De Groot 1927, Grinnell and Miller 1944, Wilbur and Tomlinson 1976).

This rail is vulnerable because the population is divided into small, isolated colonies occupying islands of suitable habitat that are separated by long stretches of uninhabitable rocky or sandy coast (Van Rossem 1929). There has been no indication of change in status recently, except for continuous attrition of the most productive habitat in south San Francisco Bay by conversion of marshes for other uses (Wilbur and Tomlinson 1976). The coastal marsh south of San Francisco

Bay at Pescadero Creek was made unsuitable for habitat by the closing of its connection to the sea by a sand bar; at Watsonville Slough, habitat was destroyed by a housing development with associated pollution. Some uninhabited marshes in north San Francisco Bay are contaminated with oil scum (Gould 1973).

PRIORITY INDEX

16

DESCRIPTION

R. l. obsoletus is a chicken-sized bird; grayish brown above with light ocraceous buff or tawney breast, flanks of grayish brown barred with white, and a white patch under the short, upcocked tail. Two color phases occur, one more brownish, the other more olivaceous. The iris is reddish orange; the bill is orange yellow at the base with the rest brown; the legs and feet are brownish gray. Downy young are jet black with greenish olive above. The legs are long (57 mm); toes 51 mm; bill 59 mm. It is a strong runner, but a weak flyer (Ridgway and Friedmann 1941, Ripley 1977). It differs from *R. l. levipes* principally in the more grayish (less brownish) edgings and blacker centers of back feathers and less reddish underparts (Van Rossem 1929). Adults weigh about 330 g (Linsdale 1936).

RANGE

The California clapper rail was formerly found in coastal marshes at Humboldt Bay (Brooks 1940), Tomales Bay, and Bolinas Lagoon in Marin County (Gill 1972), Monterey Bay at Watsonville and Elkhorn Sloughs (Silliman 1915, Gill 1972, Gould 1973), and probably Morro Bay (Brooks 1940). In the San Francisco Bay area, major populations centered in salt marshes bordering the southern arm in Alameda, Santa Clara, and San Mateo Counties and smaller populations occurred in the northern part of the bay and San Pablo Bay in Marin, Sonoma, Napa, Contra Costa, and extreme western Solano Counties (Grinnell et al. 1918, Bent 1926, Grinnell and Wythe 1927, DeGroot 1927, Grinnell and Miller 1944).

At present, the largest populations continue to be in southern San Francisco Bay, with smaller numbers in the northern San Francisco and San Pablo Bay marshes, at Corte Madera Marsh near the mouth of Gallinas Creek, Petaluma Marsh,

marsh south of San Pablo Creek; marsh north of toll plaza of the San Francisco - Oakland Bay Bridge, and at Tubbs Island. They are apparently gone from all coastal marshes on Monterey Bay except Elkhorn Slough (Gill 1972, Gould 1973, Varoujean 1972, Wilbur and Tomlinson 1976).

Although apparently nonmigratory (Wilbur and Tomlinson 1976), the rails are known to wander away from salt marshes in autumn (Linsdale 1936; Orr 1939) even to Farallon Islands (Bryant 1888).

RANGE MAP

The range map on the following page shows both past and present distribution.

STATES/COUNTIES

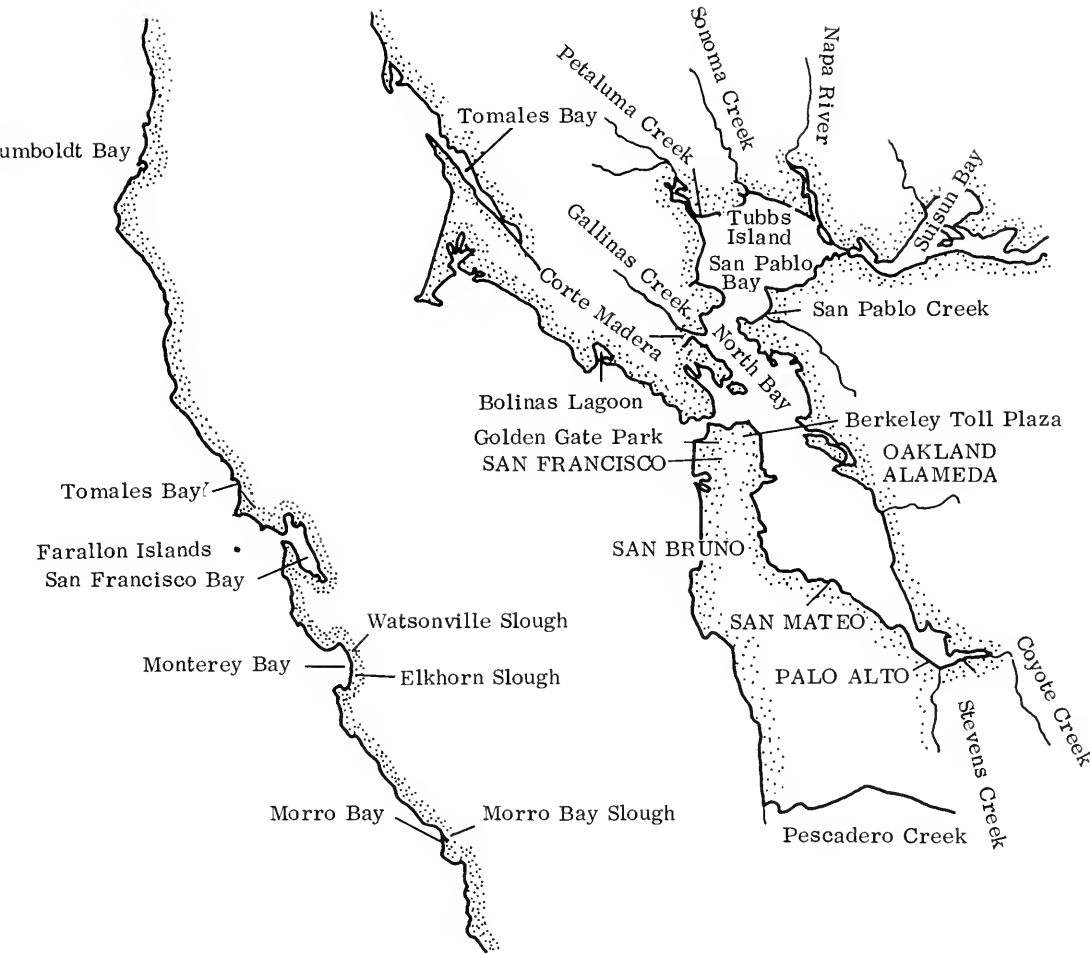
California: Alameda, Santa Clara, San Mateo, Marin, Sonoma, Napa, Contra Costa, Solano, Humboldt, Monterey, San Luis Obispo.

HABITAT

R. l. obsoletus inhabits saltwater marshes traversed by tidal sloughs, usually associated with abundant growths of pickleweed (*Salicornia*) (Grinnell and Miller 1944). Gill (1972) classified marsh habitat in southern San Francisco Bay into primary habitat or pure stands of cord grass (*Spartina foliosa*) with 0.84 to 1.08 rails per ha, and secondary habitat of pure stands of pickleweed or mixtures of cordgrass, pickleweed, and other marsh vegetation with 0.13 to 0.17 rails per ha. In southern San Francisco Bay, Zucca (1954) found 69 of 87 nests (79%) in pure stands of cordgrass, 10 in bases of gumplant (*Grindelia*) bushes, 6 in pickleweed and 2 in mixed cord grass and pickleweed. Wilbur and Tomlinson (1976) note that early writers usually described nests as occurring in pickleweed or at the base of gumweed plants, but later studies showed regular use of cordgrass as a nest site. Zucca (1954) found that time of nesting and tidal conditions determine, in part, the type of vegetation used for nesting, with early nests placed in gumweed before cordgrass growth occurs and nests placed in pickleweed, which grows at slightly higher elevations than gumweed or cordgrass, when nesting is interrupted by tidal flooding.

Moffitt (1941) points out that rails are

CALIFORNIA CLAPPER RAIL
Past and Present Distribution



CALIFORNIA COAST

SAN FRANCISCO BAY REGION

Past and present distribution of the California clapper rail

abundant in south San Francisco Bay, while being less numerous in similar marshes in northern San Francisco Bay and the south end of Tomales Bay and apparently absent from Suisun Bay, where extensive pickleweed marshes exist. He noted that the latter area has lower salinity, which may prevent occurrence of organisms on which rails depend for food. Wilbur (pers. comm.) adds that habitat in northern San Francisco Bay is almost pure pickleweed while in the southern part, where rails are more numerous, it is mixed pickleweed-cordgrass with cordgrass predominating.

Fall wanderers from the salt marshes have been observed feeding in a city park, on the edges of lawns next to shrubbery into which they retreated (Orr 1939).

FOOD AND FORAGING BEHAVIOR

Food consists almost entirely of animal matter, such as worms and crustaceans available in salt marshes. Several stomachs taken in Alameda county contained only parts of crabs (Grinnell, et al. 1918). Rails may feed on molluscs obtained by probing in mud-bottomed sloughs (Williams 1929, Moffitt 1941, Test and Test 1942). Fall wanderers away from salt marshes have been noted feeding on earthworms in a city park. One was seen to swallow 5 worms in 5 minutes (Orr 1939). Most feeding done in marshes is at low tide when the most food is available. Volumetric content of stomachs of 18 rails taken near Palo Alto, Calif. 4 February 1939 averaged 85% animal matter and 14.5% vegetable matter, all of which consisted of *Spartina* seeds. No gravel was found in any stomach. Plaited horse-mussel (*Modiolus demissus*) amounted to 66% of the animal food. Spiders of the family Lycosidae, common inhabitants of marshes, made up 17.5% of animal matter (Moffitt 1944). Williams (1929) found the little macoma clam (*Macoma baltica*) to be a principal item of food near Palo Alto. Grinnell, et al. (1918) found parts of the yellow shore-crab or mud crab (*Hemigrapsus oregonensis*) were almost the only food in clapper rails in Alameda County. Emerson (1885) found that worms and insects made up most of the food. Moffitt (1944) comments that the relative amounts of plant and animal matter in the rail's diet varies with the time of year, stage of tide, and geographic locality.

Rails often wash their food before swallowing it. They swallow small clams whole and peck larger

ones open with their bills and eat only the contents. Crabs are dismembered and pecked open before being eaten (Cohen 1895, Grinnell et al. 1918, Tomlinson and Wilbur 1976).

SHELTER REQUIREMENTS

Dense marsh vegetation for concealment and nesting.

NESTING OR BEDDING

Rails nest on or near ground, usually on a slight rise near a tidal slough; many well defined trails lead from them to the water (Bryant 1880; Taylor 1894, Cohen 1895, DeGroot 1927). Nest sites are in dense patches of pickleweed (*Salicornia*) or cordgrass (*Spartina*), or at the base of gumweed (*Grindelia*) plants (Grinnell et al. 1918, Zucca 1954, Gill 1972, Bent 1926, Wilbur and Tomlinson 1976).

The nest is a platform or heap of material of cordgrass and dead plants built up 8 to 15 cm above ground, sometimes deeply cupped and securely woven to surrounding vegetation (Bryant 1880, Cohen 1895, DeGroot 1927, Emerson 1885, Taylor 1894). Rails frequently build several nests but use only one (Adams 1900, Gill 1972, Grinnell et al., Bent 1926, Tomlinson and Wilbur 1976).

RITUAL REQUIREMENTS

Rails exhibit intraspecific hostility indicating territoriality (Williams 1929).

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

An unobstructed tidal flow of clean saltwater, saltmarsh vegetation, and mudbanks for suitable food organisms are environmental requirements of *R. l. obsoleta*.

POPULATION NUMBERS AND TRENDS

No estimate of the total California clapper rail population has been made (Wilbur and Tomlinson 1976). At least 100 were noted in an area of less than 2.5 km² of salt marsh near Palo Alto on Feb. 1939 (Moffitt 1941). Gill (1972), by dragging a rope, found densities ranging from 0.34 to 0.43 rails per ha in primary habitat (pure cordgrass) to 0.13 to 0.17 per ha in secondary habitat (mixed cordgrass, pickleweed and other marsh vegetation)

in south San Francisco Bay. By census from a boat in flooded marsh, he found 0.57 rails per ha in a 14 ha section of marsh. Zucca (1954), also using the boat count method in flooded marsh, found 0.49 rails per ha. Based on these data Gill (1972) estimated that the number of rails in south San Francisco Bay ranges from 2,420 to 2,880 (average 2,750). Probably 50% or more of all California clapper rails are in that area, where, until recently, they appeared to be maintaining their numbers. However, loss of their already restricted habitat continues and total numbers are probably being reduced. Some evidence indicates that nesting success may also be declining (R. Gill pers. comm. to Wilbur and Tomlinson 1976).

REPRODUCTION

Nesting season begins in mid-March and extends into July (DeGroot 1927). Data for 128 museum egg sets indicate even distribution of nesting from 1 April through 10 May, with only six later records, but concentration of collecting activity during periods when eggs are most likely to be found may bias data (Wilbur and Tomlinson 1976). DeGroot (1927) recorded a peak in nesting activity between 10 and 25 April, almost complete cessation of nesting from 15 May to 15 June, then renewed activity during late June and early July. Applegarth (1938) and Gill (1972) recorded a similar pattern but peak of activity was in May rather than April. DeGroot (1927) estimated that perhaps 50% of the birds raise two broods per year. Zucca (1954) and Gill (1972) suggested that late nestings were undertaken when first clutches were destroyed by high tides in May and June. Wilbur and Tomlinson (1976) suggest that late nesting by California clapper rails may include both renesting attempts and second broods.

Apparently complete clutches are reported to contain from 5 to 14 eggs, most commonly 6 to 10 eggs (Bryant 1880, Cohen 1895, DeGroot 1927, Applegarth 1938, Zucca 1954, Gill 1972).

Both sexes incubate the eggs, which hatch in 23 to 29 days (Applegarth 1938; Zucca 1954; Johnston 1956). Hatching requires approximately 48 hours after pipping (Johnston 1956). Incubation probably begins with laying of the last egg and ceases when first egg hatches (Zucca 1954).

There is no specific information on nesting success (Wilbur and Tomlinson 1976). Norway rats (*Rattus norvegicus*) are known to have

destroyed rail eggs but authorities disagree as to the magnitude of this loss (Cohen 1895, Bryant 1880, DeGroot 1927, Zucca 1954). Other nest losses are attributed to unknown mammals (Bryant 1915) and nest inundation by high tides (Zucca 1954).

MANAGEMENT

The California Department of Fish and Game considered reintroduction of clapper rails at Morro Bay in 1972, using stock from San Francisco Bay, but decided against it because of uncertainty of the racial identity of the original population and also the lack of information on whether any of that population still existed there (Sanford Wilbur pers. comm.).

Establishment of south San Francisco Bay National Wildlife Refuge and acquisition of Tubbs Island and Elkhorn Slough by the Nature Conservancy are beginnings toward habitat preservation. Proposed management includes acquisition and/or agreements with property owners to retain suitable marsh habitat for this and other water-associated birds and further improvement in controlling water quality in problem areas (Fish and Wildlife Service 1973).

AUTHORITIES

Sanford R. Wilbur
Fish and Wildlife Service
1190 East Ojai Ave.
Ojai, California 93023

Robert D. Ohmart
Randall W. Smith
Dept. of Zoology
Arizona State University
Tempe, Arizona 85281

Robert Gill
Gordon Gould
Howard Leach
California Dept. of Fish and Game
1416 Ninth Street
Sacramento, California 95814

PREPARER'S COMMENTS

Although the total population of this subspecies of clapper rail is still fairly substantial (about 2,800 individuals), its very strict requirements for relatively unpolluted tidal salt marsh

habitat, which is rapidly disappearing within its present range, and the disappearance of the bird itself from much of its former range are adequate causes for considering it in danger of extinction.

LITERATURE CITED/SELECTED REFERENCES

- Adams, E. 1900. Notes on the California Clapper Rail. *Condor* 2:31-32.
- American Ornithologists' Union. 1957. Check-list of North American birds. Baltimore, MD. A.O.U.
- Applegarth, J. H. 1938. The ecology of the California Clapper Rail on the south arm of San Francisco Bay. MA Thesis, Stanford Univ.
- Bent, A. C. 1926. Life histories of North American Marsh birds. U.S. Nat. Mus. Bull. 135:267.
- Brooks, A. 1940. The Clapper Rail of Morro Bay. *Condor* 42:126-127.
- Bryant, H. C. 1915. California Clapper Rail breeding in Alameda salt marsh. *Calif. Fish and Game* 1:192.
- Bryant, W. E. 1880. Notes on the habits of *Rallus obsoletus*, with a description of its eggs. *Bull. Nuttall. Ornith. Club* 5:124-125.
- Bryant, W. E. 1888. Birds and eggs from the Farallon Islands. *Proc. Calif. Acad. Sci. Ser. 2*, 1:42.
- Cohen, D. A. 1899. California Clapper Rail in Alameda County. *Condor* 1:31.
- DeGroot, D. S. 1972. The California Clapper Rail, its nesting habits, enemies, and habitat. *Condor* 29:259-270.
- Emerson, W. O. 1885. California Clapper Rail. *Ornith. and Oologist* 10:142-143.
- Fish and Wildlife Service 1973. Threatened Wildlife of the United States. U.S. Department of the Interior, U.S. Govt. Printing Office.
- Gill, R., Jr. 1972. South San Francisco Bay breeding bird survey Wildl. Mgmt. Branch Adm. Rep. No. 72-6 (June 1972), Fed. Aid W. L. Restor. Proj. W-54-R, Spec. W. L. Invest.
- . 1979. Status and distribution of California Clapper Rail (*Rallus longirostris obsoletus*). *Calif. Fish Game* 65(1):36-49.
- Gould, G. 1973. California Rail survey, 1973. California Dept. Fish and Game, Spec. Wildlife Invest. Job II-10, Clapper Rail Survey, 1 July 1972 - 30 June 1973.
- Grinnell, J. and Miller, A. H. 1944. The distribution of the birds of California. *Pac. Coast Avifauna* 27:126.
- Grinnell, J. and M. W. Wythe. 1927. Directory to the bird-life of the San Francisco Bay region. *Pac. Coast Avifauna* 18:62-63.
- Grinnell, J., H. C. Bryant and T. I. Storer 1918. The game birds of California. p. 283.
- Johnston, R. H. 1956. The incubation period of the Clapper Rail. *Condor* 58:166.
- Linsdale, J. M. 1936. Occurrence of the California Clapper Rail away from marshes. *Condor* 38:216.
- Moffitt, J. 1941. Notes on the food of the California Clapper Rail. *Condor* 43:270-273.
- Oberholser, H. C. 1937. A revision of the Clapper Rails (*Rallus longirostris* Boddaert). *Proc. U.S. Nat. Mus.* 84:313-354.
- Ohmart, R. D. and R. W. Smith. 1973. North American Clapper Rail (*Rallus longirostris*) literature survey with special consideration being given to the past and current status of *yumanensis*. Report in fulfillment of Bureau of Reclamation Contract No. 14-06-300-2409.
- Orr, R. T. 1939. Fall wanderings of Clapper Rails. *Condor* 41:151-152.
- Ridgway, R. and H. Friedmann. The birds of North and Middle America, Part 9. U.S. Nat. Mus. Bull. 50:73.
- Ripley, S. D. 1977. Rails of the world. Boston, David R. Godine. p. 129.
- Storer, T. I. 1915. Additional records of California Rail and Red Phalarope in California. *Condor* 17:98.
- Taylor, H. R. 1894. Among the California Clapper Rail. *Nidologist* 1:153-155.
- Test, F. H. and A. R. Test. 1942. Food of the California Clapper Rail. *Condor* 44:228.
- van Rossem, A. J. 1929. The status of some Pacific Coast Clapper Rails. *Condor* 31:213-215.
- Varoujean, D. E. 1972. A study of the California Clapper Rail in Elkhorn Slough. Calif. Dept.

- Fish and Game. Spec. Wildlife Invest., Fed. Aid Report W-54-R.
- Wilbur, S. R. and R. E. Tomlinson. 1976. The literature of the western Clapper Rails. U.S. Fish and Wildlife Service, Spec. Sci. Rept. - Wildlife No. 194.
- Willett, G. 1906. The Southern Clapper Rail breeding on fresh water. *Condor* 8:151.
- Willet, G. 1933. A revised list of the birds of southwestern California. *Pac. Coast Avifauna* 21:52.
- Williams, L. 1929. Notes on the feeding habits and behavior of the California Clapper Rail. *Condor* 31:52-56.
- Williman, O. P. 1915. Range of the California Clapper Rail. *Condor* 17:201.
- Zucca, J. H. 1954. A study of the California Clapper Rail. *Wasmann J. Biol.* 12:135-153.

Biological Services Program

FWS/OBS-80/01.57
March 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States-

AMERICAN PEREGRINE FALCON



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES

AMERICAN PEREGRINE FALCON

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: KENNETH FINK

AMERICAN PEREGRINE FALCON

Falco peregrinus anatum Bonaparte

KINGDOMAnimalia
 CLASSAves
 ORDER.....Falconiformes
 FAMILY.....Falconidae

OTHER COMMON

NAMES. . . . Duck Hawk (AOU 1931); Great-footed Hawk (Bent 1938); Rock Peregrine.

DATE

Entered into SWIS.To be determined
 Updates.To be determined

LEGAL STATUS

Federal: Endangered: (42 FR 36425, 14 July 1977).
 Protected: Migratory Bird Treaty Act of 3 July 1918 (40 Stat. 755; 16 U.S.C. 703-711) as amended 3 December 1969. Public Law 91-135.

States: Endangered: Alaska, South Carolina, Georgia, Florida, Mississippi, Texas, Alabama, Nebraska, Wyoming, California, New Mexico.
 Protected: Colorado.

REASONS FOR CURRENT STATUS

The peregrine falcon population decline almost certainly resulted from a complex of environmental factors, differing slightly from one area to another (Hagar 1969; Herbert and Herbert 1969; Hickey *ed* 1969). The population decline coincided with the introduction and wide use of organochlorine insecticides by 1967. The initial effect was reproductive failure that wiped out the reserve of nonbreeding individuals.

The second stage was the steady numerical decline in the 1950's of breeding adults in many regions. DDE (a derivative of DDT) seems to have been the chief chemical involved in the United States (Hickey and Roelle 1969).

The present total peregrine population in Utah is believed to be only 10% of what it had been in historic times; pesticide contamination and climatic changes may have been major reasons for the decline (Porter and White 1973).

At least as early as 1948, DDE was present in peregrine eggs in sufficient concentration to account for eggshell thinning, and is now considered a major factor in their decline, with DDE levels of 15 parts per million in eggs that failed to hatch (Peakall 1974, 1976). Contamination of birds and eggs by persistent pesticides and the killing and capture of birds on breeding grounds, in passage, and on wintering grounds have been the main causes of decline (King *in press*).

Peregrines have continued to decrease since 1970 in most of their North American range, and nowhere have they started to recover since reduction of DDT usage (Fyfe *et al.* 1976; Peakall 1976).

PRIORITY INDEX

10

DESCRIPTION

Peregrines are medium-sized hawk-like birds with long, pointed wings and long tail. Wing-beats are rapid and shallow. Adults are slate gray above, with wing and tail feathers and flanks barred with black, and black moustache marks on side of face. The throat is white. Below is white and reddish buffy, extensively spotted and barred with black. Legs and feet are yellow. Immature birds are brown above, streaked below. There are larger, darker and black markings on face, more extensive

than on the Arctic Peregrine falcon (*F. p. tundrius*); they are paler and more reddish, less grayish below than *F. p. pealei* (White 1968; Fish and Wildlife Service 1973).

Compared with *tundrius*, *anatum* is larger and darker, bars on dorsal feathers more contrasting with ground color; ventral surface more extensively marked and washed with darker pinkish or rufous; white auricular area less extensive in proportion to black malar stripe (White 1968).

Ground-color of the eggs varies from creamy white to pale pink, almost always nearly or wholly concealed by small blotches, spots or fine dots of rich brown or reds sometimes concentrated at one end. Measurements of 61 eggs, range 57 x 43, 56.5 x 43.5, 48.5 x 38.5 (average 52 x 41 mm) (Bent 1938).

RANGE

This falcon formerly bred in all ecogeographic regions of North America south of the Arctic tundra, which is occupied by *Falco peregrinus tundrius*, to northern Mexico; but excluding the immediate vicinity of the northwest Pacific coast, which is occupied by *Falco peregrinus pealei*, the southeastern and Gulf of Mexico coastal plains, and most of the Great Plains from Saskatchewan and Manitoba south to Texas. It does not now breed anywhere in the United States east of the Rocky Mountains or in southeastern Canada (Fyfe *et al.* 1976; Porter and White 1973; Clement *ed* 1974).

RANGE MAP

The breeding range shown (on the following page) is taken from Fyfe *et al.* 1976).

STATES/COUNTIES

Colorado:	El Paso, Boulder, Jefferson, Fremont, Montrose, Larimer Archuleta, La Plata, Montezuma, Moffat, Park, Mesa, Garfield, Conejos, Douglas, Pueblo (Bailey and Niedrach 1965; Enderson 1965).
Wyoming:	Teton, Yellowstone Park.
Montana:	Gallatin, Park, Sweet Grass, Stillwater, Cascade, Chouteau, Fergus, Blain, Custer, Dawson,



Former breeding range of the American peregrine falcon.

	Prairie (Rocky Mountain/ Southwest Peregrine Falcon Recovery Team 1977; Ender- son 1965).	Texas:	Kerr, Brewster, Jeff Davis, Culberson (Oberholser 1974).
Georgia:	Dade (Burleigh 1958).	Virginia:	Rock Bridge, Pulaski (Murray 1952).
New Mexico:	Rio Arriba, Los Alamos, Sandoval, San Miguel, Berna- lillo, Sierra, Eddy, Catron, Grant, San Juan (Bailey 1928; Hubbard 1970).	Washington:	Asotin (Jewett et al. 1953).
Illinois:	Wabash (Ridgway 1889).	Alabama:	De Kalb, Marshall, Lauderdale, Limestone (Imhoff 1962).
Indiana:	Knox, Gibson (Butler 1897).	New York:	Washington, Clinton, Franklin, Jefferson, Lewis, Hamilton, Essex, Warren, Montgomery, Albany, Greene, Columbia, Dutchess, Putnam, Ulster, Orange, Sullivan, Rockland, Tompkins, Schuyler, Clinton, New York (Bull 1974).
Iowa:	Linn (Dumont 1917).	California:	Marin, San Mateo, Santa Cruz, Monterey, Santa Barbara, San Diego, San Benito, Siskiyou, Kern, Mendocino, Napa & Sonoma (Bond 1946; Grinnell and Miller 1944).
Kansas:	Woodson (Johnston 1960).	Maryland:	Washington (Stewart and Robbins 1958).
Kentucky:	Laurel (Mengel 1965).	Nebraska:	Dawes (Lock 1977; Rocky Mountain/Southwest Peregrine Falcon Recovery Team 1977).
Louisiana:	Madison (Lowery 1955).	Arkansas:	Cleburne (Baerg 1931).
Maine:	Penobscott, Hancock, Sumer- set, Washington, Oxford (For- bush 1927; Palmer 1949).	Tennessee:	Knox, Hamilton, Obion (Howell and Monroe 1957; Spofford 1942).
New Hampshire:	Grafton, Carroll (Forbush 1927).	Utah:	Boxelder, Cache, Rich, Weber, Morgan, Davis, Salt Lake, Uinta, Utah, Tooele, Millard, Sanpete, Sevier, Emery, Dag- gett, Carbon, Grand, San Juan, Iron, Garfield, Washington, Cane (Twomey 1942; Porter and White 1973).
Massachusetts:	Berkshire, Franklin, Hamp- shire, Hampden (Forbush 1927).	South Dakota:	Harding, Lawrence (Rocky Mountain/Southwest Peregrine Falcon Recovery Team 1977).
Connecticut:	New Haven (Forbush 1927).		
Michigan:	Leclanau, Mackinac, Alger, Marquette (Wood 1951).		
Missouri:	Atchinson, St. Louis, Mont- gomery (Widmann 1907).		
New Jersey:	Bergen (Stone 1908; Bull 1974).		
North Dakota:	Dunn, Stark, Oakdale, Billings (Stewart 1975; Rocky Moun- tain/Southwest Recovery Team 1977).		
Oregon:	Harney, Lake (Gabrielson and Jewett 1940).		
Pennsylvania:	Clinton, Huntington, West- moreland, York, Allegheny (Todd 1940; Warren 1890).		
Arizona:	Cochise, Coconino, Gila, Gra- ham, Greenlee (USFS & FWS 1979).		
South Carolina:	Greenville, Pickens (Sprunt and Chamberlain 1949).		

HABITAT

This species is adapted to a wide variety of environments, ranging from the treeline south of the Arctic tundra southward into the northern Mexican mountains and the southern tip of Baja

California's tropical scrub (Porter and White 1973) up to 3,048 m in the California mountains (Bond 1946) and 3,658 m in the Colorado Rockies (T. D. Ray *in* Porter and White 1973).

Most eyries in Utah are located near marshes or streams which supply waterfowl or passerine birds for food. Most eyries all on east-and-north facing cliffs suggesting orientation away from exposure to overheating by afternoon sun (Porter and White 1973). Combination of marshes adjacent to suitable cliffs for nesting may be considered an "ecological magnet" (Hickey 1942).

In Alaska, habitat is in river valleys in boreal forest area up to 800 m elevation. Western Canada habitat varies from boreal forest to open deciduous forest to arid types. In the lower 48 states, it varies from closed or semi-closed deciduous forest in the east to semi-alpine and arid desert in the west, usually overlooking water areas. In Mexico, it is mainly along main cordilleran systems (King *in press*).

FOOD AND FORAGING BEHAVIOR

Its diet is mostly birds. Peregrine nestlings in Alaska prefer birds to mice (Dixon 1908). Birds eaten range in size from mallard ducks down to warblers and nuthatches. Pigeons, flickers, jays, meadowlarks, and other birds of medium size probably constitute the bulk of food in inland localities; on the seacoast and islands, it feeds almost entirely on the smaller seabirds. Mammals form an insignificant part of their food. Remains of hares, rabbits, woodchucks, squirrels and field mice have been found near peregrine nests. They prefer to capture prey on the wing after diving from above at great speed. The highest speed attained by diving is estimated at between 240 and 320 km per hour (Bent 1938). Small prey is seized in its claws and carried away; larger birds are stuck with the feet with such force as to kill them. Then peregrines descend to the ground to eat them. They pluck birds, at least partially before eating. The male feeds the female during the nesting season by dropping food for her to catch in the air (Bent 1938).

Food of Yukon River, Alaska Peregrines in 1966 included 49 species of birds and 4 species of mammals. Waterfowl constituted 50% of the diet composed by weight, and shorebirds 10% to 12%; small land birds composed 20% and small mammals 2% to 3%. Analysis of peregrine tissue showed that the food chain was contaminated

with significant measurable quantities of chlorinated hydrocarbon pesticides in 1966 (Cade et al. 1968). In Utah eyries 79% of food identified consisted of: American avocet (most frequent), mourning dove, willet, western meadowlark, red-shafted flicker, Wilson's phalarope, rock dove (common pigeon), red-winged blackbird and Brewer's blackbird (Porter and White 1973).

Food of peregrines of Chihuahuan Desert and adjoining mountains included 24 species of birds, 5 species of mammals (3 bats and 2 squirrels) and 1 species of lizard. Particularly frequent food items were dowitcher (sp.), white-winged dove, band-tailed pigeon, mourning dove, common nighthawk, white-throated swift, common flicker, Steller's jay, mockingbird, and thrush (sp.) (Hunt 1976; Johnson 1976).

In certain areas bats compose a greater part of the diet than in others (Stager 1941).

SHELTER REQUIREMENTS

Cliff ledges for nesting and for night roosting of young after they have fledged (Hickey *ed* 1969).

NESTING OR BEDDING

Nest site chosen by female, who makes a smooth well-rounded scrape in the accumulated soil and rubbish on the cliff ledge, 2 or 3 cm deep on the cliff ledge, to receive the eggs (J. A. Hager *in* Bent 1938). Occasionally nests in broken tops of tall trees (Ridgway 1889; Goss 1878; Spofford 1942).

Cliffs are by far the favorite nesting sites, but cut banks, ledges of tall buildings, hollows in trees, and tree nests of other large birds such as ospreys, are also utilized occasionally (Hickey and Anderson *in* Hickey *ed* 1969; Porter and White 1973).

RITUAL REQUIREMENTS

Aerial courtship display centered about the home cliff in March, consisted of the male flying excitedly from shelf to shelf, with much vocalization, in presence of female, bringing of food by male to female and then intricate aerial flight by male with vertical loops, rolls and plunges from great heights. After some time, both male and female engage in scratching about on ledges accompanied by vocalization until finally eggs are laid in one of the ledge sites (Joseph Hagar *in* Bent 1938).

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

Freedom from human interference at nest sites and lack of contamination of prey with pesticide poisons (Hickey *ed* 1969; Herbert and Herbert 1965; Clement *ed* 1974).

POPULATION NUMBERS AND TRENDS

In the eastern U.S., before that population started to decline, three Hudson River, New York, peregrines attained minimal ages of 17, 18 and 20 years (Herbert and Herbert 1965). Data indicated a low mortality rate, a strong tradition to reoccupy stable nesting sites, a tenacity to remain in face of human proximity if not molested, and a nonbreeding segment that was generally capable of supplying replacements (Hickey and Anderson *in* Hickey *ed* 1969). Hickey (1942) estimated 19 pairs in about 25,900 sq km around New York City. By 1952 R. A. Herbert and K. G. Skelton reported virtually 100% of pairs in Hudson Valley had unsuccessful reproduction (Cade 1960). In 1947 that population had 9 breeding pairs (a peak number for the century) and productivity averaged 1.1 to 1.2 young per nest in 1931-40, and 0.75 in 1941-50. No young were reared in 1950, and production ceased in 1951. Breeding pairs dropped to 7 in 1950, to 5 in 1952, to 4 in 1956 and none in 1961. Human disturbance, including highway construction, taking of young by falconers, shooting of adults, and unfavorable weather contributed to extirpation of the population (Herbert and Herbert 1969).

In Massachusetts, reproduction seemed above normal in 1946 but well below average in 1947 when broken eggs were observed for the first time.

By 1951, occupation of eyries was spotty and by 1955-57 only an occasional single bird was left (Hagar 1969). Complete failure of 14 pairs in Massachusetts was attributed by Hagar (*in* Hickey *ed* 1969, p. 32) to raccoon predation.

In Pennsylvania, despite losses to hunters, falconers and predators in 1946, there were still 17 active eyries which produced 1.25 young per nest annually in the study area. From 1947 to 1952, the number of active nests declined to 6 and productivity per pair declined sharply. From 1953 to 1959 only 0.4 young were reared per pair per year. The 3 pairs remaining in 1958 and one in 1959 reared no young despite lack of known dis-

turbance (Rice 1969).

On the upper Mississippi River in 1954 and 1955, the population was estimated at 1 pair to 30 km along one side of the river. These are now gone. The last bird was seen in March 1964. Human disturbance did not seem to account for this disappearance. The decrease seemed to progress from south to north (Berger and Mueller 1969).

By 1962, it was rumored that no young peregrines had been reared that spring in the north-eastern states, and this situation was confirmed in 1964 when a survey team found no birds nesting in 133 formerly used eyries in the eastern U.S. The peregrine falcon now appears to be extinct as a breeding bird in the eastern U.S. and south-eastern Canada from the Mississippi Valley to the Atlantic Coast and from Alabama north at least to Nova Scotia, a region that previously contained about 300 occupied nesting sites. However, captive-reared birds are being released there (Cade *et al.* 1968, Fyfe *et al.* 1976).

In the extreme northern part of the subspecies' range within the boreal forest region of Alaska, 200 to 250 pairs may have bred prior to 1950; less than 100 may remain (as of 1976). Perhaps 400 to 500 pairs bred in the 1940 to 1950 period (Fyfe *et al.* 1976). Seventeen pairs were found along 277 km of the upper Yukon River, Alaska, in 1966, with an average linear distance between occupied cliffs of 17 km (range 49 to 3 km). In 1951, average distance between 19 occupied cliffs was 15 km (range 50 to 3.5 km). On the same stretch of river, L. B. Bishop (*in* Osgood 1900) estimated about 1 pair every 16 km, showing quite similar density in the two periods and demonstrating the usual static nature of peregrine populations, each pair associated with a long-used eyrie. It also showed that the population there had not decreased as of 1966, even though levels of chlorinated hydrocarbon chemicals were found to be rather high in their eggs and tissues at that time (Cade *et al.* 1968). As of 1969 White and Cade (1977) found that populations along the upper Yukon were still holding up rather well with about 106 parts per million DDE in tissues, while populations along the parallel Tanana River to the south of it in Alaska with 334 ppm DDT in 1969 and 302 ppm in 1973 were practically gone. Egg shells of Tanana River birds had thinned about 17% by 1969 and 19.5% by 1973. Along the Mackenzie River in northeast Canada (south of the tree line), 18 known eyries were occupied

by 17 pairs (94%) in 1966 but by no more than 3 pairs and a single bird in 1973 (22% occupancy). In northern Alberta, 12 eyries were occupied by 6 pairs in 1971, but in 1973, by only 4 pairs and 2 single birds. In an overall 1973 Canadian survey of 83 eyries rechecked, 49 occupied by 44 pairs (Fyfe in Clement *ed* 1974).

In western North America, there were formerly densities of slightly more than 1 pair per 5,180 km² in areas where the bird was considered "common;" in mountains and arid regions, where it was considered "rare," density was estimated as 1 pair per 51,800 km² (Bond 1946). In the Rocky Mountain region, of 28 or 29 peregrine eyries active in 1938, not more than 4 to 6 were found occupied later. An estimated 80% to 90% of older sites in Utah, Idaho, Oregon, western Wyoming and western Montana have been deserted and the population shifted north or to higher elevations to compensate for drought conditions in recent times (Nelson 1969). In 1964, only slightly more than 33% of known peregrine nest sites in the Rocky Mountain region of New Mexico and Colorado were being used. Many sites were not used after 1950. An estimated 25 pairs currently nest in Colorado and Wyoming, approximately 25 pairs in Arizona, New Mexico and Texas, nearly 25 pairs in Montana and possibly 60 pairs in Alberta (Enderson 1969a). Enderson (1977) found that the population in the Rocky Mountains region had changed little over the last 2 years. Egg production was typical for the species but only half of the eggs were deemed hatchable. About 40 eyries in Utah are active at one time or another. Based on their density, if all eyries were active at once there would be about 5,499 km² per eyrie. If 11 suspected but unverified eyries were excluded, density would be 1 eyrie for every 7.6 km².

Peregrines are much more common around the Great Salt Lake than in other parts of Utah. Density appears to be directly related to availability of food and suitable nesting cliffs. Average distance between 13 eyries along 209 km of the west face of the Wasatch Mountains is 16.1 km. The closest spacing was about 3.2 km apart (Porter and White 1973).

In the Rocky Mountains region in general, data indicate a 50% population decline (Enderson *in* Clement *ed* 1974). Annual natural mortality there ranges from 20% to 25% for adults and 50% to 55% for juveniles (Rocky Mountain/Southwest

Peregrine Falcon Recovery Team 1977). Approximately 100 pairs were reproducing successfully in California in 1946; the decline began in the early 1950's. In 1970, 10 birds were present at 4 sites. The California population is probably reduced at least 50% from 25 years ago. Evidence indicates that the total number of successful pairs in California in 1970 did not exceed 5 (Herman 1971; Herman *et al.* 1970).

Banks (1969) found evidence of a decline in Baja California and the Gulf of California, with indication of lowered productivity in the latter area in the 1960's. Anderson (1976) found no peregrines on the west coast of Baja, California between 1971 and 1975. He estimated 35 to 50 active nests in 30 to 35 local areas along the Gulf of California and 75% of them occupied over a 5-year period. Of 6 known successful nestings, there were 2.2 young per nest. Thus it was assumed that pesticide pollution was not too acute at that time. Porter and Jenkins (1977) also found no nests occupied on the west coast of Baja, California, and the population along the Gulf of California much the same as former years.

Farther east in the northern Mexican high country, three eyries on the western slope of a single 3,000 m ridge of the Sierra Madre Occidental were separated by distances of 5 and 21 km. In the Sierra Madre Oriental 6 pairs were found in an 18.2-km circle, with the average distances separating 6 eyries 5.2 km. Of 19 pairs present in the Chihuahuan Desert region of northern Mexico in 1976, 13 (68%) produced young, indicating a moderately healthy population (Hunt 1976). Today, the mainland population in Mexico may exceed 100 pairs, while in Baja, California there may be an additional 50 pairs, although only about 20 to 30 are currently known (R. D. Porter, W. G. Hunt *in* King *in* press).

REPRODUCTION

In Massachusetts, peregrines occupied breeding stations before the end of February, and laid the first eggs by 25 March. The female chose and prepared the nest hollow on a cliff ledge. At least one day elapsed between the first, second, and third eggs, and sometimes 2 days between the third and fourth egg (Joseph Hagar *in* Bent 1938). A clutch ordinarily included 3 or 4 eggs, occasionally 5, and very rarely 6 or 7. Regional gradients in clutch size were reported by Hickey (1942) and Bond (1946).

Incubation requires 33 to 35 days. The two sexes changed places on the nest frequently from the time the first egg was laid until incubation began if the weather was cold or stormy. Incubation for the first 2 weeks was by the female; last half was mostly by male (Hager *in* Bent 1938; Herbert and Herbert 1965; Porter and White 1973). There was one brood per season unless the eggs were taken; then a second or even a third clutch was laid (Bent 1938). Sometimes the young fell from the nesting shelf and were killed (Eaton 1910). From 3 nests, the first young flew on the 33rd, 35th, and 33rd days (Hagar *in* Bent 1938).

Some peregrines, when disturbed, may desert their eggs and roost as much as 8.8 km away. RENESTING may or may not occur if the first attempt is unsuccessful (Herbert and Herbert 1965; Hickey 1942).

Northern peregrines (Yukon River, Alaska) lay about 3 eggs; the number of chicks ranges around 2.3 to 2.7 per eyrie (Cade 1960). Production of "fledglings" per occupied eyrie on the upper Yukon River dropped from 1.80 at 15 sites in 1966 to 1.40 at 10 sites in 1967 to 0.93 at 15 sites in 1968. This decline was associated with reduced eggshell thickness there in the 1960's compared with those prior to 1947 (Joseph Hickey in lit 23 Dec. 1969).

In Utah, egg laying began between 12 and 29 April (1943-1952). An average of 3.8 eggs (range 3-5) was laid per year during a 5-year period, and 2.4 (range 0-4) hatched (Porter and White 1973). Natural mortality of first year peregrines is high. Band returns indicate that 70% of fledglings die in their first year (Enderson 1969).

Predation on nestlings is by raccoons in Massachusetts (Hagar 1969), great horned owls in New York (Cade *ed* 1975), and ring-tails in the southwestern United States (White and Lloyd 1962).

Reproductive success in Chihuahuan Desert eyries of west Texas, despite significant egg shell thinning of 17.9%, was 40% in 5 eyries in 1975 and 66.7% in 6 eyries in 1976. Reproductive success was much better in mountain cliffs than in river canyons (Johnson 1976).

Of a northern Mexico high-country population in the Sierra Madre Oriental of 6 pairs, 2 failed to nest successfully in 1976. The average fledgling ratio was 2.0 per successful pair. Egg shell thinning was 17.8% (Hitchcock 1976).

In the Chihuahuan Desert region of northern Mexico in 1976, 13 broods ranging in size from 1 to 4 young averaged 2.15 young per nest, comparing favorably with pre-DDT eyries elsewhere. Eyries on mountain cliffs were 78% successful and those in river canyons, 9% successful, indicating probable higher concentrations of pesticides in river than in mountain environments. No difference was found in productivity of eyries of the U.S. and Mexican sections of the Chihuahuan Desert region. The rate of eggshell thinning was greater in the northern and eastern sections than in the southern part of the Chihuahuan Desert region (Hunt 1976).

A few peregrines produce young at 1 year of age, but it is not certain that all are breeding at age 2 (Hickey and Anderson *in* Hickey *ed* 1969). If they do not normally breed until at least 2 years of age, the average fledging rate, which is less than one per pair per year, is insufficient to replace normal adult losses (Rocky Mountain/Southwestern Peregrine Falcon Recovery Team 1977).

MANAGEMENT AND CONSERVATION

This species is listed in Appendix I, Conservation for International Trade in Endangered Species of Wild Fauna and Flora (Federal Register, Vol. 42, no. 35, 22 February 1977, p. 10476).

Critical Habitat has been designated in five areas in Sonoma, Lake, and Napa Counties California (Federal Register, Vol. 42 no. 184, 22 September 1977, p. 47842).

Four Peregrine Falcon Recovery Teams have now been appointed by the U.S. Fish and Wildlife Service. The plan of action for saving the peregrine includes: (1) increased legal protection; (2) preservation of natural habitat, especially nesting sites, and evaluation of pesticide contamination; (3) management of wild populations; (4) captive propagation for "domestication" and for stocking of vacated range; (5) educational and information program to gain public support; and (6) developing national and international cooperation and coordination. Direct killing or molestation by man is the least important threat, although it can play a part and must be guarded against. There are adequate laws, but law enforcement and the public's attitude toward birds of prey should be improved. Preservation of essential habitat, particularly irreplaceable historic falcon eyries, is the most essential action (Cade 1974). It should be

possible to increase productivity by "double-clutching," which means taking the first clutch to induce laying of a second. Removed eggs can be artificially incubated or fostered to other wild parents such as prairie falcons. Incubator-hatched and captive reared peregrines may be held in captivity during the first critical year or two, then released to the wild as adults. Artificial propagation and conditioning to survive in the wild could be achieved by modification of falconry techniques. Liberated falcons should be paired and psychologically conditioned to accept suitable nesting ledges or artificial structures in habitat where food is adequate (Cade 1974).

In 1970, the Laboratory of Ornithology and Division of Biological Sciences at Cornell University began a propagation and restocking program with \$100,000 allocated by the University. At the same time, Robert B. Berry began collaboration with a breeding project in Pennsylvania. In 1973, 20 young peregrines were reared at Cornell, using artificial insemination. Eggs were hatched in an incubator. Multiple clutches were obtained by removing eggs as laid. One pair produced 14 young in 2 years. Two other pairs laid 3 clutches each, totaling 24 eggs, and only 1 pair failed in fertilization. Only birds taken from the wild as nestlings breed easily in confinement. Reproductive capability is attained by captive birds at 3 years of age (Cade 1973). In 1974, three mature pairs at Cornell produced 21 young. A total of 23 young from all pairs was reared that season. Two young reared at Cornell were fostered to a pair of wild Colorado peregrines that had lost their second clutch through thin-shelled egg breakage due to DDE. The fostered young fledged. Experiments were begun on returning captive reared birds to the wild by "hacking," which involved feeding nestlings in two locations suitable for future nesting sites until they fledged and flew away (Cade *ed* 1974). From 1973 through 1975, 68 young from captive parents were raised. Eleven pairs were laying eggs in 1975 at Cornell, and that year a new breeding facility was started at Fort Collins, Colorado, stocked with birds from Cornell. At a facility in Alberta, the Canadian Wildlife Service raised 18 peregrines in 1975. Others were reared by private breedings in Canada and the United States (Cade *ed* 1975). Over 150 young were produced in captivity in all facilities in 1977, half of which were from western

North American *anatum* stock (Rocky Mountain/Southwestern Peregrine Falcon Recovery Team 1977).

The first major restocking with captive-reared birds was in 1975, when 16 were introduced to the wild by hacking at 5 release sites. Two placed on cliffs where peregrines formerly nested were killed by great horned owls, showing need for special protection against predators at natural nesting sites. The remaining three sites were man-made structures: one in a former gunnery tower at Edgewood Arsenal on Chesapeake Bay in Maryland; another at Moose Hill Sanctuary of Massachusetts Audubon Society; and a third in a specially built tower on an island near extensive salt marshes in New Jersey. Other captive-bred and raised individuals are being released in Canada (Cade *ed* 1975; Cade and Dayne *eds* 1976).

If reestablishment of a peregrine population in the East is successful, it must be with stock genetically different from the former typical *anatum* of the Eastern Deciduous forest areas as none of that population remains (King *in press*; Drury *in* Clement *ed* 1974). The problem of artificial rearing and restocking was reviewed at a National Audubon Society sponsored conference in 1974 (Clement *ed* 1974). Choosing ecologically adapted stock to replace the extinct "rock peregrine" population was debated. Stock from European populations was suggested as possibly better adapted to the eastern deciduous forest area than other North American stocks (White and Cade *in* Clement *ed* 1974). Stocks of various racial origins were suggested as best to achieve greater genetic diversity for natural selection to work with (Hickey *in* Clement *ed* 1974). Special protection of nesting peregrines from human disturbance at traditional sties is considered particularly important in preservation and reestablishment of populations (Hickey *in* Clement *ed* 1974).

In summary, essential elements of a management program are cooperation between government and private agencies in the United States, Canada, and Mexico in conducting population surveys; rearing, fostering and introducing captive reared birds to the wild; monitoring construction; oil, gas, and mineral exploration; and recreational activities that might interfere with peregrines, with restrictions when necessary; and extending and enforcing pesticide bans (Snow 1972; King *in press*; Rocky Mountain/Southwest Recovery Team 1977).

AUTHORITIES

Thomal J. Cade
Laboratory of Ornithology
Cornell University
Ithaca, New York 14850

Joseph J. Hickey
226 Russell Laboratories
University of Wisconsin
Madison, Wisconsin 53706

Clayton M. White
Department of Zoology
575 Widtsoe Building
Brigham Young University
Provo, Utah 84601

James H. Enderson
Department of Biology
Colorado College
Colorado Springs, Colorado 80903

D. D. Berger
1328 N. Jefferson
Apartment 311
Milwaukee, Wisconsin 53202

Walter R. Spofford II
"Aguila-Rancho"
Portal, Arizona 85632

Joseph A. Hagar
Marshfield Hills
Massachusetts 02051

R. Wayne Nelson
Department of Biology
University of Calgary
Calgary Alta.
Canada T2N 1N4

Richard Fyfe
Room 1110
10025 Jasper Avenue
Edmonton, Alta.
Canada T5J 136

Steven Herman
Department of Zoology
University of California
Davis, California 95616

Morlan Nelson
732 East Way
Boise, Idaho 83702

W. Grainger Hunt
Chihuahuan Desert Research Institute

P.O. Box 1334
Alpine, Texas 79830

PREPARER'S COMMENTS

The sudden complete loss of the eastern populations of the American peregrine and continuing decline of most other populations throughout the remainder of its extensive range, attest to its susceptibility to reproductive failure resulting from chlorinated hydrocarbon pesticide pollution of its food chain. Since the subspecies is practically nonmigratory and since most of its range is within the United States and Canada, correction of the chemical poisoning problem by reducing use of the most hazardous pesticides should be relatively easy compared with the Arctic Peregrine, which migrates to Latin American countries where pesticide use is generally excessive.

The American peregrine management program is fortunate in having an unusual amount of willing, expert private citizen volunteer help, particularly among active or former falconers. It gives those persons with keen interest and expertise in handling falcons a chance to work with their favorite species as they would otherwise be unable to do under present regulations governing falconry. The unusually large number of authorities and pertinent literature references, and the fact that there are now four Recovery Teams devoted to the American peregrine (more than for any other endangered species) shows the relatively great interest in it and bodes well for its recovery if the all important problem of chemical pollution can be solved in time.—John A. Aldrich

LITERATURE CITED/SELECTED REFERENCES

- A. O. U. 1931. Check-list of North American birds, 4th ed. Lancaster, PA., American Ornithologists Union.
- Allen, A. A. and H. K. Knight. 1913. The Duck Hawks of the Taughannock Gorge. *Bird Lore* 15:1-8.
- American Ornithologists' Union Committee on Conservation. 1977. Report of the committee on Conservation 1976-77. *Auk* 94 (Suppl.): 3DD-19DD.
- Anderson, D. W. 1976. The Gulf of California, *in* Fyfe, R. W., S. A. Temple, and T. J. Cade.

1976. The North American Peregrine Falcon Survey. *Can. Field-Nat.* 90:228-273.
- Baerg, W. J. 1931. Birds of Arkansas. Univ. Arkansas. Univ. Arkansas Agric. Exp. Sta. Bull. 258.
- Bailey, A. M. and R. J. Niedrach. 1965. Birds of Colorado, Col. 1. Denver Mus. Nat. Hist.
- Bailey, F. M. 1928. Birds of New Mexico. New Mexico Dept. Game & Fish and U.S. Bur. Biol. Surv.
- Banks, R. C. 1969. The Peregrine Falcon in Baja, California and the Gulf of California. Chapt. 6 in Hickey *ed.* Peregrine Falcon populations, their biology and decline. Univ. Wisconsin Press, Madison.
- Bellrose, F., Jr. 1938. Duck Hawks nesting in western Tennessee. *Wilson Bull.* 50: 139.
- Bent, A. C. 1938. Life histories of North American birds of prey, Part 2. U.S. Nat. Mus. Bull. 170, pp. 43-67.
- Berger, D. D. and H. C. Mueller. 1969. Nesting Peregrine Falcons in Wisconsin and adjacent areas. Chapt. 9 in Hickey, J. J. *ed.* Peregrine Falcon populations, their biology and decline. Madison, Univ. Wisconsin Press.
- Berger, D. C., C. R. Sindlar, Jr., K. E. Gamble. 1969. The status of breeding Peregrines in the eastern United States. Chapt. 13 in Hickey, J. J. *ed.* Peregrine Falcon populations, their biology and decline. Univ. Wisconsin Press, Madison.
- Bond, R. M. 1936. Observations on the food of the Duck Hawk. *Condor* 38:217-218.
- Bond, R. M. 1946. The Peregrine population of western North America. *Condor* 48:101-116.
- Brown, L. and D. Amadon. 1968. *Falco peregrinus*. Peregrine Falcon in Eagles, hawks and falcons of the world. Vol. 2. McGraw Hill, New York.
- Bull, J. 1974. Birds of New York State. Doubleday/Natural History Press, Garden City, NJ.
- Burleigh, T. D. 1958. Georgia Birds. Univ. Oklahoma Press, Norman.
- Butler, A. W. 1897. Birds of Indiana. Ind. Dept. Geol. and Nat. Resources, 22 Ann. Rep.
- Cade, T. J. 1960. Ecology of the Peregrine and Gyrfalcon populations in Alaska. Univ. Calif. Publ. Zool. 63:151-290.
- Cade, T. J. 1974. Current status of the Peregrine in North America. Raptor Research Report No. 3.
- Cade, T. J. 1974. Plans for managing the survival of the Peregrine Falcon. Proc. Conf. Raptor Conserv. Techniques, Fort Collins, Colo. 22-24, March 1973 pt. 4. Raptor Res. Rept. 2: 89-104.
- Cade, T. J. *ed.* 1973. Captive breeding - the 1973 season. The Peregrine Fund, Cornell Univ. Lab. of Ornith. Newsletter No. 1.
- Cade, T. J. *ed.* 1974. Captive breeding - 1974 season. Introduction to wild begins. The Peregrine Fund. Cornell Univ. Lab. of Ornith. Newsletter No. 2.
- Cade, T. J. *ed.* 1975. Captive breeding - 1975 season. Restoring Peregrines to Nature. The Peregrine Fund, Cornell Univ. Lab. of Ornith. Newsletter No. 3.
- Cade, T. J. and P. R. Dayne *eds.* 1976. The Peregrine Fund Newsletter No. 4, Cornell Univ. Lab. of Ornithology.
- Cade, T. J. and R. Fyfe. 1970. The North American Peregrine survey, 1970. *Canadian Field-Nat.* 84:231-245.
- Cade, T. J., C. M. White and J. R. Haugh. 1968. Peregrines and pesticides in Alaska. *Condor* 2: 179-178.
- Clement, R. C. *ed.* 1974. Proceedings of a conference on Peregrine Falcon recovery. *Ann. Conserv. Repts.* 4.
- Dixon, J. 1908. A family of young Duck Hawks. *Condor* 10:198-200.
- Dumont, P. A. 1917. A revised list of the birds of Iowa. *Iowa Studies* 15(5):1-171.
- Eaton, E. H. 1910. Birds of New York. New York State Mus. Mem. 12. Vol. 2.
- Enderson, J. H. 1965. A breeding and migration survey of the Peregrine Falcon. *Wilson Bull.* 77:327-329.
- Enderson, J. H. 1969. Peregrine and Prairie Falcon life tables based on band recovery data. pp. 505-509 in Peregrine Falcon populations their biology and decline, J. J. Hickey *ed.* Univ. Wisconsin Press, Madison.
- Enderson, J. H. 1969a. Population trends among Peregrine Falcons in the Rocky Mountain

- region. Chap. 5. in Hickey *ed.* Peregrine Falcon populations their biology and decline. Univ. Wisconsin Press, Madison.
- Enderson, J. H. 1977. Status of the Peregrine Falcon in the Rocky Mountain Region - 1977. Project Report, World Wildlife Fund Proj. US-18. U.S. Fish and Wildlife Service Contract 14-16-0008-2055.
- Enderson, J. and D. Berger. 1968. Chlorinated hydrocarbon residues in Peregrines and their prey species from northern Canada. *Condor* 70:149-153.
- Enderson, J. H. and J. Craig. 1974. Status of the Peregrine Falcon in the Rocky Mountains in 1973. *Auk* 91:727-736.
- Fish and Wildlife Service. 1973. Threatened Wildlife of the United States, 1973 Edition. U.S. Dept. of the Interior, Resource Pub. 114. GPO, Washington, D.C.
- Forbush, W. H. 1927. Birds of Massachusetts and other New England states, Part II. Mass. Dept. Agric.
- Fyfe, R. W., S. A. Temple and T. J. Cade *eds.* 1976. The 1975 North American Peregrine Falcon survey. *Canad. Field-Nat.* 90:228-273.
- Fyfe, R. 1976. Rationale and success of the Canadian Wildlife Service Peregrine Breeding Project. *Canad. Field-Nat.* 90:308-319.
- Gabrielson, I. N. and S. G. Jewett. 1940. Birds of Oregon. Oregon State College, Corvallis.
- Goss, N. S. 1878. Breeding of the Duck Hawk in trees. *Bull. Nuttall Ornith. Club* 3:32-34.
- Grinnell, J. and A. H. Miller, 1944. The distribution of the birds of California. *Pac. Coast Avifauna* 27.
- Groskin, H. 1947. Observations of Duck Hawks nesting on man-made structure. *Auk* 69:246-253.
- Hagar, J. A. 1969. History of the Massachusetts Peregrine Falcon population 1935-57, Chapt. 10 in Hickey, J. J. *ed.* Peregrine Falcon populations, their biology and decline. Univ. Wisconsin Press, Madison.
- Herbert, R. A. and K. G. S. Herbert. 1965. Behavior of Peregrine Falcons in the New York City Region. *Auk* 82:62-94.
- Herbert, R. A. and K. G. S. Herbert. 1969. The extirpation of the Hudson River Peregrine Falcon population Chapt. 11 in J. J. Hickey *ed.* Peregrine Falcon populations their biology and decline. Univ. Wisconsin Press, Madison.
- Herman, S. G. 1971. The Peregrine decline in California, II, Breeding status in 1970. *Amer. Birds* 25:818-820.
- Herman, S. G., M. N. Kirven and R. W. Risebrough. 1970. The Peregrine Falcon in California I. A preliminary review. *Aud. Field Notes* 24:609-613.
- Hickey, J. J. 1942. Eastern population of the Duck Hawk. *Auk* 59:176-204.
- Hickey, J. J. *ed.* 1969. Peregrine Falcon populations, their biology and decline. Univ. Wisconsin Press, Madison.
- Hickey, J. J. and D. W. Anderson. 1969. The Peregrine Falcon: life history and population literature. Chapt. 1 in Hickey, J. J. *ed.* Peregrine Falcon populations, their biology and decline. Univ. Wisconsin Press, Madison.
- Hickey, J. J. and J. E. Roelle. 1969. Conference summary and conclusions, Chapt. 47 in Hickey, J. J. *ed.* Peregrine Falcon populations, their biology and decline. Univ. Wisconsin Press, Madison.
- Hitchcock, M. 1976. A breeding survey of Peregrine Falcons in the mountains of northern Mexico 1975-76. Report of Chihuahuan Desert Research Institute, Alpine Tex. for U.S. Fish and Wildlife Service and Nat. Audubon Soc.
- Howell, J. C. and M. B. Monroe. 1957. Birds of Knox County. *Journ. Tenn. Acad. Sci. Univ. of Tennessee Press*, Knoxville.
- Hubbard, J. P. 1970. Checklist of The Birds of New Mexico. New Mexico Ornithological Society Publication No. 3. 103 pp.
- Hunt, W. G. 1976. The Peregrine Falcon population in the Chihuahuan Desert and surrounding mountain ranges: an evaluation through 1976. Report of Chihuahuan Desert Research Institute, Alpine, Tex.
- Imhof, T. A. 1962. Alabama Birds. Alabama Dept. Cons., Game & Fish Div. Univ. Alabama Press.
- Jewett, S. G., W. P. Taylor, W. J. Shaw, J. W. Aldrich, 1953. Birds of Washington State. Univ. Wash. Press, Seattle.

- Johnson, B. S. 1976. Peregrine Falcons in west Texas: Results of the 1976 nesting survey. Report of Chihuahuan Desert Research Institute, Alpine Tex., for Texas Parks and Wildlife Dept.
- Johnston, R. F. 1960. Directory to the bird-life of Kansas. Univ. Kansas Mus. Nat. Hist. Misc. Pub. 23:1-69.
- King, W. in press. (Revised) Red data book, Aves. Survival Service, I.U.C.N. Morges, Switzerland.
- Lock, R. A. 1977. Nebraska's endangered and threatened wildlife. Neb. Game and Parks Comm.
- Lowery, G. H., Jr. 1955. Louisiana birds. La. Wildlife and Fisheries Comm., La. State Univ. Press.
- McCreary, O. 1939. Wyoming bird life. Burgess Publishing Co. Minneapolis.
- Mengel, R. M. 1965. Birds of Kentucky. Ornith. Mon. No. 3, A.O.U.
- Murray, J. J. 1952. A check-list of the birds of Virginia. Virginia Soc. Ornith.
- Nelson, M. W. 1969. The status of the Peregrine Falcon in the northwest, pp. 61-72, in J. J. Hickey *ed.*, Peregrine populations their biology and decline. Univ. Wisconsin Press, Madison.
- Nelson, R. W. 1970. Observations on the decline and survival of the Peregrine Falcon. Canadian Field-Nat. 34:313-319.
- Oberholser, H. C. 1974. The bird life of Texas, Vol. I. Univ. Tex. Press, Austin.
- Osgood, W. H. 1900. Results of a biological reconnaissance of the Yukon River region. North Amer. Fauna No. 19.
- Palmer, R. S. 1949. Maine birds. Bull. Mus. Comp. Zool. 102:1-656.
- Peakall, B. 1974. DDE: its presence in Peregrine eggs in 1948. Science 183:673-674.
- Peakall, D. B. 1976. The Peregrine Falcon (*Falco peregrinus*) and pesticides. Canad. Field-Nat. 90:301-307.
- Porter, R. D. and A. Jenkins. 1977. Peregrine Falcon studies in Baja, California. Report to Direction General Fauna Silvestre of Mexican government.
- Porter, R. D. and D. B. Marshall. 1977. The recovery team approach to restoration of endangered species. ICBP World conference on Birds of Prey. Proc.:314-319.
- Porter, R. D. and C. M. White. 1973. The Peregrine Falcon in Utah, emphasizing ecology and competition with Prairie Falcon. Brigham Young Univ. Sci. Bull. Brigham Young Univ. Sci. Bull. Biol. Ser. 18(1):1-74.
- Rice, J. N. 1969. The decline of the Peregrine population in Pennsylvania, Chapt. 12 in J. J. Hickey *ed.* Peregrine populations, their biology and decline. Univ. Wisconsin Press, Madison.
- Ridgway, R. 1895. Nesting of the Duck Hawk in trees. *Nidologist* 3:42-44.
- Ridgway, R. 1889. The Ornithology of Illinois Vol. 1, H. W. Rokker, Springfield.
- Rocky Mountain/Southwest Peregrine Falcon Recovery Team. 1977. Rocky Mountain/Southwest Peregrine Recovery Plan (draft) U.S. Fish and Wildlife Service.
- Shor, W. 1970. Peregrine Falcon population dynamics deduced from band recovery data. *Raptor Research News* 4:49-59.
- Snow, C. 1972. American Peregrine Falcon, *Falco peregrinus anatum* and Arctic Peregrine Falcon, *Falco peregrinus tundrius*. Bur. Land Mangt. Technical Note, Habitat Management for Endangered Species Report No. 1.
- Spofford, W. R. 1942. Nesting of the Peregrine Falcon in Tennessee. *Migrant* 13:29-31.
- Sprunt, A., Jr. and E. B. Chamberlain. 1949. South Carolina bird life. Univ. S. Carolina Press, Columbia.
- Stager, K. E. 1941. A group of bat-eating Duck Hawks. *Condor* 43:137-139.
- Stewart, R. E. 1975. Breeding birds of North Dakota. Tri-college Center for Environmental Studies, Fargo.
- Stewart, R. E. and C. S. Robbins. 1958. Birds of Maryland and the District of Columbia. North Amer. Fauna No. 62.
- Stone, W. 1908. The birds of New Jersey. Ann. Rept. New Jersey State Mus. Part 2.
- Todd, W. E. C. 1940. Birds of western Pennsylvania. Univ. Pittsburgh Press.
- Twomey, A. C. 1942. Birds of Uinta Basin, Utah. *Ann. Carnegie Mus.* 28:341-490.

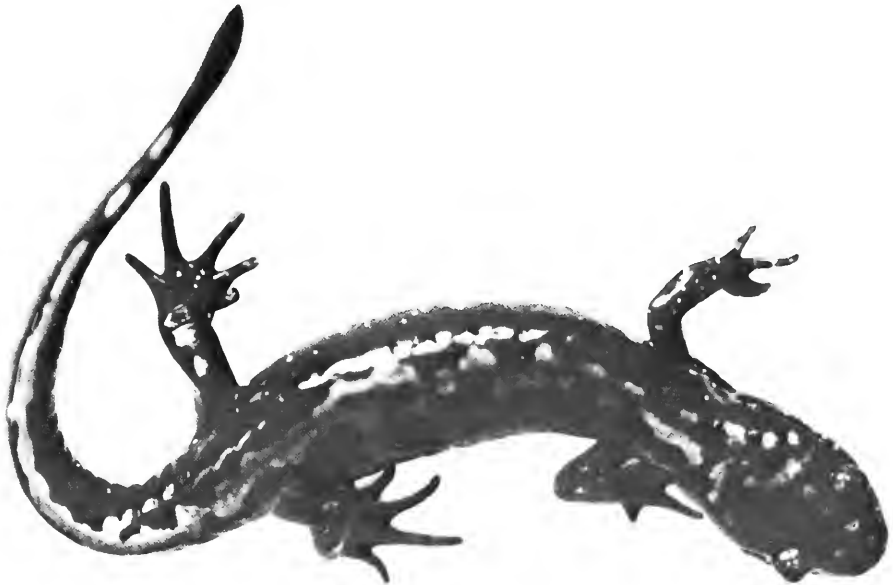
- Warren, B. H. 1890. Report on the birds of Pennsylvania. E. K. Meyers, Harrisburg.
- White, C. M. 1968. Diagnosis and relationships of the North American tundra - inhabiting Peregrine Falcon. *Auk* 85:179-191.
- White, C. M. 1968a. Biosystematics of North American Peregrine Falcons. Ph.D. dissertation, Univ. Utah, unpubl. 195 pp.
- White, C. M. and G. D. Lloyd. 1962. Predation on Peregrines by Ringtails. *Auk* 79:277.
- White, C. M. and T. J. Cade. 1977. Long-term trends of Peregrine population in Alaska, *in* Rep. of Proceedings World Conf. on Birds of Prey, Vienna, 1-3 Oct. 1975. R. D. Chancellor ed. I.C.B.P.
- Widmann, O. 1907. A preliminary catalogue of the birds of Missouri.
- Wilson Ornithological Society Conservation Committee. 1977. Falconry: effects on raptor populations and management in North America. *Wilson Bull.* 89:360-369.
- Wood, N. A. 1951. The birds of Michigan. Misc. Pubs. Mus. Zool. Univ. Mich. No. 75. Univ. Mich. Press, Ann Arbor.

Biological Services Program

FWS/OBS-80/01.58
March 1980

Selected Vertebrate Endangered Species Of the Seacoast of the United States-

SANTA CRUZ LONG-TOED SALAMANDER



Fish and Wildlife Service

U.S. Department of the Interior

PREFACE

The purpose of this series of species accounts is to provide resource managers and the public with information about Federally listed endangered and/or threatened vertebrate species that occur along, or within 100 kilometers of, the seacoast of the United States. Information about life history, distribution, requirements and conservation of the subject species is included (range maps and other distributional data are not necessarily equivalent to critical habitat as defined in the Endangered Species Act of 1973, as amended).

This series of accounts is intended to complement the computerized Sensitive Wildlife Information System (SWIS) developed by the U.S. Army Corps of Engineers in coordination with the Offices of Endangered Species and Biological Services of the Fish and Wildlife Service. A 3-ring binder is used for this series to facilitate additions and deletions as new accounts are prepared or as the status of species is changed.

Suggestions or questions regarding SWIS should be directed to:

Office of Endangered Species
U.S. Fish and Wildlife Service
Interior Building
Washington, D.C. 20240

Suggestions or questions regarding this report should be directed to:

Information Transfer Specialist
National Coastal Ecosystems Team
U.S. Fish and Wildlife Service
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

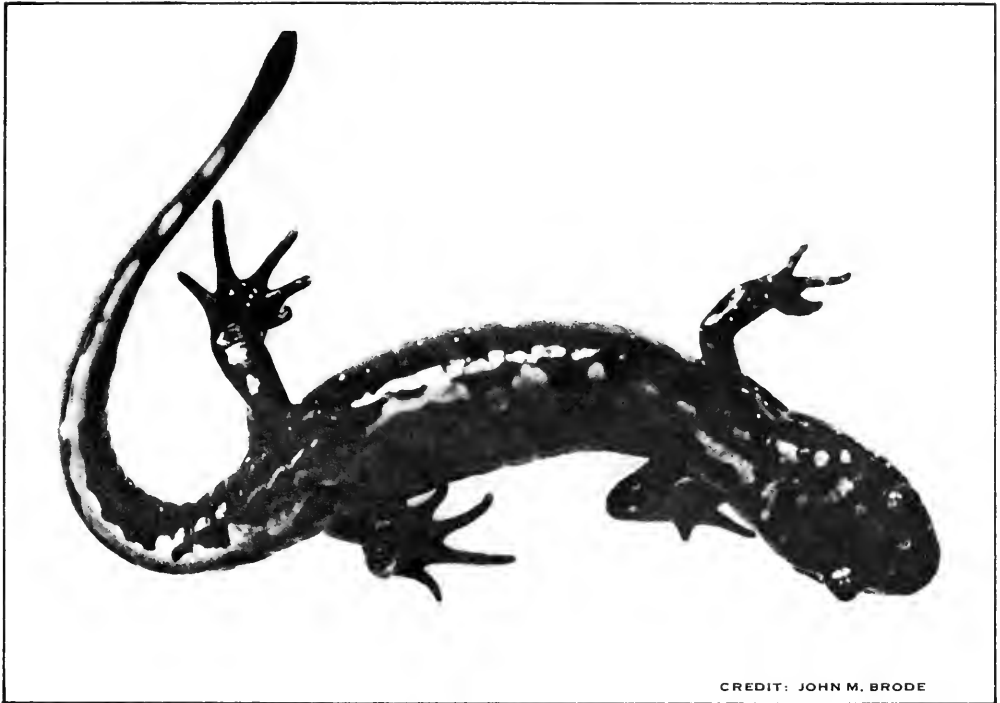
FWS/OBS-80/01.58
March 1980

SELECTED VERTEBRATE ENDANGERED SPECIES
OF THE SEACOAST OF THE UNITED STATES—
SANTA CRUZ LONG-TOED SALAMANDER

A Cooperative Effort
by the
National Fish and Wildlife Laboratory,
the Office of Endangered Species
and the
National Coastal Ecosystems Team,
Office of Biological Services

Project Officer
Donald W. Woodard
National Coastal Ecosystems Team
NASA-Slidell Computer Complex
1010 Gause Blvd.
Slidell, Louisiana 70458

Performed for
Coastal Ecosystems Project
Office of Biological Services
Fish and Wildlife Service
U.S. Department of the Interior



CREDIT: JOHN M. BRODE

SANTA CRUZ LONG-TOED SALAMANDER

Ambystoma macrodactylum croceum

KINGDOMAnimalia
 CLASSAmphibia
 ORDER..... Urodela
 FAMILY..... Ambystomatidae
 OTHER COMMON NAMES None

DATE

Entered into SWIS.....To be determined
 Updates.....15 November 1979

LEGAL STATUS

Federal Endangered (32 FR 4001, 11 March 1967)
 States Endangered: California (21 May 1971)

REASONS FOR CURRENT STATUS

This salamander was first discovered in 1954

(Russell and Anderson 1956). It is now known to occur in only six localities near the coast in the Monterey Bay region of central California. This area is undergoing accelerated residential and commercial development that once destroyed or threatened to disrupt populations of this salamander. The type locality at Valencia Lagoon was drastically disturbed by freeway construction and related storm drainage channels between 1955 and 1969, and acceleration of residential construction nearby threatens the upland habitat of the species. A second population, about 6.4 km to the southeast, occurs in and near an ephemeral pond, which was threatened in 1971 with being developed as a trailer park. This action was not taken. These were the only known populations up to 1972. Recently, a population was discovered at Seascape, between Valencia Lagoon and Ellicott, and three sites with a few individuals were located near Elkhorn Slough, about 18 km south of Valencia Lagoon. The four later sites all appear to be threatened by agricultural or subdivision development.

PRIORITY INDEX

Not assigned.

DESCRIPTION

This small salamander is 55 to 88 mm in snout-to-vent length. Adults are usually less than 125 mm in total length. The toes are relatively long, the dorsum is jet black with irregular mid-dorsal spots or blotches of metallic yellow-gold to orange color, undersides are sooty, and the sides and limbs are flecked with white.

Larvae are small and usually transform at a snout-to-vent length varying from 36 to 48 mm. If water remains in breeding ponds through the spring or early summer, larvae transform later, at a larger body size. Metamorphosis may take place from early May to mid-August.

Illustrations and description appear in Russell and Anderson (1956) and Stebbins (1966).

RANGE

Six localities known to support populations of *A. m. croceum* are (from north to south): Valencia Lagoon, Seascape Pond, Ellicott Station, McClusky Slough, Bennett (Struve) Slough, and Moco Cojo Slough. These sites are all near the coast of Monterey Bay. The populations are centered in and adjacent to the breeding ponds.

RANGE MAP

Localities are shown on the accompanying map (from Santa Cruz Long-Toed Salamander Recovery Team 1976 and Reed 1978).

STATES/COUNTIES

California Santa Cruz, Monterey.

HABITAT

This salamander occurs in rolling hills of mixed grassland, coastal chaparral and oak woodland, and along coastal seascapes. Adults and transformed individuals spend most of their lives on land in underground retreats—in mammal burrows, beneath logs and rocks, and along the root systems of plants (Ruth and Tollestrup 1973). It frequents heavily vegetated areas, typically live oak woodland (*Quercus agrifolia*) having a few madrones (*Arbutus menziesii*) and Douglas

firs (*Pseudotsuga menziesii*). The understory may include hazelnut (*Corylus rostrata*), coffeeberry (*Rhamnus californica*), currant (*Ribes sanguineum*), and California lilac (*Ceanothus thyrsiflorus*). The ground cover and low shrubs often include blackberry (*Rubus* sp.), poison oak (*Rhus diversiloba*), and ferns (*Polystichum munitum*, *Pteridium aquilinum*). Willow thickets (*Salix* sp.) are used as refuges. Adults also seek shelter in coastal scrub (Northern Coastal Scrub and Coastal Sage Scrub), which includes coyote brush (*Baccharis pilularis*), coastal sagebrushes (*Artemisia californica*, *A. suksdorfii*), lilac (*Ceanothus* sp.), lupine (*Lupinus variicolor*), sage (*Salvia* sp.), cowparsnip (*Heracleum lanatum*), and varying elements of understory shrubs and ground cover described above for the oak woodland community.

Aquatic plants in and adjacent to breeding ponds include spike rush (*Eleocharis* sp.), knotweed (*Polygonum* sp.), and pondweed (*Potamogeton* sp.). Cattail (*Typha* sp.) occurs at the Valencia site; the adjacent freeway drainage channel was planted with kikyu grass (*Pennisetum clandestinum*). Emergent and submergent vegetation is apparently necessary for egg-laying sites, cover, and food.

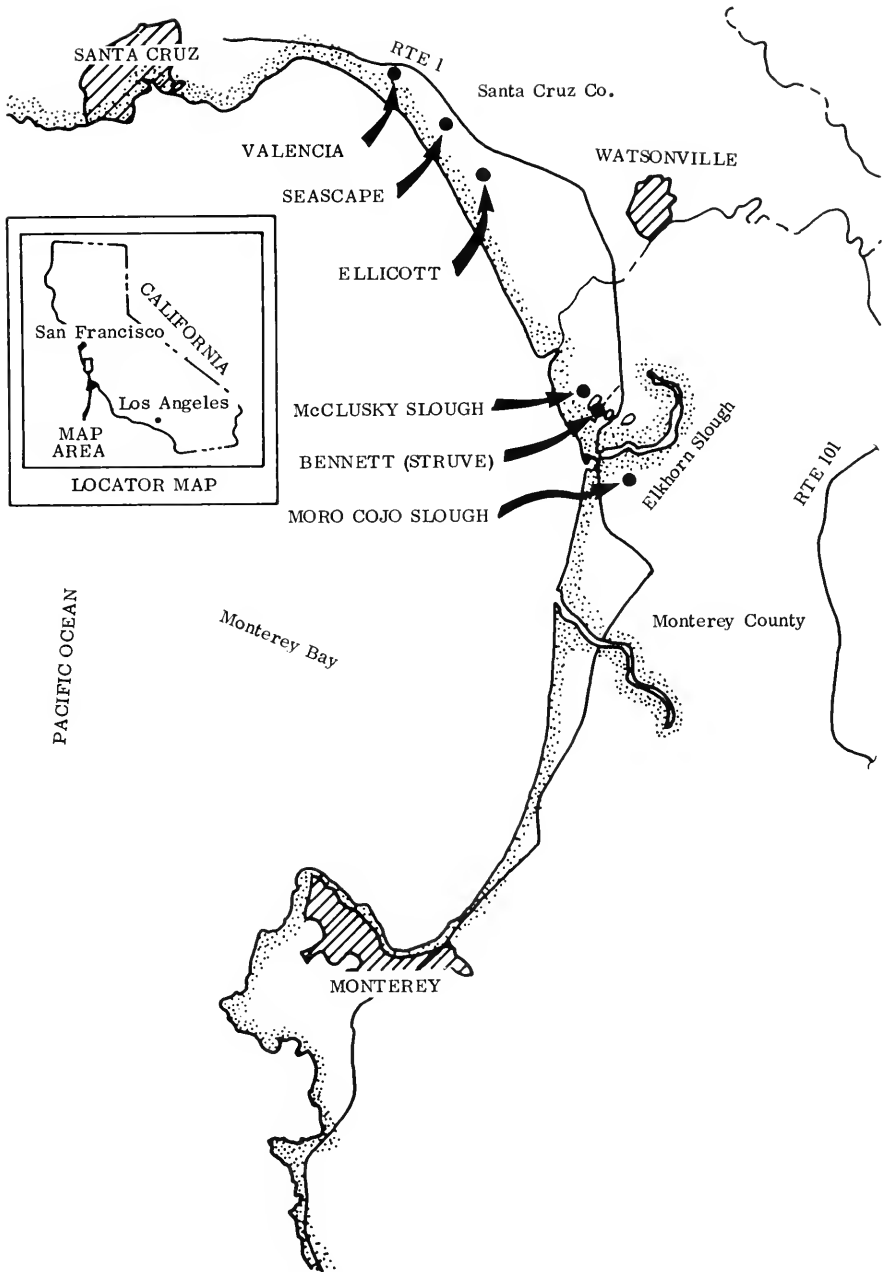
This salamander breeds principally in shallow, ephemeral ponds with vegetation present. A vital factor to transformed salamanders is the availability of relatively dense vegetative cover adjacent to or within migrating distance (presumably less than 0.5 km) from the breeding pond (SCLTSRT 1976).

FOOD AND FORAGING BEHAVIOR

Arthropods and isopods are the most important prey for adults throughout the year, and especially in the drier months (Anderson 1968). In wetter seasons, the adults take more beetles, centipedes, earthworms, and spiders. Small larvae feed mainly on planktonic invertebrates (cladocerans and copepods); larger larvae principally forage on small-sized prey such as cladocerans, copepods, ostracods, and chironomid larvae, also occasionally taking larger aquatic insects, snails, earthworms, and tadpoles (Anderson 1968).

SHELTER REQUIREMENTS

Adults apparently depend on densely vegetated



Range of the Santa Cruz Long-Toed Salamander.

tated areas or subterranean retreats for cover while on land (see HABITAT.) Breeding ponds have emergent or aquatic plants that provide cover for both adults and larvae. Breeding ponds become choked with vegetation soon after they fill.

NESTING OR BEDDING

Eggs are deposited singly, about 2 to 3 cm apart, on aquatic vegetation, principally spike rush (Anderson 1968). Ruth and Tollestrup (1974) found some small clusters of 2 or 3 eggs and some unattached eggs floating on the surface.

RITUAL REQUIREMENTS

Courtship behavior consists of a distinct sequence (Anderson 1961): clasping, rubbing, and an elaborate walking sequence, followed by spermatophore deposition by the male and subsequent recovery by the female.

OTHER CRITICAL ENVIRONMENTAL REQUIREMENTS

Adults seem to have well-developed orientation abilities that are used to locate the breeding pond. Transformed juveniles may spend 3 or 4 years on land before returning to the 'home' pond.

They frequent ephemeral ponds that are free of predators, especially predatory fish and the introduced bullfrog (*Rana catesbeiana*), both of which are capable of seriously reducing salamander numbers. Larval salamanders are especially vulnerable to fish predation.

Low winter rainfall occasionally results in small ponds or early drying out of the ponds, so that breeding is unsuccessful or the larvae die of desiccation (Ruth and Tollestrup 1973). Sometimes several consecutive years of low rainfall occur, and considerable reproductive effort may be lost.

Larval transformation usually succeeds when there is more than 760 mm of rainfall per season, and may succeed in years with between 635 and 760, depending on the timing of the rainfall; it is usually unsuccessful when there is less than 635 mm of rain (Ruth and Tollestrup 1973). Migration to the breeding site occurs only on rainy nights in winter.

POPULATION NUMBERS AND TRENDS

Once estimated to number several thousand

just at Valencia Lagoon (Anderson 1960), the salamander population has decreased because of habitat disruption. In 1972, field census studies estimated that about 500 adult salamanders were living at this site (Ruth and Tollestrup 1973), and in 1973-74 about 1,000 salamanders were established here (Tollestrup 1974). In 1974, Reed estimated that there were 2,720 individuals in the breeding area. The higher number may be due a more comprehensive study than done by early workers.

Several thousand salamanders migrated to Ellicott Pond in the winter of 1971 (R. Marlow, personal communication). About 4,000 were marked during this period, and the total population probably numbers 5,000 to 8,000 animals. The other breeding sites presumably have only small populations.

The Valencia population now uses two small artificial ponds for breeding. These ponds enable the salamander to survive, but at a lower and consequently more vulnerable level (SCLTSRT 1976). The Ellicott population appears to be stable following habitat protective measures (see MANAGEMENT AND CONSERVATION).

REPRODUCTION

Breeding occurs from November to February and largely depends on mass migrations during heavy rainstorms. Adults do not remain long in the pond. Each female lays about 200 eggs, which hatch in 30 to 45 days, and larvae transform into juveniles after 90 to 145 days (Reed 1978).

MANAGEMENT AND CONSERVATION

Considerable sustained effort by many individuals and agencies has provided protection for this salamander (Bury 1971, 1972; Bury and Ruth 1972; Ruth and Tollestrup 1973; Ruth 1974; Tollestrup 1974; California Department of Fish and Game 1975; SCLTSRC 1976; Reed 1978).

The Valencia site was partially restored by CALTRANS (California Division of Highways) following disruption due to construction of a freeway and a drainage canal. A "salamander pond" was dug and natural vegetation replanted in 1970. This artificial pond is being used by the adult salamanders as a breeding site, but the population appears to be smaller than in times past. The reduction in numbers is thought to be

due to the decreased size of the aquatic area available for breeding and larval development. CALTRANS and the California Department of Fish and Game are now making the Valencia site into essential habitat for the salamander, including restoration of the original vegetation and manipulation of the water level to increase the area of standing water.

Santa Cruz County has adopted several residential regulations designed to minimize the impact of housing near Valencia Lagoon. The California Coastal Commission, in coordination with the state Department of Fish and Game (DFG) has established guidelines for development near Valencia Lagoon. A DFG habitat acquisition program is underway at Valencia and the Nature Conservancy is helping with the effort.

Areas at Ellicott (12 ha) and Valencia (1.1 ha) were purchased in 1973 and are now Ecological Reserves administrated by the California Department of Fish and Game. At Ellicott, the U.S. Fish and Wildlife Service purchased 47 ha of habitat in 1975-76, principally terrestrial areas used by the adults for retreats during most of the year. The upland habitat had been severely disrupted by off-road vehicle use, which removed hillside vegetation and resulted in erosion. Vehicular travel has been significantly reduced in the terrestrial habitat by patrols, and posting no-trespassing signs. Erosion-control techniques are being employed to restore the vegetation. The reserve area was fenced in 1975-76.

There are continuing efforts to protect the salamander. In 1978, the U.S. Fish and Wildlife Service proposed Critical Habitat designations for the areas used by the salamander at Ellicott and Valencia. Needed biological studies on the salamander are being conducted through the cooperative efforts of the California Department of Fish and Game the U.S. Fish and Wildlife Service. From 1973 to 1978, four additional localities where some salamanders live were discovered, but the status of these populations is not well known.

Potential threats to the recently discovered populations at Seascap and near Elkhorn Slough are being evaluated and, if proven serious, may warrant protective measures.

AUTHORITIES

Elden H. Vestal
California Dept. of Fish and Game

P.O. Box 47
Yountville, California 94599

John M. Brode, Acting Leader
Santa Cruz Long-Toed Salamander
Recovery Team
California Dept. of Fish and Game
1701 Nimbus Road
Rancho Cordova, California 95670

Kristine Tollestrup
Museum of Vertebrate Zoology
University of California
Berkeley, California 94720

Richard Sage
Museum of Vertebrate Zoology
University of California
Berkeley, California 94720

PREPARER'S COMMENTS

There have been significant efforts to save the Santa Cruz long-toed salamander from extinction. It was one of the first animals to be included on the Endangered Species List (1967). Thousands of hours of volunteer and professional help prevented the possible extinction of this life form. Present interagency cooperation is assisting in the recovery of this salamander and its associated habitat.

Further biological studies are needed to assess population trends at the Ellicott localities, and to determine the status of recently discovered populations near Elkhorn Slough.

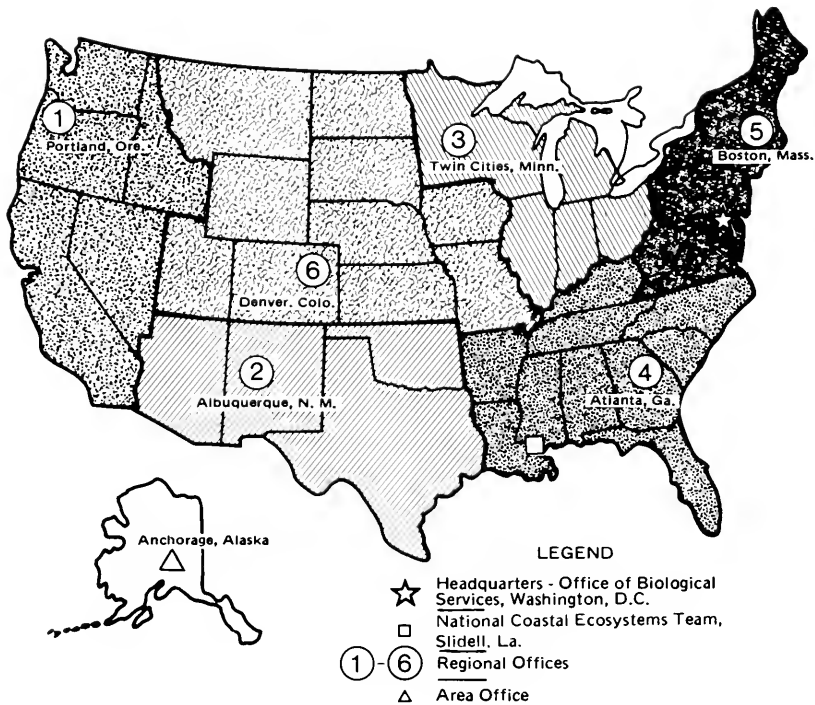
LITERATURE CITED/SELECTED REFERENCES

- Anderson, J. D. 1960. A comparative study of coastal and montane populations of *Ambystoma macrodactylum*. Ph.D. thesis, Univ of Calif., Berkeley.
- . 1961. The courtship behavior of *Ambystoma macrodactylum croceum*. Copeia 1961 (2): 132-139.
- . 1967. A comparison of the life histories of coastal and montane populations of *Ambystoma macrodactylum* in California. Am. Midl. Nat. 77(2):323-355.
- . 1968. A comparison of the food habits

- of *Ambystoma macrodactylum sigillatum*, *Ambystoma macrodactylum croceum*, and *Ambystoma tigrinum californiense*. Herpetologica 24(4):273-284.
- Bury, R. B. 1971. Endangered and rare reptiles and amphibians of California. Biol. Library Univ. Calif., Berkeley. Unpubl. Rep. 60 pp.
- . 1972. Status report on California's threatened amphibians and reptiles. Calif. Dept. Fish Game, Inland Fisheries Admin. Rep. 72-2. 31 pp.
- Bury, R. B. and S. B. Ruth. 1972. Santa Cruz long-toed salamander: survival in doubt. Herpetol. Rev. 4(1):20-22.
- California Department of Fish and Game. 1975. Fish and wildlife management plan for the Santa Cruz long-toed salamander ecological reserve, Santa Cruz County, California. Unpubl. Rep. 12 pp.
- . 1978. At the crossroads: a report on California's endangered and rare fish and wildlife. Biannual Report. 103 pp.
- Ferguson, D. E. 1961. The geographic variation of *Ambystoma macrodactylum* Baird, with the description of two new subspecies. Am. Midl. Nat. 65(2):311-338.
- Reed R. J. 1978. Population study of the Santa Cruz long-toed salamander (*Ambystoma macrodactylum croceum*) at Valencia Lagoon 1977-78 with notes and occurrence in Santa Cruz and Monterey Counties. Calif. Dept. Fish and Game, Contract No. S-1180. 115 pp.
- Russell, R. W. and J. E. Anderson. 1956. A disjunct population of the long-nosed (sic) salamander from the coast of California. Herpetologica 12(2):137-140.
- Ruth, S. B. 1974. The current status of the Santa Cruz long-toed salamander — an endangered animal. Herp. Rev. 5(1):27-29.
- Ruth, S. B. and K. Tollestrup. 1973. Aspects of the life history and current status of the Santa Cruz long-toed salamander (*Ambystoma macrodactylum croceum*) at Valencia Lagoon, Santa Cruz County, California. Mus. Vert. Zool., Univ. Calif., Berkeley. Unpubl. Rep. 54 pp.
- Santa Cruz Long-Toed Salamander Recovery Team. 1976. Santa Cruz long-toed salamander recovery plan. U.S. Fish and Wildlife Serv. 50 pp.
- Stebbins, R. C. 1966. A field guide to western reptiles and amphibians. Houghton Mifflin Co., Boston. 279 pp.
- Tollestrup, K. 1974. Study of the terrestrial habits and migratory movements of the Santa Cruz long-toed salamander (*Ambystoma macrodactylum croceum*) in the Valencia Lagoon area near Aptos, Santa Cruz County, California. U.S. Bur. Sport Fish. Wildl. 27 pp.

PREPARED/UPDATED BY

National Fish and Wildlife Laboratory
1300 Blue Spruce Drive
Fort Collins, Colorado 80524



U.S. FISH AND WILDLIFE SERVICE REGIONAL OFFICES

REGION 1
Regional Director
U.S. Fish and Wildlife Service
Lloyd Five Hundred Building, Suite 1692
500 N.E. Multnomah Street
Portland, Oregon 97232

REGION 2
Regional Director
U.S. Fish and Wildlife Service
P.O. Box 1306
Albuquerque, New Mexico 87103

REGION 3
Regional Director
U.S. Fish and Wildlife Service
Federal Building, Fort Snelling
Twin Cities, Minnesota 55111

REGION 4
Regional Director
U.S. Fish and Wildlife Service
Richard B. Russell Building
75 Spring Street, S.W.
Atlanta, Georgia 30303

REGION 5
Regional Director
U.S. Fish and Wildlife Service
One Gateway Center
Newton Corner, Massachusetts 02158

REGION 6
Regional Director
U.S. Fish and Wildlife Service
P.O. Box 25486
Denver Federal Center
Denver, Colorado 80225

ALASKA AREA
Regional Director
U.S. Fish and Wildlife Service
1011 E. Tudor Road
Anchorage, Alaska 99503



DEPARTMENT OF THE INTERIOR U.S. FISH AND WILDLIFE SERVICE



As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

