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SCIENTIFIC PAPERS

RAPTOR RESEARCH

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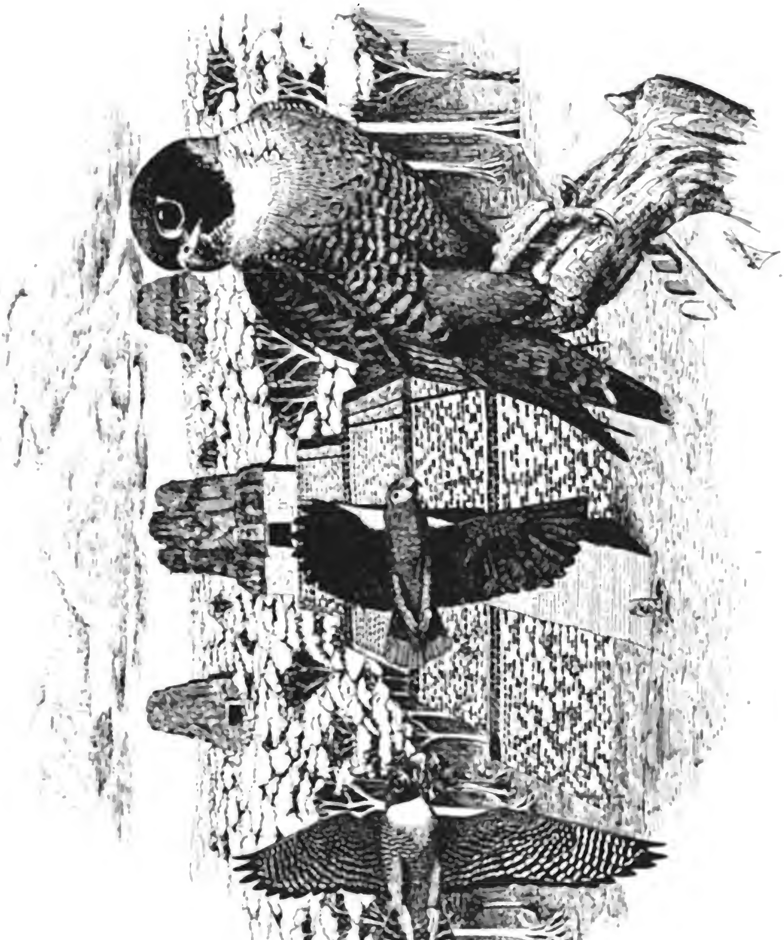

HUNTING AND PRENESTING BEHAVIOR OF THE ORANGE-BREASTED FALCON

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Introduction

Distribution of the Orange-breasted Falcon *Falco deiroleucus*) extends from Veracruz, Mexico (Friedmann 1950), south into Paraguay and northern Argentina (Haverschmidt 1968). Haverschmidt (1963), Smithe (1966), and Hardy et al. (1975) indicate that *F. deiroleucus* is a tropical forest species, but observations by Howell (1972), Kirven (pers. comm.), and Short (1975) suggest that it has a wider habitat selection with a tendency to use drier regions. However, individual falcons may prefer wet cloud-forested middle altitudes along Caribbean slopes (Slud 1964).

Species observed captured or attacked throughout the falcon's range are birds usually found at forest edges and clearings. These include Red-rumped Cacique (*Cacius haemorrhous*), Ruddy Ground-dove (*Columbia talpacoti*), Aztec Parakeet (*Artinga astec*), Blue-crowned Parrot (*Amazona farinosa*), Red-lored Parrot (*Amazona autumnalis*), Keel-billed Toucan (*Ramphastos sulfuratos*), and Montezuma Oropendola (*Gymnostineps montezuma*). Such prey suggest that the Orange-breasted Falcon prefers ecotones, especially where complex mature forests are interrupted by savannas, clearings, high cliffs, or rivers. This habitat use is shown in Surinam where falcons perch in the upper canopy of trees at forest edges (Haverschmidt 1968). Howell observed *F. deiroleucus* perched in a dead pine located in a Nicaraguan lowland pine savanna adjacent to an extensive rain forest. Slud (1964) noted them perched at "medium height in a tree beside a road passing through partially cleared forest" and in a tree in semi-open country. Mike Parmeter (pers. comm.) observed several falcons perched in upper branches of tall dead trees along the Javari River's edge. Smithe and Paynter (1963) observed a pair in the Great Plaza, a clearing in the heart of the Mayan ruins at Tikal, Guatemala, usually perched in one of the trees adorning the temple tops. Undoubtedly *F. deiroleucus* uses the edge effect, capitalizing on high species diversity and densities there.

Methods and Materials

I watched Orange-breasted Falcons during a ten-day period at Tikal National Park, Guatemala, in early February 1976, mostly at the Great Plaza located in the heart of the Mayan ruins. I selected the upper landings of Temples I and II for viewing the falcons. These sites gave me an excellent view of the plaza below and an unobstructed view east across the top of the jungle canopy. I used 7 x 35 Bushnell binoculars and a Bausch and Lomb zoom 15–60 power spotting scope to aid my observations.

Falcon History at Tikal

At Tikal *F. deiroleucus* was apparently first recorded by E. P. Edwards in June 1958 (Smithe and Paynter 1963) in the vicinity of the Great Plaza. Smithe also observed a pair in June and July 1959 perched in a tree on one of the most prominent temples in

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the area. A pair was noted by Smithe at Tikal each year from 1958 to 1963. In 1963 the falcons nested in the roof-comb on Temple II, but Smithe did not examine the nest. They were suspected of nesting within cavities on Temples I and III in previous years.

During the early 1970s *F. deiroleucus* nested upon Temple IV, the highest pre-Columbian structure in North and South America. Concurrently, in 1972 the Bat Falcon (*Falco rufigularis*) nested in a hole in a rotted-out beam in Temple I, utilizing the Great Plaza for foraging territory (Dora Weyer pers. comm.—a long-time resident of Belize). In March 1973 Bat Falcons again nested in a rotted-out beam hole on the east wall of Temple I and foraged over the Great Plaza (Kirven pers. comm.). *F. deiroleucus* was not seen in the area in 1973; however, regurgitated pellets on top of Temple IV suggested their presence (Kirven pers. comm.). During 1974 and 1975 both falcon species occurred in the Great Plaza, and considerable interaction and harrassment of *F. deiroleucus* by *F. rufigularis* took place. By February 1976 only the Orange-breasted Falcon remained in the Great Plaza. However, Bat Falcons were reported to forage along the Tikal airstrip (John Kant pers. comm.—anthropologist working at Tikal).

Hunting Behavior

Little is known concerning the behavior of *F. deiroleucus* other than "it resembles a small peregrine in habits and looks like one in flight" (Brown and Amadon 1968:847). Because of this resemblance and behavior, Short (1975) treats *F. deiroleucus* as an allospecies of *F. peregrinus*. Ridgely (1976) considers *F. deiroleucus* the neotropical ecotype of the peregrine, and Wetmore (1965) treats them only as congeners.

On the morning of 4 February 1976 in the Great Plaza, *F. deiroleucus* pursued a Blue-crowned Parrot between Temples I and II, continuing out of sight in the upper canopy of the surrounding forest. Immediately thereafter the same sequence was repeated with either the same Blue-crowned Parrot or another. Additional observations indicated that this repetitive pursuit behavior was centered around the Great Plaza. In the following days active pursuits of prey were carried out regularly through, around, and above the Great Plaza.

Fortunately for my observational purposes, the adult falcons chose to perch in a tree just north of Temple I at the same height as the upper landing of the Temple. The falcons' preferred perch was in the middle of the tree, consistent with Slud's (1974) observation. Haverschmidt (1968), however, reported that *F. deiroleucus* perched at the top of a tree. The perched falcons generally faced east with an unobstructed view toward the Tikal airstrip. The view from atop Temple I to the west was blocked at the clearing edge by giant trees. Therefore an expansive view to the east would appear to be more advantageous to the falcons for prey identification and selection. In fact, prey approaching from the east was often pursued in the immediate vicinity of the Great Plaza.

I saw the female falcon attack prey around the Great Plaza thirteen times, the male eight times. The female successfully struck a Red-lored Parrot in flight but did not hold onto it. She unsuccessfully attacked other Red-lored Parrots, Montezuma Oropendolas, Blue-crowned Parrots, Keel-billed Toucans, and an unidentified species of parakeet. The male attacked Red-lored Parrots and Blue-crowned Parrots. The falcons attacked the parrots as they flew by the Great Plaza near the upper jungle canopy. Toucans and Oropendolas were attacked as they tried to cross the Great Plaza moving from tree to tree through, rather than above, the canopy. I therefore did not see the falcons catch any prey; attacks initiated in the Great Plaza may have been made in defense of the nest site.

Prey avoided capture by outmaneuvering the falcons or seeking shelter in the foliage. By simply flying into the foliage of the trees the Toucans and Oropendolas eluded capture since the falcons would not pursue them into the trees. Red-lored Parrots managed to escape capture when closely pursued by actually flying at high speed directly into the foliage—crashing rather awkwardly and apparently at considerable danger to themselves. The evasive tactic of 'ditching' is similar to what I have seen the Dunlin (*Erolia alpina*) and Western Sandpiper (*Ereunetes mauri*) do when closely pursued by falcons at Humboldt Bay in northern California. The only difference is that the Dunlins and sandpipers escape capture (sometimes) by diving at high speed into water rather than into trees.

Three types of attacking flights were observed. The first type was a direct pursuit around the periphery of the Great Plaza, through and above the upper jungle canopy. The prey, only a few meters in front of pursuing falcons, executed evasive moves that were followed closely by the falcons. The second type of attack was a direct flight at the prey interspersed with short stoops or dives. The intended prey usually evaded the falcons at the critical moment of impact. The final attack technique was a spectacular vertical stoop initiated approximately 300 meters above the jungle canopy and ending with the falcon disappearing below the tree tops. Only the male dived in this fashion, twice in the area of the Tikal access road. Apparently, the falcons forage over jungle edges from high overhead. On 9 February at 1330 hours at the government-provided tourist camp, the male Orange-breasted Falcon flew through the camp clearing at mid-tree height at high velocity. They may also hunt man-made clearings (other than the Mayan ruins), such as roads, airstrips, and campgrounds.

The Orange-breasted Falcons defended the airspace directly above the Great Plaza from invasion by other Falconiforms. A Hawk-Eagle (*Spizaetus sp.* or *Spizastur*), which flew high over the plaza, was attacked by the male falcon. The falcon gained altitude quickly and disappeared as the Hawk-Eagle set its wings and immediately left the area. King Vultures (*Sarcoramphus papa*) that flew high over the Great Plaza were not attacked by the falcons.

Courtship

The male was observed with an unidentifiable bird in his talons on 8 February 1976 while perched on the roof-comb of Temple II. The female immediately flew to his perch, causing him to fly to another perch. For the next 30 minutes she pursued him from perch to perch around the Great Plaza. The male was able to consume portions of prey only when the female temporarily interrupted her harrassment by pursuing Montezuma Oropendolas and Toucans. Finally she flew above him, circled several times with her legs and feet extended when directly above him, and then flew to a tree snag where she perched and called. The male then flew to Temple I, with the remainder of the prey, landed, and called. Suddenly the male flew without the prey directly to the female and landed on her back. Copulation lasted two to three seconds. The male then flew off, circled over the North Acropolis, calling, and returned to perch next to her. One other copulation was observed on 9 February in the same snag. This time at the end of copulation the female flew from the tree and returned to perch next to the male.

Nests and Their Selection

In February 1976 both adult falcons inspected vertical slots in the roof-combs of Temples I and II by walking along the upper ledges. The slots are located both to the right and left of center at the top of the temples. The female falcon usually led the pair to the slots for inspection, or she went alone. She preferred the southern slot of Temple I. The male occasionally accompanied her to the slots, but he rarely led the inspection or inspected the slots himself. Smithe (1963) and Weyer (pers. comm.) noted *F. deiroleucus* nesting in cavities in the roof-combs. However, the slots that the falcons were inspecting in February 1976 did not appear to have any overhead protection (as would cavities).

I could not confirm nesting at Tikal in 1976. Interestingly, the falcons seemed not to spend evenings in the Great Plaza (unless they returned after dark and left before sunrise). The falcons always heralded their arrival with a series of calls as they approached the Great Plaza early in the morning. Temple III was not checked at sunset for roosting falcons. Temple IV was climbed at sunset in the hope that the falcons may have roosted there. Others, aware of my study, reported the falcons on Temple IV near sunset. Unfortunately, the falcons did not arrive at sunset while I was there.

Human Disturbance

The falcons were not disturbed by tourists and park employees wandering around the Great Plaza near their roosting trees or by me when I climbed to within 75 meters of their perch. The only detectable human disturbance occurred when a vendor rolled his cart up the Great Plaza access road which leads directly below the falcons' perch. The loud noise of the approaching cart caused the falcons to cackle and peer down at the approaching vendor. They did not flush, and after the cart passed, they remained quietly perched.

A Minor Controversy

Griscom (1932) has been criticized by Ridgely (1976) and Wetmore (1965) for reporting *F. deiroleucus* as nesting in "cathedral and church towers and in belfries in the heart of towns and cities in both Nicaragua and western Panama." Ridgely and Wetmore believe that the Bat Falcon was the species noted by Griscom. However, Smithe and Paynter observed *F. deiroleucus* nesting in the Great Plaza, which is similar to many Latin American church towers and cathedrals located on or near open town squares. Also, my observations of one pair's tolerance of humans suggests the species may comfortably occupy urban areas containing suitable habitat. Temporal differences in use of these areas by competitors may occur as evidenced by the congeneric interaction between the Orange-breasted Falcon and Bat Falcon at Tikal.

Acknowledgments

I am grateful to Monte N. Kirven and Dora Weyer for sharing their Orange-breasted Falcon observations with me. Appreciation is extended to Clayton M. White and Richard R. Olendorff for their suggestions on the manuscript. I am particularly grateful to John Schmitt for contributing his Orange-breasted Falcon pen-and-ink drawing.

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HAWK MT. RESEARCH AWARD

The board of directors of the Hawk Mountain Sanctuary Association announces its third annual award for raptor research. Jane E. Anderson graduate research assistant, Arizona Cooperative Wildlife Research Unit, University of Arizona, Tucson, Arizona, is this year's recipient. Miss Anderson's study, "Influence of Range Conditions on Hunting Areas of Red-tailed Hawks and Kestrels," is a much-needed investigation demonstrating the relationship between grazing intensity and raptor ecology. This basic research will be important in future management practices on grazing lands, particularly on BLM land use by private cattle interests.

To apply for the $500.00 annual award, students should submit a description of their research program, a curriculum vitae, and two letters of recommendation by October 31, 1980, to:

Mr. Alexander C. Nagy, Curator
Hawk Mountain Sanctuary Association
Route 2, Kempton, Pennsylvania
19529

The final decision by the board of directors will be made in February 1981.

Only students enrolled in a degree-granting institution are eligible. Both undergraduate and graduate students are invited to apply. Projects will be picked completely on the basis of their potential contribution to improve understanding of raptor biology and their ultimate relevance to conservation of North American hawk populations.

OWL MORTALITY AND ABANDONED FISHING LINE

by
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On 18 May 1978, in Thurston County, Washington, a live Barn Owl (*Tyto alba*) was found tangled in monofilament fishing line in the vicinity of a freshwater lake. The fishing line was removed and the owl was released unhurt.

On 1 July 1978, in the same county, a dead Screech Owl (*Otus asio*) was found hanging by monofilament fishing line suspended from an Oregon ash (*Fraxinus latifolia*) growing along the Deschutes River. The fishing line was wrapped several times around the owl's right wing at the juncture of the wing with the body. There were approximately 3 m of fishing line hanging from the tree. The line was firmly caught in the tree, causing the owl to hang suspended in the river which apparently caused death by drowning.

Abandoned fishing line is commonly found along heavily fished waterways (Anonymous, Oregon Wildl. 33:6, 1978). Although the frequency of fishing-line collisions by birds is not known, it would be worthwhile to monitor such occurrences. Conceivably, fishing line in trouble areas could be removed.

We thank Walter Matia for assistance in the field and Dr. Dwight G. Smith and Stephen G. Jones for critically reading this note.

ANNOUNCEMENT

The New England Hawk Migration Committee of the Connecticut Audubon Council wishes to announce plans for a *New England Regional Hawk Migration Conference* to be held in April 1981. This meeting will commemorate ten years of organized hawk watching in New England. Detailed announcements will be forthcoming. For information write: Hawks, P.O. Box 2121, Portland, Connecticut 06480.

Ten years of New England hawk migration data are now available collectively at the library of Taft School in Watertown, Connecticut 06795. Persons wishing to use these data may do so by contacting New England Hawk Migration Committee member, Neil Currie (203-274-3050).

ARTIFICIAL NEST STRUCTURES AND GRASSLAND RAPTORS

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Abstract

During a four-year study at the Birds of Prey National Conservation Area in Idaho, nest structures were placed in three different habitat types. Two species, the Ferruginous Hawk (*Buteo regalis*) and the Raven (*Corvus corax*), successfully nested on these structures. Ferruginous Hawks utilized sites where no raptor nests had previously been found. Component factors are discussed that may affect the selection of artificial nest by raptors. Applications are presented in which artificial nest structures may serve to mitigate loss of natural nest sites and associated habitat.

Introduction

Interest in the role of artificial nest platforms as an enhancement technique has encouraged many investigators to place them in a variety of habitats. Postupalsky and Stackpole (1974) and Reese (1970) have demonstrated the effectiveness of these structures for Osprey (*Pandion haliaetus*). Dunstan and Borth (1970) found that a pair of Bald Eagle (*Haliaeetus leucocephalus*) would accept a reconstructed nest. Fyfe and Armbruster (1977) pioneered the improvement of potholes for the Prairie Falcon (*Falco mexicanus*) and the use of basket structures for grassland raptors. Bohm (1977) erected a number of nest platforms in Minnesota to encourage nesting of the Great Horned Owl (*Bubo virginianus*) and Red-tailed Hawk (*Buteo jamaicensis*). Anderson and Follett (1978) reversed a downward trend of available nest sites and productive Ferruginous Hawk (*Buteo regalis*) pairs on the Pawnee National Grassland by providing new supporting structures.

The impetus for the present project was suggested by Olendorff and Stoddart (1974) and was motivated by projected habitat loss due to agricultural conversion and energy development on rangelands in the west.

Methods

In 1975, a survey was conducted to determine the presence of nesting raptors in three selected habitat types within and near the proposed Birds of Prey National Conservation Area (BPNCA). An assessment was made of the available prey base in these habitat types utilizing data generated by studies at BPNCA. By 1976, a plan was implemented

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whereby nesting structures designed to attract Ferruginous Hawks were built in and adjacent to the BPNCA (see figures 1 and 2). The plan called for placement of a total of 24 nesting structures in these three habitat types. Two structures in close proximity (150 meters), one with a shade cover and one without, were placed at each of twelve selected sites.

The experiment was designed to test the hypothesis that: (1) Ferruginous Hawks can be attracted to nest on artificial platforms; (2) platforms will attract breeding pairs to nest in an area where none were previously known; (3) higher productivity will result from structures that are shaded than from those that are unshaded.

The three habitat types selected for the nest sites are typical of western Idaho Great Basin vegetation. They include native shadscale/winterfat (*Atriplex confertifolia/Cerratoides lanta*), sagebrush/bluegrass (*Artemisia tridentata/Poa sandbergii*), and forbs/grass (Pure forbs or 1–20% blue grass or cheat grass (*Bromus tectorum*). Four nest sites, a total of eight nest structures, were placed in each habitat type.

The structures were surveyed twice each spring—once in March, to check for occupation and to repair any damage sustained during the winter, and again in June, to count and band young.

Results

Our results show that raptor nest platforms provide a feasible technique for increasing the local nesting population within certain limits. Our first hypothesis, i.e., Ferruginous Hawks can be attracted to nest on artificial platforms, was demonstrated one year after placement of structures (see table 1).

Table 1. Ferruginous Hawk Nesting Success, 1976–1979

Year	No. of occupied nests	No. of successful nests	No. of young fledged	$\overline{X}$. No. of young fledged/ occupied nests
1976	0	0	0	0
1977	1	1	2	2
1978	3	2	5	1.6
1979	3	2	5	1.6
TOTAL	7	5	12	1.7

The pair that nested in 1977 also confirmed our second hypothesis, i.e., platforms will attract breeding pairs to nest in the area where none were previously known. The forbs/grass habitat type was the area where all pairs except one nested. This habitat type supports a substantial population of rodents (138/hectare) and Townsend Ground Squirrels (*Spermophilus townsendi*) (14/hectare) (DOI Report 1979). The third hypothesis was not confirmed, i.e., higher productivity will result from structures that are shaded than from those that are unshaded. No pairs of Ferruginous Hawks nested on shaded structures. In 1979, we moved a shading device to the nearby unshaded nest platform, which had been occupied by a successful pair for two years. When the birds returned in 1979, they utilized the platform from which the shading device had been removed.

Ravens were very successful in pioneering the use of the platforms in 1976 but declined thereafter (table 2). They nested within the shadscale/winterfat and sagebrush/bluegrass habitat types but did not nest in the forbs/grass type where the Ferruginous Hawks nested.

Table 2. Raven Nesting Success, 1976-1979

Year	No. of occupied nests	No. of successful nests	No. of young fledged	$\bar{X}$. No. of young fledged/ occupied nests
1976	4	4	13	3.2
1977	2	1	4	2
1978	3	2	9	3
1979	1	1	3	3
TOTAL	10	8	29	2.8

Somewhat to our surprise, ravens used the shaded structures quite readily. They fledged 29 young during the four-year study, of which 23 were from nest structures with shade covers. One can only conclude that we now have a marvelous technique for raven management.

Discussion

As more human demands are placed on areas where Ferruginous Hawks and other raptors exist, it may become crucial to find other areas where they might exist but can't because of a missing requirement. We have demonstrated the application of nest structures as a technique to expand the breeding population of a species within a local area. Utility companies are beginning to cooperate in accepting the use of similar platforms on steel towers (Nelson and Nelson 1977).

Requirements to implement a basic raptor management program of this type are few. The following information should first be secured: (a) population history of target species and its competitors; (b) evaluation of feasibility and methods; (c) habitat and nesting requirements of the species; (d) whether the prey base will support additional populations of raptors; (e) determination that the introduction of nest structures will not displace or affect threatened and endangered species.

Acknowledgments

We thank Douglas Smithey, former BPNCA manager, and Pat Benson for helping us to initiate this study.

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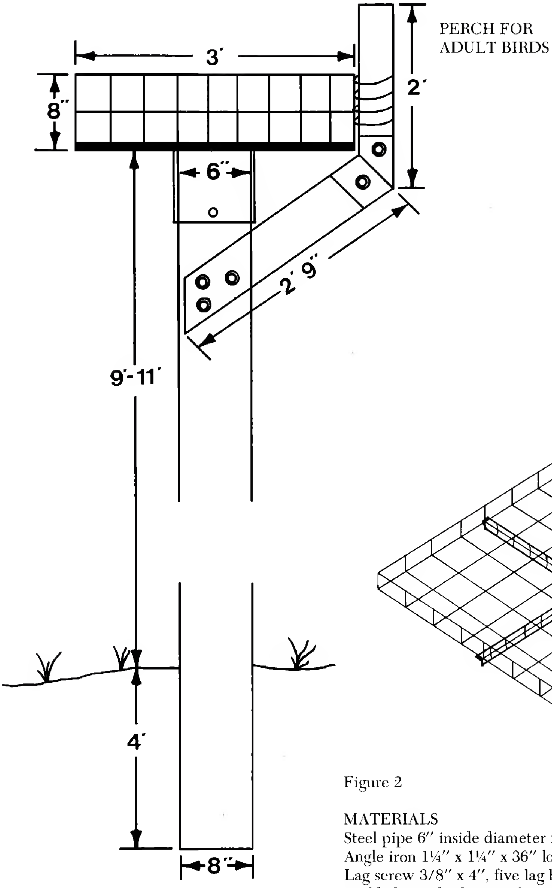
Addendum

In the spring of 1980, the nest structures were resurveyed for occupancy and productivity. During the first week in May, three were occupied by Ferruginous Hawks while no Ravens were found nesting in the structures. The structures were checked in late May. Of 24 surveyed, three supported 10 nestlings ($\bar{x} = 3.3$).

Two pair of Ferruginous Hawks utilized unshaded structures. One pair utilized a shaded structure and produced three young. We suspect this was the same pair that utilized an unshaded structure in 1978 and 1979 at this site. During the winter of 1979, this structure fell over. When the birds returned in 1980, they built their nest in the shaded structure. Its evident by our results that a shaded structure of this design is not desirable for nesting raptors. They were utilized only once in five years.



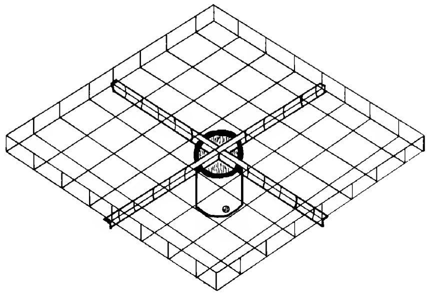


Figure 1

BUTEO NEST PLATFORM

Figure 2

MATERIALS
Steel pipe 6″ inside diameter x 9″ long
Angle iron 1¼″ x 1¼″ x 36″ long
Lag screw 3/8″ x 4″, five lag bolts with washers and nuts
Welded wire basket, mesh size 4″ x 4″, basket size 36″ x 36″
1-4′ board 2″ x 6″ for perch
1-utility pole 13′–15′ long
Note: Wire into basket about two dozen sage brush sticks.
Sticks should be dead—without leafy branches and 15″–25″ long.

PRAIRIE FALCONS NEST ON AN ARTIFICIAL LEDGE

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Abstract

Four days during fall 1978 were needed to measure, construct, and install an artificial nesting ledge on a historical Peregrine Falcon nesting cliff in the Mendocino National Forest, California. The platform was constructed of steel with rock nesting material added onto it. Expansion bolts inserted into predrilled holes held the ledge in place. Prairie Falcons laid four eggs on the artificial ledge in April 1979. Two young hatched in May and fledged from the ledge in June 1979.

Introduction

There are two general categories of man-made raptor nesting structures. First, man-made *structures* intended for man's own use are sometimes adopted and subsequently used as nesting sites by raptors. Examples of such structures include bridges, high-rise buildings, and buoys. Second, *artificial platforms* can be designed and installed specifically to encourage raptors to nest.

Large falcons have frequently adopted man-made *structures* as nesting sites. White and Roseneau (1970) reviewed artificial nest site use by different species of falcons. Some noteworthy examples are the Gyrfalcon (*Falco rusticolus*) nesting on arctic gold-dredges, Lanner Falcon (*Falco biarmicus*) nesting on Egyptian pyramids (Meinertzhagen 1954), Orange-breasted Falcon (*Falco deiroleucus*) nesting on Mayan temple ruins in Guatemala (Smithe 1966), and Peregrine Falcon (*Falco peregrinus*) nesting on metropolitan sky-scrapers (Groskin 1952) and bridge piers (Craighead and Craighead 1939).

Artificial nesting platforms have been used by a wide variety of tree-nesting raptors, such as Osprey (*Pandion haliaetus*), Bald Eagle (*Haliaetus leucocephalus*), Great Horned

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Owl (*Bubo virginianus*), Great Grey Owl (*Strix nebuloso*), and Ferruginous Hawk (*Buteo regalis*) (Bohm 1977). Very few artificial platforms, however, have been constructed to encourage falcons to nest. In Alaska artificial wooden ledges placed along the sloping Sagavanirktok River banks have failed to attract nesting Gyrfalcons or Peregrines (White pers. comm.). So far, only the Raven (*Corvus corax*) has shown interest in these ledges. Both Peregrines and the Prairie Falcon (*Falco mexicanus*) (particularly the latter) were attracted to excavated cavities in sandstone cliffs in Canada (Fyfe and Armbruster 1977). These cavities however, contain no artificial structures.

The Mendocino National Forest Ledge

The historical Peregrine nesting cliff at which we constructed the artificial nesting ledge is situated on a 1,500-meter ridge. Facing east, the 110-meter-tall metagraywacke cliff overlooks the west side of the northern Sacramento Valley. The nesting ledge is in a rock chimney (a large vertical fissure, roughly the size and shape of a house chimney) 60 meters below the cliff top.

During a 1978 Mendocino National Forest Peregrine Falcon nesting survey, the historical nesting ledge was discovered to have fallen from the cliff. The remnant ledge was restricted to only 80 square centimeters. No alternative nesting ledge exists on the cliff. Therefore, an artificial platform project to encourage renesting by Peregrines was contracted to Wilderness Research Institute by the U.S. Forest Service.

Methods and Materials

Ledge Design. All materials, supplies, and personnel were airlifted by helicopter to within 300 meters of the cliff. Three climbers (Lehman, Hipp, and Boyce) rappelled down the cliff face, using standard rock climbing equipment, to reach the site. A large piece of stiff cardboard from a packing crate served as a template. The cardboard was cut using a grocer's razor to fit the rock chimney exactly. The template location was marked so that the artificial ledge could be placed in the proper position.

Ledge Construction. A U.S. Forest Service welder used the template to guide his assembly of the ledge. Arc and acetylene welding joined all metal pieces. All materials were selected to reduce ledge weight while providing necessary strength.

Galvanized slotted angle iron (1½-inch by 3-inch angle) formed the supporting perimeter of the ledge (fig. 1). Slotted angle iron with its multitude of holes was used for easy bolt placement (thus eliminating the need to drill through metal). Two-inch expanded metal (diamond pattern) was then welded on top of the slotted angle-iron perimeter (fig. 1) to give support to nesting substrate to be added later. One-inch expanded metal (diamond pattern) was laid on top of the two-inch expanded metal. The two expanded metal patterns were placed at right angles to each other. In this way large gaps resulting from spaces in the diamond pattern were reduced. A brass mesh screen (nonrusting) was inserted between the two expanded metal sheets to prevent finer nesting substrate particles from falling through the expanded metal sheets. A black pipe (1½-inch inside diameter) was positioned along the ledge's front edge for use as a perch.

Ledge Placement. The ledge was designed to be bolted to the cliff, and a gasoline driven generator was used to power heavy duty impact drills. Three types of drill bits—standard rock climbing hand drill bits, masonry drill bits, and masonry drill bits with carbide tips—were used.

Climbers drilled the holes while suspended from climbing ropes. Drilling while suspended on ropes posed the problem of pressing drills into the cliff while hanging free. This problem was solved by having an additional climber exert pressure on the drill operator's back.

Once holes were drilled, the ledge was positioned. Masonry expansion bolts were inserted through the slotted angle iron and into the holes. Each bolt was capable of supporting several thousand pounds. A piton was inserted in one corner.

Three types of substrate (115 kg) were applied to the ledge in layers. First, one-inch river gravel was poured over the metal ledge surface to cover small holes in the expanded metal. Next, half-inch river gravel was placed on top to close any remaining spaces. Finally, river sand and comparable cliff substrate material were laid down. The fine sand material was placed 5–8 centimeters thick to allow a falcon to build a scrape for eggs. The final available nesting area was increased to 1 square meter. Figure 2 shows the ledge in place on the cliff.

Results and Discussion

Four days were required to design, construct, and install the ledge. A limiting factor was finding and using the proper drill bit. Hand drill bits, used in power drills, virtually melted in 30 second's use. Masonry bits required an hour to drill one-half inch. Carbide-tipped bits proved to be most effective; all drilling was accomplished in just 4 hours.

On 7 April 1979 C. M. White and Boyce flew by the site in a helicopter and found two adult Prairie Falcons and four eggs on the ledge. Boyce climbed into the eyrie on 14 May 1979 and found two young falcons, approximately one week old, and two addled eggs (fig. 3). In June two fully feathered young were seen on the artificial ledge.

The drier habitat surrounding the cliff is conducive to nesting by Prairie Falcons. In fact, Boyce and White (1979) found Prairie Falcons commonly nesting all along the western edge of the northern Sacramento Valley. Just a few kilometers west, in more humid forested areas, Prairie Falcons are replaced by Peregrines. The authors expect nest site competition to occur between Prairie Falcons and Peregrine Falcons in these drier habitats. Ogden (1972) and Granger Hunt (pers. comm.) have observed Peregrines outcompeting Prairie Falcons when such interactions occur. By numbers alone it might be expected that Prairie Falcons would use the ledge first.

Artificial ledge construction and placement at suitable nesting sites might increase the number of nesting Peregrines in California. Four northwestern California National Forests recently conducted a Peregrine Falcon nesting habitat survey to determine where suitable nesting habitat occurred and to select, among identified habitats, those that might be enhanced to encourage nesting by Peregrines. Six Rivers National Forest has taken Mendocino National Forests' lead and begun a small-scale ledge enhancement project on lands they administer.

Acknowledgments

Without the assistance of Lynn Murray and helitak crew nine this study would have taken weeks instead of days. The U.S. National Forest Service provided funding and transportation, and Wilderness Research Institute provided the technical expertise to accomplish the project. We are also grateful to Dr. Richard Olendorff for editorial comments.

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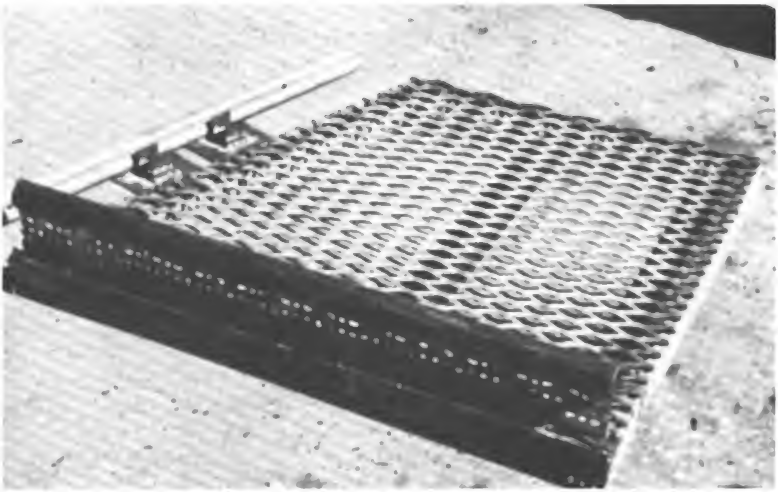

Figure 1. Partially completed artificial ledge showing slotted angle iron, expanded metal (diamond pattern), and 1½-inch inside diameter black pipe perch.

Figure 2. The ledge as installed on the cliff. Note the black pipe perch at the front of the ledge.

Figure 3. Two downy young Prairie Falcons and two addled eggs on the ledge in May 1979. These young fledged from the ledge in June.

THE EGG OF THE ORNATE HAWK-EAGLE (*SPIZAETUS ORNATUS*)

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Two eggs laid recently by an Ornate Hawk-Eagle (*Spizaetus ornatus*) in the Los Angeles Zoo appear to be the first that have come to the attention of ornithologists. The eggs are now in the collection of the Western Foundation of Vertebrate Zoology (WFVZ).

The female hawk-eagle was obtained by the zoo in 1966 and was probably captured in Guyana. Although she has laid at least annually since 1976, all previous eggs were destroyed before they could be retrieved by zoo personnel.

An egg (WFVZ 107,978) laid 19 February 1979 was unspotted and bright bluish-white in color when fresh but rapidly faded to a much paler bluish-white after it was blown. The whole egg weighed 60.294 g before preparation and measured 57.71 x 44.18 mm; the empty dry shell weight is 5.216 g. The egg is short oval in shape (Preston *in* Palmer, *Handbook of North American Birds*, vol. 1, Yale Univ. Press, New Haven, 1962), not glossy, and has a somewhat pitted surface.

A second egg (WFVZ 108,034) was laid by the female on 21 March 1979, or 30 days after the first egg. The specimen is identical to the first in color, shape, and texture. When whole, it weighed 58.520 g, and it measures 58.17 x 43.37 mm. The empty dry shell weight is 5.056 g.

Although nests of this species have been reported from Chiapas, Mexico, and Panama (Brown and Amadon, *Hawks, Eagles, and Falcons of the World*, vol. 2, New York, McGraw-Hill, 1968) and from British Honduras (Russell, *A Distributional Study of the Birds of British Honduras*, A.O.U. Ornithol. Monogr. no. 1, 1964), the clutch size could not be determined with certainty at any of the sites. A *Spizaetus ornatus* nest found in Oaxaca, Mexico, in 1968 contained only a single well-grown nestling when found (R. Galley, pers. comm.). The laying schedule of the Los Angeles Zoo female also suggests a clutch size of one, as appears to be typical for other species in the genus (Brown and Amandon op. cit.; Kiff, *Raptor Research* 13(1):15).

We thank Roger Cobb, Dana Gardner, and Ed Harrison for their assistance in the preparation of this note.

A TECHNIQUE FOR ESTIMATING BARN OWL PREY BIOMASS

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Abstract

A technique is described by which prey mandibles are used to estimate consumed prey biomass of Barn Owls. Such a technique can be used to estimate owl food consumption rates in the field.

Introduction

In this study a technique is described using the recovered mandibles of prey to estimate the biomass of prey individuals consumed by Barn Owls (*Tyto alba*). In previous Barn Owl studies, investigators used one of two methods for determining the consumed prey biomass. First, some investigators trapped small mammals in the owl's hunting area and determined mean weights (i.e., biomass) for these species. The biomass was then estimated by applying these weights to the species occurring in pellet samples (Evans and Emlen 1947, Fitch 1947, Otteni et al. 1972). Secondly, some authors converted prey weight into "prey units" (Southern 1954), using a 20 g mammal as the standard (Glue 1967, Webster 1973). When comparing different prey species of varying sizes, Southern (1954) believed an equalization of biomass ("prey units") is needed rather than comparing only total numbers of prey species. Both methods result in the determination of size differences among prey species but fail to consider the variation in size among individuals within a given prey species.

Materials and Methods

The Barn Owls investigated resided in an abandoned water tower 16 km NE of Fort Worth, Tarrant County, Texas.

Trapping results from a 1.3-hectare area adjacent to the nest site revealed four species of potential mammalian prey. Log-log regressions of right mandible length (mm) as a function of body wet weight (g) were determined from museum specimens of the known prey species and used to estimate the biomass of individuals in the pellets (table 1). Mandible length was measured from the anteriormost border of the concavity between the mandibular and angular processes and the dorsal border of the incisor socket (measured to the nearest 0.1 mm with a vernier caliper) (fig. 1). I chose this measurement because during the anlaysis of pellets (NaOH boiling method, see Schueler 1972), portions of mandibles are destroyed, but the portion shown in fig. 1 remained intact. Mandible measurements recovered from owl pellets were then applied to the regression equations to estimate the biomass of each individual represented in the pellets. Specimens used in the log-log regressions were obtained from local museums and were collected from 1973 to 1977 in north central Texas. Because of added body weight induced by reproductive conditions, gravid and lactating female specimens were excluded when determining regression equations.

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Table 1. Log-log regressions[1] from museum specimens.

Species	N	Range of Mandible Lengths (mm)	Log a	b	r	Level of Significance
Sigmodon hispidus Hispid cottonrat	73	12.4–18.4	-4.234	5.239	0.8957	P<0.001
Reithrodontomys fulvescens Fulvous harvest mouse	15	7.5–9.7	-1.769	2.958	0.7798	P<0.001
Baiomys taylori Pygmy mouse	17	7.2–8.6	-1.397	2.579	0.6173	P< 0.01
Peromyscus sp. White-footed mouse	13	8.3–11.5	-2.972	4.146	0.9519	P<0.001

[1]Log Y = Log a + b(Log X)

Results

Table 1 lists mammalian species potentially encountered by foraging Barn Owls, and the log-log regression equations of mandible length as a function of body wet weight for each species (all regressions were significant). Trapped specimens from the study area were not used to determine regressions because use of such individuals would present an added feeding pressure against the owls.

To demonstrate the biomass estimation technique, 73 museum specimens of *Sigmodon hispidus* (the dominant prey species recovered from pellets) were used to compute the following regression equation:

$$\text{Log } Y = -4.234 + 5.239(\text{Log } X)$$
$$(r = 0.8957, P<0.001)$$

where Log Y is the estimated prey biomass and Log X is the mandible length (see table 1). From pellet data, the mandible length variation of S. *hispidus* ranged from 10.0 mm to 17.8 mm, and was calculated to be from 10.1 g (apparent young) to 207.5 g (apparent adult) of prey biomass, respectively. Maximum and minimum mandible lengths and estimated biomass data for all prey species consumed by the owls are summarized in table 2.

Table 2. Variation in size of prey individuals recovered from Barn Owl pellets.

Prey Species	Mandible Length Max.	Min. (mm)	Estimated Biomass Max.	Min. (g)
Sigmodon hispidus	17.8	10.0	207.5	10.1
Reithrodontomys fulvescens	9.8	6.0	14.6	3.4
Baiomys taylori	9.7	6.5	14.1	5.0
Peromyscus sp.	10.3	8.5	16.8	7.6

Discussion

The Barn Owl is one of the species best suited for pellet analysis (Errington 1932, Glading et al. 1943, Raczyński and Ruprecht 1974). They swallow their prey whole without decapitation, insuring an accurate feeding record (Glading et al. 1943, Glue 1970, Marti 1974), and their prey can be identified by examination of skulls and mandibles. In a comparative study of Tawny Owl (*Strix aluco*), Long-eared Owl (*Asio otus*) and Barn Owl pellets, Raczyński and Ruprecht (1974) stated both avian and mammalian mandibles had the best recovery rate of the osseous remains in all three types of pellets. In fact, Barn Owl pellets had the lowest number of missing skeletal elements, and the lowest losses of prey individuals. Because of the relatively constant occurrence of mandibles in pellets, mandibles seem feasible as estimators of prey weight.

Otteni et al. (1972) used a mean weight value method of prey biomass estimation in their Barn Owl study. They reported that *Sigmodon hispidus* was the dominant prey of Barn Owls on the basis of biomass (20.8%) and used a mean weight of 170.0 g for each individual recovered from the pellets. In the present study, the technique described here indicated that Barn Owls consumed *S. hispidus* that ranged in estimated weight from 10.1 g to 207.5 g with a mean of 80.4 g/individual (S.D. ± 41.6, n = 478) (table 2). Since the breeding seasons of the small mammals in Texas are nearly continuous throughout the year (Davis 1974), it is possible for owls to capture young, juvenile, and/or adult prey in almost any month of the year. Application of mean weights of prey to the number of recovered individuals per species as a means of estimating biomass may not be as reliable as needed for prolonged studies of food habits.

Many British investigators use the "prey unit" method (Southern 1954) to compare the importance of prey species in owl diets (Glue 1967, Webster 1973). Glue (1967) stressed that this method served as an indicator of the relative importance of each prey species in the owl's diet rather than reflecting its absolute nutritional importance.

The significance of the biomass estimation technique discussed here is that it will allow the investigator to accurately measure owl food consumption rates in the field. This precise method is applicable to any field bioenergetic or food optimization study.

Acknowledgments

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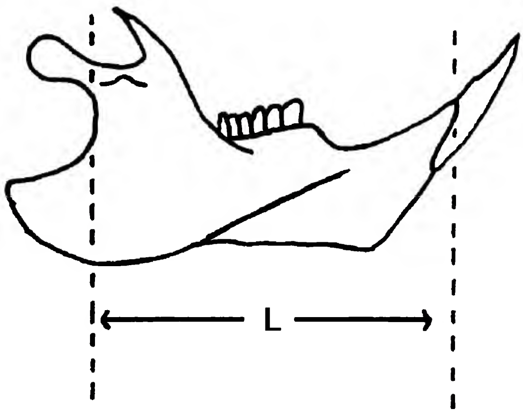

Figure 1. Mandible length (L) measurement used for estimates of individual prey biomass from museum specimens and recovered pellet materials.

OSPREY FALL MIGRATION AT THE NINIGRET BARRIER BEACH CONSERVATION AREA, RHODE ISLAND

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Introduction

The Osprey (*Pandion haliaetus carolinensis*) has been included on the Audubon Society Blue List (Arbib 1971) because there has been a drastic decline in its populations in northeastern North America since the 1970s (Emerson and Davenport 1963, Ames and Mersereau 1964, Schmid 1966, Dunstan 1970, and others). It is thus important to document for comparative purposes areas that are frequented by Ospreys. Secondly, these data, including observations on behavior, can be used as an indicator of environmental changes that may occur, or may serve to aid in the management of the area for the species.

This paper reports on Osprey migrations at the Ninigret Barrier Beach Conservation Area, Charlestown, Rhode Island. We suggest herein a means to increase Osprey use of the area.

Methods

During the fall of 1975, 1976, and 1977, a total of 455 hours of observations were made of migrating Ospreys. The area of observation is the longest (2 km long) of 27 Rhode Island barrier beaches. The beach is bordered by Charlestown Pond and Block Island Sound. Charlestown Pond (1,711 acres) is the largest salt pond in the state (Stolgitis et al. 1976).

Ospreys that passed an observation point in a southerly or southwesterly direction were counted; individuals that were seen flying in the opposite direction were subtracted. Observations were recorded in one-hour segments, and behavioral notes were made when birds appeared to be actively hunting over the pond or the sound.

Results

One hundred and thirty-three Ospreys were recorded, an average of 3.1 birds per day. The number of birds was recorded each day (table 1) by hourly intervals (table 2). Wind direction was also noted although these data are not presented here.

Seventy-five percent of the birds were hunting as they passed along the barrier beach. A minimum of 18 birds (13.5%) hunted over Charlestown Pond to such an extent that they repeatedly flew back and forth past the observation point. A maximum of five birds was noted hunting over the pond simultaneously. One individual with distinctive white primaries remained in the area for five days.

Discussion

The Ninigret Barrier Beach Conservation Area is frequented by a considerable number of Ospreys during fall migration. A substantial percentage of these Ospreys hunt

Table 1. Number of Ospreys Observed at the Ninigret Barrier Beach Conservation Area during Fall Migration

	September												October											
	19	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12
1975	-*	—	—	—	—	—	—	—	4	5	2	2	2	1	0	7	5	3	6	4	1	1	1	1
1976	6	5	2	8	3	5	4	1	1	5	1	6	0	0	3	1	1	0	0	0	—	—	—	—
1977	—	—	—	—	—	—	—	—	—	—	—	—	—	0	14	10	4	1	3	2	—	—	—	—

*No observer present.

along the beach. The data, however, do not indicate the potential importance of the area. The utilization of the area by migrating Ospreys in itself is indicative of the importance of the existing habitat to the species. However, since this area now lacks suitable perches (poles, snags, etc.), the full potential for Osprey utilization is probably not realized. The low number of Ospreys observed during the first and last hour of daylight may indicate that few roosting sites are available in the immediate vicinity. The erection of perching sites along the edge of the pond might substantially increase utilization by Ospreys. Providing perching and roosting snags, as well as nesting platforms, has been recommended as a vital part of Osprey management (Zarn 1974). In addition, since Osprey populations have shown a recent upward trend in Rhode Island (Myers pers. comm.), proper management might increase the possibility of Ospreys' nesting in the area in the future.

Table 2. Mean Number of Ospreys Observed During One-Hour Intervals*

Time interval (EDT)	No. of samples	Mean no. of birds
0600–0659	34	.12
0700–0759	40	.42
0800–0759	41	.20
0900–0959	42	.62
1000–1059	42	.31
1100–1159	42	.43
1200–1259	42	.30
1300–1359	43	.26
1400–1459	42	.21
1500–1559	39	.26
1600–1659	35	.31
1700–1759	28	.04

*Data from three years pooled.

Acknowledgments

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FOOD CACHING BEHAVIOR OF NESTING WILD HAWK-OWLS

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The literature contains a number of references pertaining to the caching or "deliberate hiding or placement of food" (Oliphant and Thompson 1976) by raptors. Many owl species are known to cache. Collins (1976) and Collopy (1977) provide recent reviews. However, these accounts have most often been outside of the breeding season. During 1975 and 1976 I recorded 11 caching incidents by nesting Hawk-Owl (*Surnia ulula*) near Fairbanks, Alaska. Previously, Smith (1922) once noted caching in the wild, and Collins (1976) saw captive Hawk-Owls cache.

My observations are summarized in table 1. Caching was usually preceded by a ritual similar to that described by Balgooyen (1976) for the Kestrel (*Falco sparverius*): male

Table 1. Caching by nesting Hawk-Owls, Fairbanks, Alaska

Date and Time	Caching Observations
14 June 1975, 0930 hrs	♀ (?) left nest and retrieved vole from spruce tree, 40 m from nest.
14 June 1975, 1000–1430 hrs	An adult flew from the nest and retrieved voles on three occasions.
15 June 1975, 0740 hrs	An adult attempted to feed nestlings a vole; young did not respond, and it flew to spruce mentioned above and cached prey.
22 May 1976, 0745 hrs	♂ brought vole to perch, eviscerated it, made "screeee-yip" call, then cached vole in birch.
22 May 1976, 0835 hrs	♂ uttered "screeee-yip" call, ♀ responded, prey transferred at nest; ♀ cached uneaten portions.
22 May 1976, 1040 hrs	♂ uttered "screeee-yip" call, no response from ♀; ♂ fed, called again; ♀ flew to ♂, fed on vole and cached remainder.
22 May 1976, 1100–1530 hrs	♂ brought two voles to plucking perch, fed ♀ first, cached the second.
22 May 1976, 1800 hrs	♂ inactive, perched near nest; ♀ uttered "screeee-yip" call, but ♂ did not respond; ♀ then flew to spruce nearby and retrieved vole.
22 May 1976, 1850–1900 hrs	♂ flew from perch to birch 10 m from nest, retrieved vole; flew to perch, fed, called, ♀ responded; ♂ flew to nest and transferred prey.

brings prey to perch, feeds on and/or eviscerates prey, calls female, and depending on response transfers or caches prey item. The female hides or retrieves food without calling. Male Hawk-Owls made a "screeee-yip" sound similar to that described for adults and young by Smith (1970), before bringing prey to the nest.

In 1976, after the male was killed by an auto (Jim Curatolo pers. comm.), we tried to feed the nonhunting, brooding female by transferring food to the nest cavity and caching it in trees previously used for this purpose. Although these efforts failed in assisting the young to fledge, the female was observed caching uneaten portions of red squirrels (*Tamiasciurus hudsonicus*) we had given her.

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Caching has been described as an effort to exploit the seasonal and/or daily abundance of prey. Southward movements of Hawk-Owls in winter (Eckert 1974) suggest a cyclic availability of their prey, but do not necessarily explain breeding season caching. What purposes might caching during the nesting season serve?

First, caching might provide a key to more efficient expression of duties by the pair. My observations were similar to Mikkola's (1972) indicating that male Hawk-Owls hunted while females incubated and brooded. The caching rituals helped to maintain this segregation of duties. Applegate (1977) has proposed a similar hypothesis for the Loggerhead Shrike (*Lanius ludovicianus*).

Secondly, caching may also reduce potential conflicts at the nest. Although behavioral interpretations for size dimorphism in birds of prey have not been satisfactorily defined (Amadon 1975), caching could reduce possibilities for aggressive interactions by limiting the number of food exchanges and contacts between members of a pair. Caching locations, usually in view of the brooding female, represent neutral intermediates. Furthermore, fewer visits to the nest might reduce its conspicuousness and the likelihood for predator attraction. Finally, storage of food elsewhere might facilitate sanitation in the crowded nest environment and maximize use of the prey resource.

I would like to thank Skip and Michelle Ambrose and Bobbie Ritchie for their assistance in monitoring these nests.

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SUCCESSFUL RELEASES OF CAPTIVE BARN OWLS

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Currently there is much interest in rehabilitation of raptors including release of young birds raised in captivity. However, little information is available on survival of these birds following release. Thus, 2 observations we made during a continuing study of Barn Owl (*Tyto alba*) ecology in northern Utah may be of interest.

In 1978, two broods and one other young Barn Owl were turned over to us. Rather than raise the birds in captivity and release them, we decided to place them with broods of wild Barn Owls in nest boxes that we had previously erected (Marti et al., *Wildl. Soc. Bull.*, 7:145–148, 1979). One or two young were added to broods of similar ages after we banded them with U.S. Fish and Wildlife Service bands and unique combinations of colored plastic bands. All six young treated this way fledged. The remaining four young owls were put in a nest box in place of four infertile eggs. Two of these birds fell out of the box during a cold rain and died, but the other two fledged. In 1979, one of these fostered birds, a male, was found nesting successfully in another of our nest boxes 60 km north of the box from which he fledged.

The second instance involved a very tame female Barn Owl less than 1 year old which had been raised in captivity and appeared to be imprinted on humans. This owl was acquired by the Utah Division of Wildlife Resources and kept at Weber State College for several months. Age and sex were determined from wing molt and plumage. She was later transferred to Tracy Aviary in Salt Lake City, Utah, from where she escaped in the fall of 1978. Little hope was given for survival because of her tameness and the fact that she had killed only a few white mice in captivity and had had no experience hunting in the wild. However, on 30 March 1979, she was discovered with a mate in a warehouse in Salt Lake City. Identification was made by jesses placed on her at the aviary and by a peculiar toe injury incurred while in captivity. It is remarkable that an owl imprinted on humans, with no hunting experience, could survive and successfully form a pair bond in the wild. This bird provides yet another example of the adaptability of Barn Owls.

These examples, although a small sample, indicate that young Barn Owls may either be raised in captivity and released at maturity or fostered to wild Barn Owls. The fostering technique certainly requires less human effort, and we would favor it intuitively because the young owls probably learn hunting techniques from the adults.

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The study of Barn Owl ecology of which these observations were a part is funded by the Utah Division of Wildlife Resources and research and professional growth grants from Weber State College to the senior author. We thank Stellanie Ure for her cooperation and information concerning the imprinted female Barn Owl.

CARRION UTILIZATION BY TWO SPECIES OF AUSTRALIAN GOSHAWKS

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Introduction

The Brown Goshawk (*Accipiter fasciatus*) and Grey Goshawk (*Accipiter novaehollandiae*) are reported to prey on live vertebrates and insects (Cayley 1968, Brown and Amadon 1968, Wattel 1973, Morris 1976, Frith 1976). The most favored prey items of these hawks are birds and small mammals (Brown and Amadon 1968, Wattel 1973, Frith 1976). Observations made by the author, however, indicate that these birds also include carrion in their diets.

Observations

Three observations of carrion-feeding (one by *A. fasciatus* and two by *A. novaehollandiae*) were made during routine field work in southeastern Queensland, Australia. They are presented below in chronological order.

The first observation was made in open, pastoral land at Maleny (26° 46′, 152° 51′) on 27 November 1969. A single, immature female *A. fasciatus* was flushed from cover within a hedge. This bird attempted to carry a heavy food item for a short distance before abandoning it. I found the food to be a piece of cowhide, the adherent flesh of which was in an advanced state of decomposition.

The second observation was made along a roadway through subtropical rainforest near Kenilworth (26° 36′, 152° 44′) on 17 November 1974. A lone female *A. novaehollandiae* was observed feeding on the carcass of a small wallaby (*Thylogale thetis*) which had been killed by motor traffic. The carcass was bloated, but little smell of decomposition was apparent.

The final observation was made in similar habitat to the preceding, near Imbil (26° 28′, 152° 41′) on 23 September 1977. A male *A. novaehollandiae* was flushed from a road-killed *T. thetis* carcass, where it had been feeding. This carcass was bloated with a pronounced smell of decomposition.

Discussion

Apparently only the Goshawk (*Accipiter gentilis*), has been previously recorded taking carrion (Sutton 1927, Brown and Amadon 1968). Unfortunately, these records do not assist in the interpretation of the above observations. There was no evidence to suggest either prey scarcity or inability of these three individuals to secure active prey. The *A. fasciatus*, in particular, was observed at other times to make successful captures of Honey eaters (Meliphagidae), the Clamorous Reed-Warbler (*Acrocephalus stentoreus*), and small rodents (Muridae). The absence of regular encounters of the same individuals taking carrion or either species taking carrion elsewhere, in addition to the absence of published records of such behavior, suggests that the above cases were rare, opportunistic events.

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BOOK REVIEWS

The Country Life Book of Birds of Prey. Gareth Parry and Rory Putman. Country Life Books, London, 1979. 120 pages, 35 color plates. £20.

Recently there has been a deluge of books about birds of prey on the market, some aimed at the specialist, the majority at a much wider field. This latest volume is of the latter variety—a coffee-table spectacular containing 35 color plates of raptors—including owls—which have been recorded in the British Isles. It is of only marginal interest to the serious ornithologist.

The text by Rory Putman is both accurate and readable but breaks no fresh ground. The book is designed to show off the paintings of Gareth Parry. Here the reviewer wishes he could be more complimentary. Although Parry displays very considerable technical skill, many of his pictures appear highly contrived and static. The immense detail overwhelms the eye, and the living bird is lost.

The book is beautifully bound and printed but marred by a series of irritating errors. The distribution maps are out of date, e.g., Peregrine and Montagu's Harrier. The photographs have been poorly selected and greatly blown-up—the one of the Sea Eagle is so badly touched up it appears grotesque! The plate purporting to show a typical Merlin habitat is totally misleading, and to add insult to injury the drawing of a Goshawk's bill shows a falcon's tooth.

It may well appeal to the drinkers of erstaz coffee, but those who can tell a hawk from a handsaw will doubtless invest their dollars somewhere else.—R. B. Treleaven

Population Ecology of Raptors. Ian Newton. T & A.D. Poyser, England, and Buteo Books, Vermillion, South Dakota, 1979. 399 pages, 32 plates. $35.00.

Here is a gem that stands out from the dross of modern ornithological literature, a book entirely devoted to the study of a single subject: What regulates raptor populations? Ian Newton is well known as a lecturer and author with a sharp, incisive mind. In this new volume he has collated a vast wealth of material from more than eight hundred separate papers, all of which have some bearing on an aspect of population control. The data are carefully sifted, evaluated, and presented to the reader as a coherent whole.

Although the book breaks little fresh ground, all serious students of ornithology, and raptors in particular, will want to purchase it; for nowhere else will you find such a rich harvest of knowledge in such readable form. Each chapter has its own brief summary—a real boon for those seeking quick references.

The regulators of all bird populations are the availability of food supplies and nest-sites in a given area, but in the case of birds of prey, many additional factors may affect the outcome: pesticide residues, loss of habitat, and the conflicting interests of man, including game preservation. Light is shone on some old problems: Do 60% of all eyasses really succumb in their first year? How long does it take a Peregrine to find a replacement mate in the breeding season? Is there a correlation between size dimorphism and diet?

At the rear of the book there are sixty-eight pages of invaluable statistics and a complete bibliography. The text contains fifty figures, some of which appear, at first glance, highly complex but on closer inspection prove to be models of succinctness. The photographs are without exception of very high quality, and the eagle-eyed reader will have no difficulty in spotting that many of the birds depicted are in various stages of moult: Sparrowhawk (plate 13), tail feathers; Merlin (plate 25), Jack Merlin (plate 26), and Kestrel (plate 27), primaries—a point not made by the author probably because it is not considered relevant.

Jim Gammie provides some splendid vignettes which are both accurate and pleasing to the eye. The production is excellent and well up to the high standard one has come to expect of Poysers. I feel certain it will soon become one of the most thumbed books on my shelf. It is worth every penny of the price.

R. B. Treleaven

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