THE ROCKY MOUNTAIN POPULATION OF THE WESTERN CANADA GOOSE: ITS DISTRIBUTION, HABITATS, AND MANAGEMENT

UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Special Scientific Report—Wildlife No. 229

Library of Congress Cataloging in Publication Data

Krohn, William B
The Rocky Mountain population of the western Canada goose.

(Special scientific report—wildlife; 229)
1. Canada goose. 2. Birds—Rocky Mountains. I. Bizeau, Elwood G., joint author. II. Title. III. Series.
SK361.A256 no. 229 [QL696.A52] 639.9'79'0973s [591.4'1] 80-607889

THE ROCKY MOUNTAIN POPULATION OF THE WESTERN CANADA GOOSE: ITS DISTRIBUTION, HABITATS, AND MANAGEMENT

By William B. Krohn
Elwood G. Bizeau

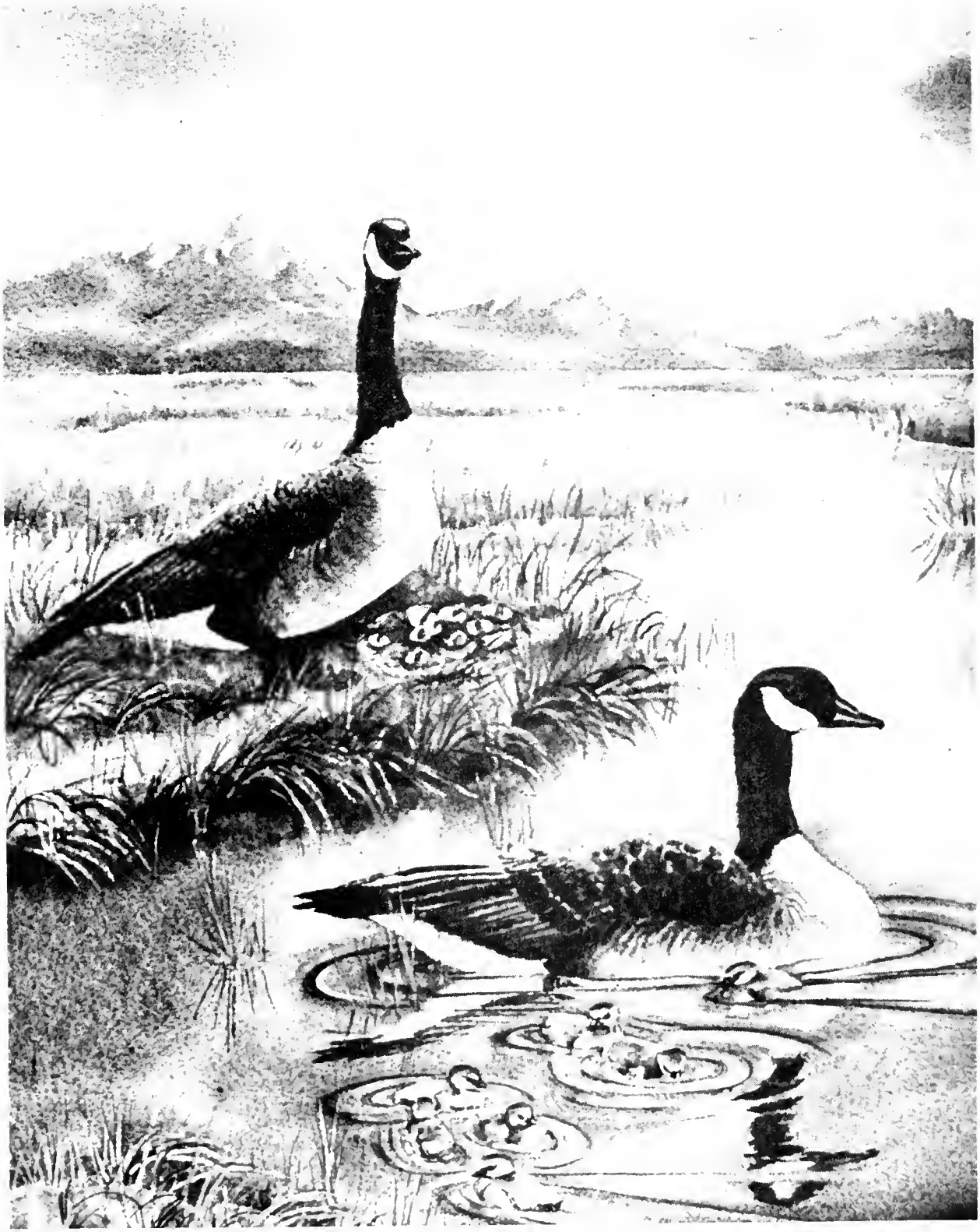
UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Special Scientific Report—Wildlife No. 229
Washington, D.C. • 1980

Contents

Page

Abstract 1
Introduction 2
  Management Needs 2
  Study Objectives 3
Definitions and Methods 3
  Banding Records 3
    Banding definitions 3
    Data source and analysis 4
  Habitat Inventory 5
    Habitat definitions 5
    Data source and analysis 5
Description of Reference Areas 6
  Southern Alberta 7
  Central Montana 7
  Southeastern Idaho 8
  Western Wyoming 8
  Central Wyoming 9
  Northwestern Colorado 9
  Northern Utah 9
  Southern Utah 9
  Northeastern Nevada 10
  Northwestern Nevada 10
  Southern Nevada 10
  Central California 10
  Southern California 10
  Western Arizona 10
  Eastern Arizona 10
Population Characteristics 11
  Major Limitations 11
    Representativeness of bandings 11
    Band reporting rates 11
  Band Recovery Distributions 11
    Southern Alberta 12
    Central Montana 12
    Southeastern Idaho 13
    Western Wyoming 14
    Central Wyoming 14
    Northwestern Colorado 16
    Northern Utah 16
    Southern Utah 17
    Northeastern Nevada 17
    Northwestern Nevada 18
    Southern Nevada 19
    Central California 19
    Southern California 19
    Western Arizona 19
    Eastern Arizona 19
  General Band Recovery Patterns 20
    Dispersion of nesting flocks on wintering areas 20
    Postmolt movement of yearlings 20
    Lack of fidelity to specific molting areas 20

Recovery axes 20
East-west gradient in breeding-wintering area relations 20
Molt Migration 20
Breeding Biology and Productivity 22
Nesting chronology 22
Spring population composition 24
Breeding age and nonbreeders 26
Clutch size 27
Nesting success 27
Influence of nesting structures 29
Gosling survival 32
Harvest Characteristics 34
Distribution and size 34
Recovery and survival rates 36
Habitat Characteristics 37
Reference Area Patterns 38
Southern Alberta 38
Central Montana 39
Southeastern Idaho 39
Western Wyoming 40
Central Wyoming 40
Northwestern Colorado 41
Northern Utah 41
Southern Utah 42
Northeastern Nevada 42
Northwestern Nevada 42
Southern Nevada 42
Central California 42
Southern California 42
Western Arizona 43
Eastern Arizona 43
General Habitat Patterns 43
Breeding areas 43
Molting areas 44
Wintering areas 44
Discussion 45
Population Delineation 45
Taxonomy and Evolution 47
Population Size and Regulation 48
Management Recommendations 50
Population nomenclature and subcommittees 50
Breeding-ground surveys 50
Wintering-ground surveys 51
Banding programs 51
Management objectives 52
Summary 53
Acknowledgments 54
References 55
Appendix A. Definitions of the Reference Areas Used in this Report 58
Appendix B. Geographic Distributions of Band Recoveries by Reference Areas and Banding Types 59
Appendix C. Chronologic-Geographic Distributions of Band Recoveries by Reference Areas and Banding Types 77



Frontispiece. "Rocky Mountain Canada goose family." From an original watercolor by Vivian Drewien.

The Rocky Mountain Population of the Western Canada Goose: Its Distribution, Habitats, and Management[1]

by

William B. Krohn[2] and Elwood G. Bizeau

U.S. Fish and Wildlife Service
Idaho Cooperative Wildlife Research Unit
University of Idaho
Moscow, Idaho 83843

Abstract

The western Canada goose (*Branta canadensis moffitti*) was divided into a Rocky Mountain population (RMP) and a Pacific population (PP) on the basis of band recovery patterns examined in this study and recovery data from other investigators. Habitat information obtained from nine cooperating wildlife agencies within the RMP's range provided a base line for evaluating future changes in nesting, molting, and wintering areas. The habitat inventory indicated that none of the seasonal habitats were currently limiting the size of the RMP. The RMP's range is divided into 15 reference areas and these are briefly described. Past studies of Canada geese in the Intermountain Region are reviewed. Topics covered in the discussion of breeding biology are nesting chronology, spring population composition, breeding age, clutch size, nesting success, artificial nesting structures, and gosling survival. Much of the mortality of Canada geese occurs before the birds are fledged. Man-made nesting structures reduce losses during incubation, but research is needed on the relations between brooding sites and gosling survival. Some western Canada geese, mainly prebreeders and unsuccessful nesters, make molt migrations to and from molting areas during and after the brood-rearing season. More than half of these molt-migrants are yearlings too young to nest; there are indications that even some successful nesters leave nesting areas to molt before the fledging of their offspring. Geese 2 years old or older may serve as guides to traditional molting areas for the first-time migrants (i.e., yearlings). Lack of disturbance appears to influence selection of specific molting areas within the nesting range of *moffitti*, whereas movements of molters out of the Intermountain Region may be related to the evolution of this subspecies. Apparently, molters of both the PP and RMP that leave the Region go to the Northwest Territories of Canada. Although the taxonomic status of *moffitti* as related to the giant Canada goose (*B. c. maxima*) is unclear, these two subspecies are closely related, as evidenced by similar molt migrations to subarctic Canada, similar blood serum proteins, and only clinal differences in body size and color. Mean annual survival rates for birds banded on nesting areas averaged 53 ± 2% ($\bar{\bar{X}}$ ± SE) for immatures and 64 ± 1% for adults. Mean annual survival rates of adults captured on molting areas averaged 70 ± 1%. Sport hunting accounts for more than 86% of the mortality of fledged Rocky Mountain geese, and hunting may limit the population's growth. Because the number of waterfowl hunters in the Rocky Mountain West is increasing, the continued expansion or future maintenance of the RMP may require more restrictive hunting regulations. Other management recommendations include the refinement and standardization of spring and winter aerial surveys, and more accurate age and sex determinations when geese are banded and color-marked.

[1]A contribution of the Idaho Cooperative Wildlife Research Unit which is jointly supported by the U.S. Fish and Wildlife Service, Idaho Department of Fish and Game, Wildlife Management Institute, and the University of Idaho (College of Forestry, Wildlife and Range Sciences). Contribution 155 of the University of Idaho's Forest, Wildlife and Range Experiment Station. Financial support for the first year of study was provided by the Idaho Department of Fish and Game through the Idaho Cooperative Wildlife Research Unit. The remaining 2½ years of work were funded by U.S. Fish and Wildlife Service, Contract Number 14-16-0008-2084.

[2]Present address: Office of Biological Services, Fish and Wildlife Service, U.S. Department of the Interior, Washington, D.C. 20240.

Introduction

This publication presents local and regional information useful in understanding Canada geese (*Branta canadensis*) in the Intermountain Region. Agencies responsible for the management of wild geese in the Rocky Mountain West have collected a wide range of information for more than 25 years; these data have not previously been assembled and analyzed.

Prehistorical information on Canada geese and their habitats in western North America is meager. Bedwell (1973:60) reported finding waterfowl remains, including those of geese, in caves used by early humans in a now dry basin with ancient lakeshore terraces, in south-central Oregon. The locations of 68 Pleistocene lakes in what now is the semiarid Great Basin were plotted by Meinzer (1922:550-552); these bodies of water ranged in size from a few square miles to the thousands of square miles of Lake Bonneville in northern Utah and Lake Lahontan in western Nevada. Although the sizes and numbers of lakes varied through time as climate fluctuated, there is no doubt that extensive waterfowl habitat once existed throughout the Great Basin.

Canada geese inhabited the Pleistocene marshes of the West. Loud and Harrington (1929:35) unearthed bones of three goose species from pre-European deposits in Lovelock Cave, Nevada, near Humboldt Sink (a remnant of Lake Lahontan). More remarkable, however, was their discovery of stuffed goose heads which were presumably used as decoys; nine stuffed goose heads were found, of which eight were from Canada geese (Loud and Harrington 1929:49). Working in the same area, Brooks (1956:107, 112) found the remains of nine geese of four species (including two Canada geese) in Humboldt Cave and concluded that these remains were left by early humans.

Geese of the genus *Branta* have existed in what now is the western United States since at least the lower Pliocene (Miller and Ashley 1934). The great Pleistocene lakes and marshes may have been the habitat centers in which the western subspecies of the Canada goose (*B. c. moffitti*) evolved. Unfortunately, present archaeological data are too scanty to support or refute this speculation. Because bird bones are fragile and thus poorly represented in the fossil record and Indian middens, our understanding of the evolution of Canada geese will probably always remain incomplete.

The first white explorers of the West found Canada geese widely distributed and extremely abundant in some areas. In their expedition of 1804-06, Lewis and Clark frequently noted Canada geese during their travels through the drainages of the upper Missouri and lower Columbia rivers (Burroughs 1961:193-195). Trapper Osborne Russell reported that his party shot geese on 29 August 1838 on the hot springs at what now is West Thumb in Yellowstone National Park (Haines 1955:105). Russell also noted "myriads" of geese at the mouth of the Bear River on Great Salt Lake on 2 April 1842 (Haines 1955:125).

Not all areas of the West supported the numbers of Canada geese found there today. Yocom (1962) suggested that geese did not nest on the Snake River in Washington or along the lower Columbia River before Caucasian settlement. He attributed their establishment and increase in those areas to a number of factors, including the increasing availability of food that resulted from agriculture, and protection from hunting.

Today the western Canada goose nests over an extensive region ranging in latitude from central Alberta and British Columbia south to northern California, southern Utah, and east-central Arizona (the Arizona flock was transplanted). Longitudinally, *B. c. moffitti* breeds from the Cascade Mountains east across the Continental Divide into central Montana, central Wyoming, and Alberta. It has long been suspected that a number of populations, each with relatively separate breeding and wintering ranges, occupied this vast area. Hansen (1968:46) defined the nesting range of one such population of the western Canada goose, the so-called Great Basin population, as consisting of "a loose aggregation of numerous isolated flocks in Utah, Idaho, Colorado, Wyoming, Montana, and Alberta. . . ." The wintering range of this population, as illustrated by Hansen (1968:46), covers the lower Colorado River in Arizona, California, and Nevada; central Arizona; and the Salton Sea area in southern California.

A major contribution of the present investigation was a delineation of the Canada goose population inhabiting the Rocky Mountain Region west of central Colorado. Since the "Great Basin population" was found to live in a region much larger than the Great Basin, and since the population's breeding range runs along both sides of the Rocky Mountains, the term Great Basin was dropped in favor of Rocky Mountain. The reader should not confuse the Rocky Mountain population (RMP) of the present report with the inadequately defined Intermountain Flyway discussed by Williams (1967:6-7), nor with the Intermountain population of Bellrose (1976:145, 152-53). Bellrose's population was too broadly delimited and more closely corresponded to the entire range of *B. c. moffitti*.

Management Needs

In 1955 a marked decrease was noted in what was then termed the Great Basin population. This decline was thought to be caused by both excessive hunting and weather unfavorable to nesting (Nagel and Wrakestraw 1968:117). Management agencies responded to

this decrease by significantly shortened hunting seasons, and although hunting was liberalized somewhat in 1962, seasons have remained relatively conservative ever since the 1955 decline.

To more closely monitor these geese and prevent future declines, State and Federal agencies formed the Great Basin Canada Goose Subcommittee (GBCGS) in 1958. This Subcommittee, which has remained active, consists of one biologist from each of eight States—Arizona, California, Colorado, Idaho, Montana, Nevada, Utah, and Wyoming—plus representatives from the Province of Alberta and the U.S. Fish and Wildlife Service (FWS). The GBCGS meets at least once each year, in late June or early July, to review the status of Canada geese in the Rocky Mountain Region. Subcommittee recommendations concerning the hunting and management of this population go to the Waterfowl Councils of the Pacific and Central flyways by way of the Pacific and Central Flyway Technical committees. The Councils, representing State wildlife agencies in both flyways, annually make management recommendations to FWS.

The GBCGS estimated that the population should be maintained at a posthunting level of at least 50,000 geese. Unfortunately, the breeding and wintering ranges of the population were never clearly defined, nor was the population goal based on estimates of the capacities of available habitats to support Canada geese.

State, Provincial, and Federal wildlife personnel responsible for Canada geese in the Intermountain West have amassed a variety of information since the 1950's. Types of data collected include (1) bandings at various times of the year, (2) counts during the breeding season, and (3) censuses of migrating and wintering birds. In addition, the nesting biology of the western Canada goose has been extensively studied. This information is scattered in various scientific journals, filed in unpublished agency reports, and stored on computer tapes. Many of the data are not readily accessible to wildlife managers and other interested persons. In the present report, we attempt to organize and present some of the information pertinent to the consumptive use of the Canada goose resource in the Intermountain Region.

Study Objectives

Specific objectives to meet the management needs outlined above were (1) to evaluate distributional patterns and estimate survival rates based on band recoveries; and (2) to classify and inventory breeding, molting, and wintering areas and assess the capacities of these areas to support the RMP at a posthunting season level of 50,000 birds.

Definitions and Methods

Banding Records

Banding records and a habitat inventory provided most of the information for this report. Following is an alphabetical listing of terms used in reference to the banding data; some are also used in conjunction with the habitat inventory.

Banding Definitions

Adult.—A Canada goose at least 1 year old. Adults banded during the preseason period on nesting areas are assumed to be local breeders. Adults banded on molting areas are assumed to be nonbreeders.

Band reporting rate.—The proportion of goose bands encountered that are reported to the FWS Bird Banding Laboratory, Office of Migratory Bird Management, Laurel, Maryland. For example, if 10 bands were encountered but only 5 reported, the band-reporting rate was 0.5 (i.e., $5/10=0.5$).

Breeders.—Adult geese associated with goslings on a specific nesting area. Geese captured during the fall, winter, or spring were considered "age undetermined," since many of the birds, even if recorded as adults by banders, were less than 1 year old.

Crippling rate.—The fraction of the total hunter kill that is lost as cripples; crippling rate equals the unretrieved kill divided by the total number of birds shot down by hunters (retrieved and unretrieved).

Direct recovery.—A preseason-banded goose reported encountered during the first hunting season after banding. Direct recoveries of breeders or molters were usually made in only one direction—southward—from the banding locality, whereas first-hunting-season recoveries of geese banded after the hunting season could have moved northward, as well as southward, before recovery. Consequently, all recoveries from postseason bandings are indirect recoveries (see definition below).

Direct recovery rate.—The quotient of the number of direct recoveries divided by the number of geese banded before the hunting season, expressed as a percentage (i.e., $10/100\times100=10\%$). We realize that Brownie et al. (1978: 20) considered direct recovery rates to be inefficient estimators of first-year recovery rates and did not recommend their use. However, we selected the "old" definition because of the ease with which weighted averages could be calculated; furthermore, we generally found only small differences between our mean direct recovery rates and the recovery rates obtained by use of the methods in Brownie et al. (1978).

Flock.—The Canada geese inhabiting a specific nesting, molting, or wintering area.

Hunting season.—The dates of legal hunting for Canada geese which varied among areas and years. In the Intermountain Region the earliest seasons have been in Alberta, Canada (September), and the latest in California (January). Thus, a hunting season recovery was defined as a banded goose reported shot or found dead (assumed to have been shot) between 1 September and 31 January.

Indirect recovery.—A goose banded preseason and reported encountered during a hunting season subsequent to the season immediately following the banding, or banded during or after the season and later recovered.

Inseason banding.—Geese banded within the hunting season. Generally, geese banded during this period are migrating and thus cannot be directly related to any specific nesting or wintering area.

Locals.—Goslings believed to have hatched on the nesting area where banded. Locals have not yet attained the flight stage when captured; adults caught with these locals are the presumed parents.

Molter.—A yearling or older bird that is unable to fly at the time it is banded, because its flight feathers are being replaced. Molting flocks are distinguished from breeding flocks in that they consist mainly of nonbreeding birds and cannot be positively assigned as originating from specific nesting areas.

Nonbreeder.—A yearling or older Canada goose either physiologically or psychologically unable to nest.

Population.—A unit of Canada geese consisting of the same subspecies and made up of birds with interrelated nesting and wintering ranges. The population is the major management unit and, if a subspecies is divided into more than one population, wintering as well as nesting ranges must be distinct.

Postseason.—The period between the end of the hunting season and the start of the spring migration (generally February). Birds banded in this interval are usually caught on their wintering area.

Prebreeder.—A subadult Canada goose that is too young to nest—generally a yearling or 2-year-old (some 2-year-olds nest).

Preseason.—The season following the spring migration but preceding the hunting season (generally it lasts from April through August).

Recovery axis.—The line formed when the clumps of indirect recoveries from preseason bandings in a region are connected. Indirect recoveries tended to occur in three clumps as follows: southern Canada, banding region, and wintering regions.

Reference area.—One of 15 geographic units (Appendix A) into which the Intermountain Region was divided to facilitate the presentation of our data. Reference areas were defined on the basis of similarity in band recovery distributions. Reference areas are capitalized as proper nouns throughout this report to distinguish them from more general geographical areas.

Region.—Refers, when capitalized, to the 15 reference areas constituting the range of the RMP (i.e., Rocky Mountain Region).

Relative recovery rate.—A rate calculated by dividing the direct recovery rate of one age and sex class into the direct recovery rate of a different age and sex class. Direct recovery rates included only geese reported shot, and thus relative recovery rates are an expression of the degree to which vulnerability to gunning differs between age and sex classes.

Total recovery rate.—The number of geese banded during a given time period divided into the total number of recoveries. The total recovery rate is the sum of the direct and indirect recovery rates.

Data Source and Analysis

Banding and recovery data were obtained on computer tapes from the FWS Bird Banding Laboratory. Bandings covered the years 1938-73 and recoveries the period from January 1938 through August 1974 (i.e., recoveries through the 1973-74 hunting season). Bandings and recoveries used in this report were limited to normal, wild Canada geese; experimental birds, such as transplanted or color-marked geese, were excluded.

Bandings were of three general types: (1) preseason banding of breeders and locals on nesting areas, (2) preseason banding of adults on molting areas, and (3) fall-winter-spring bandings of all ages, cannon-netted on migration and wintering areas. All adults captured on areas with both types of preseason bandings during the same years were considered molters—i.e., type (2).

The distribution of recovery locations for geese banded preseason on individual nesting and molting areas provided the basis for delineating reference areas. Illustrations showing recovery distributions by reference areas are given in Appendix B. Data were combined for banding years. Recoveries from preseason bandings were separated into direct and indirect recoveries to enable us to study movements of molters. Recoveries from geese captured on nesting areas were not divided into age-sex classes, since we assumed that Canada geese migrate south from breeding areas as families, and family-like groups (i.e., goslings raised in gang broods). Recoveries from inseason and postseason bandings were pooled by age, sex, and years of banding and recovery.

Most banding records related to geese caught on nesting areas. In terms of relating breeding and wintering areas, and thus defining reference areas and populations, these records provided the most useful type of data. Recovery distributions from bandings on migration and wintering areas were used to check the breeding-wintering ground relations observed from summer banding of breeders. Molting areas are often

used by geese originating from many nesting areas. Thus, recoveries from banded molters were generally more widespread and hence of little use in defining reference areas or populations.

If geese banded in substantial numbers at A were not reported shot in areas where birds banded at B were recovered, it was assumed that geese from area A did not winter at, or migrate through, the locations used by birds from B (and vice versa). This was the basis for delineating migration and wintering areas used by Canada geese from individual nesting areas.

Survival rates of adults were estimated with four models, involving various assumptions regarding constant versus year-specific survival (and recovery) rates (see Brownie et al. 1978:13-55). We termed these models, collectively, the Adult Method. This method is specifically designed to be used with age-independent data (i.e., adults). In contrast, the method that we termed the Young-Adult Method is age-dependent and consists of six models for estimating immature and adult survival (and recovery) rates from banding data that must include samples of two distinct age classes (see Brownie et al. 1978:56-115). Both methods are superior to life table calculations of mortality because, among other advantages, they are based on sound mathematical theory, estimate variances, and have realistic and testable assumptions (Brownie et al. 1978:170). Computer programs provided by FWS, Laurel, Maryland, were used to calculate adult and young-adult survival estimates (i.e., programs ESTIMATE and BROWNIE, respectively).

Samples of bandings and recoveries were generally too small to enable us to adequately estimate survival rates by sex, individual years, or reference areas (i.e., estimates had high variances). Thus, only average annual survival rates for sexes combined and those reference areas best represented by bandings are presented here.

Habitat Inventory

This section includes a listing, in alphabetical order, of terms used in the habitat inventory, followed by a discussion of inventory methods.

Habitat Definitions

Area.—A unit of water or part of a drainage used by nesting, molting, or wintering Canada geese. Areas were classified as one of six habitat types and information for each area was generally recorded on one form (sometimes data for similar areas were combined).

Brooding site.—That portion of a nesting area where goose families feed and loaf, such as pastures adjacent to rivers or marshes.

Feeding site.—That portion of a wintering area where geese move to feed, such as agricultural fields or reservoir shorelines.

Flooded bottomland.—A river valley that floods because the gradient is low; most geese nest on elevated sites in oxbows, pastures, marshes, or meadows adjacent to the main river channel.

Lake.—Natural body of standing, open water that has a nearly constant water level over which man asserts little or no control.

Loafing site.—The portion of a wintering area where geese rest; generally an extensive open area such as a large reservoir, sandbar, or mud flat that is relatively free from human disturbance.

Nesting site.—Portions of a nesting area where geese nest, such as islands in lakes or rivers or high ground and elevated vegetation in bottomlands, impoundments, and marshes.

Marsh.—A natural, shallow-water area with most of its surface covered by emergent vegetation during the growing season.

Reservoir.—A man-made body of standing, open water not specifically constructed or managed for waterfowl; water levels can fluctuate greatly due to man's control.

River.—A natural body of free-flowing water; most geese nest on islands. Data for rivers and flooded bottomlands were recorded by sections as defined during previous surveys, segments based on physical differences, or sections divided by reference area boundaries.

Waterfowl impoundment.—An area of open water and emergent vegetation, usually with dikes and water control structures, built and managed for waterfowl.

Data Source and Analysis

It was not feasible to survey all areas that could be, or had been, used by geese in the Rocky Mountain Region. Consequently, the inventory was limited to the areas known to be used by nesting, molting, or wintering Canada geese in the early 1970's. Although an attempt was made to include all such areas, the inventory undoubtedly was incomplete. The major limitations of this inventory are that the percentages of habitats sampled probably differ between reference areas, and exceptionally large areas, mostly of marginal value to geese, exaggerated the quantity of goose habitat present in some reference areas.

Inventory development included a literature review, tours, and discussions with cooperators. Once a system was agreed upon, instructions and forms were sent out in January 1976. Persons in wildlife agencies most familiar with each unit of habitat furnished the required information. Areas were assigned to one of three groups: flooded bottomlands and rivers, lakes

and reservoirs, and marshes and waterfowl impoundments. In addition to habitat type, data collected included habitat amount, use by geese, anticipated habitat changes, principal managers, and hunting status.

The amounts of habitats were recorded in miles for bottomlands and rivers and in acres for the other four types of habitat. The main channels of bottomlands and rivers were measured to the nearest mile, and the areas of lakes and reservoirs were determined to the nearest acre of open water. Measurements of large bodies of water, only parts of which were used by geese, were limited to the portions most heavily used. For example, since molters concentrate in the southeastern arm of Yellowstone Lake, only the area of that arm was included. Marshes and impoundments were measured in acres of open water and emergent vegetation, excluding mud and salt flats. Generally, sizes of managed areas were provided by cooperators; the acres and miles of unmanaged areas were measured on U.S. Geological Survey maps at scales of 1:62,500 or 1:24,000.

The use of breeding areas by geese was evaluated in terms of numbers of nesting pairs, the use of molting areas according to the numbers of molters (excluding local nesters and their young), and the use of wintering areas in terms of numbers of geese present during January. Specifically, the number of geese using an area was recorded according to (1) the 5-year mean for 1971-75, and (2) the maximum number ever counted. We considered the mean as the use index, to avoid selecting a year of exceptionally high or low use. The maximum number, combined with a question to determine whether an area had deteriorated since the peak was noted, was used to estimate the potential of an area to support geese. The preceding does not apply to Southern Alberta, where data were available for only 1 year for most nesting areas.

The number of nesting pairs per area was based on either ground or aerial surveys conducted by the respective management agencies. Ground searches probably slightly underestimate the true number of nests, whereas aerial counts of pairs as an index to nests could be biased either high or low, primarily because of variations among observers and in visibility. Limited data suggested that, to avoid overestimating the breeding population, the number of pairs counted from the air should be used as an estimator of nests, rather than "indicated breeding pairs" (Table 1). Generally, the use of molting areas was estimated from aerial counts or banding operations. Wintering goose populations were estimated by counts from the Midwinter Waterfowl Inventory, coordinated annually by FWS.

To assess the degree of protection from hunting, we listed each State and Federal wildlife area used by Canada geese in terms of its being closed, partly open, or totally open to Canada goose hunting during the 1975-76 season.

Description of Reference Areas

The RMP of the western Canada goose is associated with about 597,237 square miles, subdivided into 15 reference areas (Fig. 1). Precise definitions of the 15 reference areas, based on counties, are given in Appendix A. Following is a discussion of some characteristics of the reference areas. Attention is given to climate, land use, and human population sizes. A brief review of Canada goose studies done in the Rocky Mountain Region and some adjacent areas is also presented. To help in later discussions of band recovery distributions, we identify areas where transplanted geese are now established.

Table 1. *Comparison of the mean number of breeding Canada geese censused from the air and ground on 16 nesting areas in Idaho and Wyoming, 1971-75 ($\bar{X} \pm SD$; Data from Idaho Department of Fish and Game, and Wyoming Game and Fish Department).*

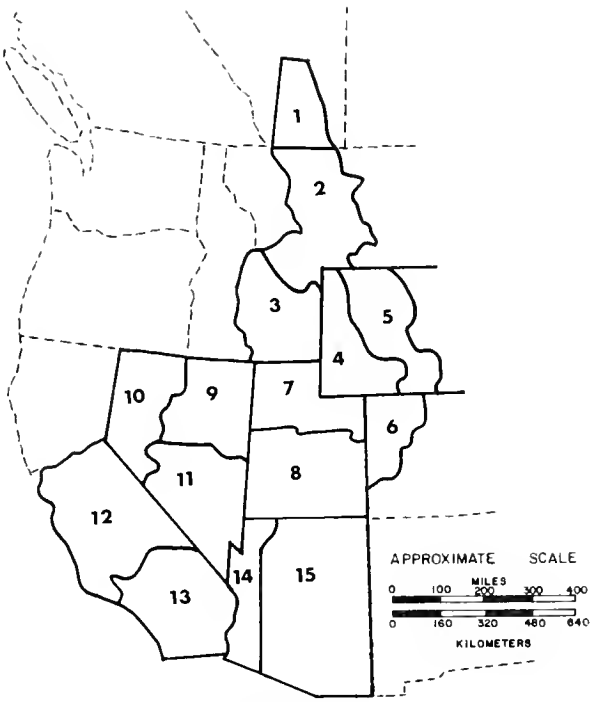
State	No. of areas	Aerial counts		Ground counts, number of nests
		I B P[a]	Pairs	
Idaho	5[b]	365 ± 97[c]	253 ± 68	216 ± 7[c]
Wyoming	11[d]	205 ± 50[c]	148 ± 49	140 ± 21[c]
Total	16	570 ± 113[c]	401 ± 84	356 ± 28[c]

[a]Indicated breeding pairs = pairs plus singles.

[b]Blackfoot Reservoir, Island Park Reservoir, Mud Lake, Railroad Ranch, and Snake River (Marsing to Adrian).

[c]Significant difference (t-test, $P < 0.05$). Aerial pair counts and ground nest counts were not statistically different and thus aerial censuses of pairs appear to be a usable index of nest numbers.

[d]Cameawhait Pond, Green River (Fontenelle Reservoir to Black's Fork), Kinnear Pond, Lower-Middle-Upper Depressions, Morton Lake, Morton Seep, North Pavillion Pond, Ocean Lake WMA, Yellowtail WMA.



REFERENCE AREAS

1=Southern Alberta
2=Central Montana
3=Southeastern Idaho
4=Western Wyoming
5=Central Wyoming
6=Northwestern Colorado
7=Northern Utah
8=Southern Utah
9=Northeastern Nevada
10=Northwestern Nevada
11=Southern Nevada
12=Central California
13=Southern California
14=Western Arizona
15=Eastern Arizona

Fig. 1. Reference areas defined by the Rocky Mountain Canada goose study.

Southern Alberta

This reference area, which covers about 24,000 square miles, is a portion of the southern third of the Province lying between the Rocky Mountains and the Saskatchewan border. Most of the land is 2,500 to 3,500 feet above mean sea level. Rivers are incised 200 to 400 feet into the Alberta Plain, which originally was an extensive and unbroken grassland. The northern end of the reference area is within the southern extension of the aspen (*Populus* spp.) parkland. The land is now largely devoted to agriculture, especially to grain farming and cattle ranching. Numerous reservoirs have been constructed throughout the southern portion of the Province, mainly from the 1940's through the mid-1950's.

The boundaries of this reference area are subject to revision as more data become available. In establishing the eastern boundary, we attempted to separate the nesting ranges of the RMP and the Highline Canada goose population (HLP), which lies immediately east of the Rocky Mountain Region. Also, Canada geese nest west of longitude 114°W, the western side of the reference area, and north of latitude 52°N, the northern boundary. The numbers and wintering grounds of breeders north and west of the reference area are unknown, but the highest nesting densities occur within the boundaries as herein defined (H. R. Weaver, personal communication).

A number of studies of geese have been made in the southern Alberta reference area. Vermeer (1970) studied nesting Canada geese on Lake Newell in the east-central part of Southern Alberta, and on Dowling Lake (Highline geese). Ewaschuk and Boag (1972) investigated the factors influencing densely nesting geese on an island in Dowling Lake. Surrendi (1970) studied the behavior and survival of flightless geese moved from their natal lakes near Brooks to lakes in the vicinity of Hanna. The relocating of Brooks-area geese to the north, conducted by the Alberta Fish and Wildlife Division and Ducks Unlimited (Canada), is continuing; 1,975 birds were transplanted to 27 locations during 1963-75. The 1,461 birds transplanted before 1972 were all goslings, whereas adults were moved with the young in 1972-75 in an attempt to reduce hunting losses (H. R. Weaver, personal communication). A 3-year survey of goose nesting populations throughout southern Alberta was completed in 1975 by the Alberta Fish and Wildlife Division (D. Cole, personal communication).

Central Montana

Almost all of Central Montana is situated east of the Continental Divide and immediately south of Southern Alberta. This reference area of more than 47,500 square miles has a small human population which is slowly increasing (Table 2). The nesting ranges of the RMP and HLP merge along the eastern edge of Central Montana; the collection of additional data may lead to changes in the location of the eastern boundary.

The appearance and land use of the northern half of Central Montana are similar to those of Southern Alberta. However, the climate is drier and agriculture is less intensive; more land is being used to raise cattle than grain. Thousands of small stock ponds have been built in the northern part of this region during the past 40 years. McCarthy (1973) documented the nesting response of Highline geese to islands in stockponds in north-central Montana. Also working with Highline birds, Hinz (1974) studied the seasonal distribution and activities of geese along the lower Yellowstone River in eastern Montana.

Freezout Lake, a State waterfowl management area (WMA), is the major production area in Central Montana. Hook (1973) investigated the nesting ecology of

Table 2. *Some characteristics of reference areas defined by the Rocky Mountain Canada Goose study.*[a]

Reference area	Location (Fig. 1)	Area (square miles)	Human population 1960	Human population 1970	Change 1960-1970 (%)	1970 Population per square mile
Southern Alberta	1	24,000	695,704[b]	775,240[b]	+ 11.4	—
Central Montana	2	47,547	282,846	286,795	+ 1.4	6.0
Southeastern Idaho	3	37,223	250,821	262,247	+ 4.6	7.1
Western Wyoming	4	25,451	41,262	42,709	+ 3.5	1.7
Central Wyoming	5	31,501	85,545	82,181	- 3.9	2.6
Northwestern Colorado	6	20,025	114,731	120,806	+ 5.3	6.0
Northern Utah	7	30,447	779,675	951,683	+ 22.1	31.3
Southern Utah	8	51,649	110,952	107,590	- 3.0	2.1
Northeastern Nevada	9	35,870	24,152	27,722	+ 14.8	0.8
Northwestern Nevada	10	33,862	126,686	178,943	+ 41.2	5.3
Southern Nevada	11	40,157	134,440	282,073	+109.8	7.0
Central California	12	65,442	5,892,059	7,487,510	+ 27.1	114.4
Southern California	13	40,646	8,657,594	11,037,066	+ 27.5	271.5
Western Arizona	14	23,200	53,971	86,684	+ 60.6	3.7
Eastern Arizona	15	90,217	1,248,190	1,686,912	+ 35.2	18.7
Total		597,237	18,498,628	23,416,161	+ 26.6	39.2

[a]Data from Rand McNally and Company (1975).
[b]1966 and 1971 censuses of Divisions 1-8 (population from area larger than Southern Alberta).

Canada geese there. Although these birds belong to the RMP, they originated from Highline geese, which were transported and used as captive breeders at the Freezout Lake WMA.

The southern half of Central Montana is mountainous, and goose habitat is scattered. Forestry, mining, ranching, and various forms of outdoor recreation are the major economic activities in southern Central Montana. Childress (1971) studied the nesting and production of geese along the Madison River immediately south of Lake Ennis. He is also evaluating the benefits to Canada geese and other wildlife of efforts by the U.S. Water and Power Resources Service (formerly the Bureau of Reclamation) to control dust at the south end of Canyon Ferry Reservoir by creating waterfowl impoundments (Childress and Eng 1979). Hildebrand (1979) studied the habitat needs of molting geese at Lima Reservoir, situated in Central Montana just north of the Idaho line.

Southeastern Idaho

This 37,200-square-mile region has a relatively sparse human population which increased by less than 5% during the 1960-70 decade (Table 2). However, the human population is expected to increase rapidly as phosphate deposits are mined along the southeastern edge of the region.

Breeding habitats in Southeastern Idaho range in elevation from 4,100 to 4,500 feet along the Snake River to more than 6,300 feet at Island Park Reservoir and Gray's Lake. Much of the land at higher elevations along the Idaho-Montana-Wyoming borders is in National Forests, where livestock grazing is the major land use and timber harvesting is becoming increasingly important. Most of the land along the Snake River—much of it irrigated farmland—is privately owned.

Canada geese nesting at Gray's Lake were investigated in 1950 and 1951 (Steel et al. 1957). In 1952 and 1953, Reeves (1954) studied the production of Canada geese, together with that of ducks and muskrats (*Ondatra zibethica*), at Dingle Swamp adjacent to Utah.

Extensive breeding-ground surveys on geese have been conducted by the Idaho Department of Fish and Game since 1952. Methods and some of the initial results of these surveys were reported by Salter (1956); more recent results are summarized in the present report (see *Breeding Biology and Productivity*). Merrill and Bizeau (1972) surveyed the South Fork of the Snake River to evaluate the influence of water discharge from Palisades Dam on goose nesting during the spring of 1972.

Western Wyoming

Western Wyoming, 25,500 square miles in area, is defined as the five Wyoming counties west of the Continental Divide plus Yellowstone National Park. This is a mountainous reference area encompassing much federally owned land, including forests, parks,

and wildlife refuges. Cattle ranching is the main agricultural activity.

In 1947, Craighead and Craighead (1949) documented the number, distribution, and productivity of Canada geese nesting along 40 miles of the South Fork of the Snake River below Jackson Lake. The nesting, molting, migration, and population dynamics of geese of Jackson Hole, a high mountain valley which includes Jackson Lake and the upper Snake River in Wyoming, were later investigated by Dimmick (1968). The upper Bear River, about 160 miles south of Jackson Hole, supports the largest goose breeding flock in Western Wyoming. Appel (1969) and Saul (1970) documented the use of man-made nesting structures by geese along the Bear River in Wyoming and Utah. The early status of Wyoming geese was reported by Patterson and Ballou (1953). Ballou (1955) studied the breeding biology of color-marked geese along the Green River.

Central Wyoming

Central Wyoming is the portion of the State, excluding Yellowstone Park, between the Continental Divide and roughly the 107th meridian. The 31,500-square-mile region is sparsely settled. The terrain is less mountainous than Western Wyoming. Cattle ranching and farming are the major economic activities; the extraction of fossil fuels is becoming increasingly important.

Ballou (1955) studied the nesting of color-marked geese at Ocean Lake. Many of the nesting flocks in this reference area, especially those at Ocean Lake and the Big Horn River, originated from eggs and goslings transplanted from Utah and released before they fledged. Ballou (1957) reviewed Wyoming's goose restoration program, which started in 1953. About 580 Canada geese were released between 1953 and 1956 on eight areas, two in Central Wyoming (Ocean Lake and Boysen Reservoir) and six in eastern Wyoming.

Northwestern Colorado

Northwestern Colorado, slightly more than 20,000 square miles in size, is the smallest of the 15 reference areas. This region has a moderate-sized human population that increased by more than 5% between 1960 and 1970 (Table 2). Most goose nesting in the region occurs in Moffat and Routt counties. Geese transplanted into the southern part of this seven-county reference area have become established nesters. Between 1967 and 1969, 127 goslings artificially raised from eggs taken along the Yampa and Little Snake rivers were released, and subsequently nested, on the Colorado River near Loma. In addition, 106 goslings were relocated to Totten Reservoir in the extreme southwestern corner of Colorado in 1970-72. In 1969-72, 830 geese were released at North Park in north-central Colorado. Some of these birds nested and now winter within the ranges of both the RMP and HLP. However, most of the North Park transplants reported shot were taken along the lower Colorado River bordering Arizona and California (M. R. Szymczak, personal communication).

The production of waterfowl, including Canada geese, was studied in the Yampa River Valley by Boeker (1953) and in Brown's Park on the Green River by Tester (1953). Since 1952, annual estimates have been made of the size, trend, and productivity of geese nesting on the Yampa and Green rivers in Colorado. Methods used by the Colorado Division of Wildlife and early results were presented by Grieb et al. (1961). Since 1968, F. N. Folks (personal communication), Utah Division of Wildlife Resources, has studied the ecology of geese throughout the year on the Green River from Brown's Park, Utah, through Dinosaur National Monument, Colorado and Utah.

Northern Utah

This reference area consists of 14 counties in Utah north of Juab, Sanpete, Carbon, and Grand counties. This is one of the most densely populated of the reference areas even though it covers more than 30,400 square miles. Northern Utah's human population increased by more than 20% from 1960 to 1970 (Table 2). The Great Salt Lake Valley is occupied by thousands of geese. The area on the eastern edge of Great Salt Lake is highly urbanized, but supports diversified agriculture.

Goose nesting (Williams and Marshall 1937) and gosling survival (Williams and Marshall 1938) were studied in the marshes of the Bear River delta in the northeastern corner of Great Salt Lake. Martin (1964) studied the behavior and survival of geese at the Ogden Bay WMA, 15 miles south of the Bear River Migratory Bird Refuge, from 1956 to 1958, and Dey (1964) continued the Ogden Bay nesting studies in 1959-60. Some harvest characteristics of Utah geese, based on analysis of about 25,000 bandings and 9,000 recoveries, were reported by Tautin and Low (1975); a more detailed analysis of these data was given by Tautin (1976). Most of these bandings were of geese associated with Great Salt Lake. Arneson (1970) investigated molting geese and selected environmental factors at Neponset Reservoir, about 80 miles northeast of Great Salt Lake.

Southern Utah

Southern Utah is defined as the 15 Utah counties south of the Northern Utah reference area. This is the

third largest of the 15 regions, being more than 51,600 square miles. It is a semiarid region in which most nesting occurs on man-made bodies of water, 4,500 to 7,000 feet in elevation, in the south-central portion of the reference area. The productivity of these small and scattered flocks has been surveyed annually since 1969 by the Utah Division of Wildlife Resources.

Northeastern Nevada

This 35,900-square-mile reference area is made up of four counties in Nevada east of the 117th meridian and south of the 39th parallel. The density of the human population here is the lowest of the 15 reference areas, but has increased by almost 15% between 1960 and 1970 (Table 2). Northeastern Nevada is arid; ranching and mining are the mainstays of the economy.

No studies have been published concerning Nevada's Canada geese.

Northwestern Nevada

Most of Nevada's population and wetlands are in the nine counties west of longitude 117°W. Although these 33,900 square miles of Northwestern Nevada are not now densely populated, the number of people increased by more than 40% from 1960 to 1970 (Table 2).

Data from molters banded at Pyramid Lake were analyzed by W. C. Rienecker (personal communication) of the California Department of Fish and Game.

Southern Nevada

Southern Nevada consists of the four counties south of the previous two reference areas. This region of 40,100 square miles supports few geese. The moderate-sized human population grew almost 110% between 1960 and 1970 (Table 2). Geese moved to the Kirsch WMA by the Nevada Department of Fish and Game have become successfully established; this is one of the most southern nesting flocks in the RMP.

Central California

This reference area is made up of the 28 California counties west of Nevada. Central California extends from the city of Sacramento south to the Tehachapi Mountains. In terms of size (65,500 square miles), and 1960-70 population growth (27.1%), it ranks second and sixth, respectively, among the 15 reference areas (Table 2). Agriculture is a major land use and economic activity in Central California, especially in the San Joaquin Valley. Numerous reservoirs were built in this region, mostly during the late 1800's to early 1900's and during the late 1950's to early 1960's.

No major technical studies of the geese in this reference area have been published except for the early taxonomic research by Swarth (1913).

Southern California

The six southern counties in California make up this 40,700-square-mile reference area. The human population is concentrated along the coast and relatively few people live inland. Southern California's human population grew by 27.5% from 1960 to 1970 (Table 2). Where water is available, agriculture is a major land use. The most noteworthy of these agricultural areas, especially from the standpoint of wintering geese, are the Imperial and Coachella valleys adjacent to the Salton Sea.

No investigations have been published on the wintering geese of Southern California.

Western Arizona

This 23,200-square-mile reference area comprises Arizona's two most western counties. The human population in this arid and sparsely populated area grew almost 61% between 1960 and 1970 (Table 2). Most geese wintering here are associated with the Colorado River, which forms the western boundary of the reference area. Habitat data from the lower Colorado River, whether in Arizona or California, were included in Western Arizona because most of the wintering areas are in this State.

Early information on Arizona's waterfowl, including the Canada geese of the lower Colorado, was summarized by Fleming (1959).

Eastern Arizona

Eastern Arizona, consisting of the 12 counties east of Mohave and Yuma counties, is the largest of the 15 reference areas (90,200 square miles). Human population increased by over 35% during 1960-70 (Table 2). Canada geese mainly winter south of the Mogollon Plateau.

Canada geese, not originally known to have nested in Arizona, were transplanted into the White Mountains from 1966 through 1968. The release consisted of goslings, most of which were artificially hatched and raised from eggs collected in Nevada (1966), Utah (1966), Washington (1968), and Wyoming (1966-68). In recent years a few pairs of geese have nested in east-central Arizona, making the White Mountains (latitude 33° 50′ N) the southern nesting limit for Rocky Mountain geese.

Population Characteristics

Major Limitations

Following is a discussion of major limitations in the available banding data. An understanding of these problems is needed if banding programs are to be of maximum use to waterfowl managers.

Representativeness of Bandings

Banding is a sampling method, and as such, the representativeness of the banded sample is critical. Aggregations of Canada geese on molting, migrating, and wintering areas often include birds from widespread nesting areas. Consequently, there is no assurance that in annual banding on such areas the same fraction of geese from specific nesting areas is marked each year. Changes in the geographic distribution of recoveries from geese banded on non-nesting areas are difficult to interpret because such shifts could merely reflect year-to-year differences in the breeding-ground origins of birds using given banding sites. For instance, the possibility of sampling molters from different nesting areas over the years was ignored by Dimmick (1968:60), who suggested that molters using Turbid Lake in Yellowstone Park, Western Wyoming, were changing their wintering range from central Arizona to western Arizona-southern California, 1956-63. Also, an apparent but unreal shift could be caused by changes, through time, in band reporting rates.

Canada geese banded on nesting areas represent local breeders and their offspring. However, breeding flocks within a reference area can have different migration patterns and thus a particular banded flock may not be representative of an entire reference area (Raveling 1978). For example, in Central Montana, birds nesting at Ennis Lake were more sedentary than Canada geese elsewhere in this reference area. Since most of the geese banded in Central Montana were captured at Ennis Lake, it is unlikely that the high percentage of Ennis Lake birds taken within Central Montana was representative of the entire reference area.

Band Reporting Rates

If 50% of all recoveries from area A geese were taken within area A, this does not necessarily mean that area A harvests 50% of its Canada geese. Obviously, band reporting rates must be considered; however, since no specific studies have been done, little can be said with certainty about the harvest distribution of Rocky Mountain geese. As a generality, however, it is likely that band reporting rates were lowest in the reference area of banding, especially near banding sites (Henny and Burnham 1976). Thus, in the above example, one would suspect that more than 50% of the harvest of geese from area A occurred there.

We do not discuss variations in the distribution of recoveries through time, since apparent shifts in distribution patterns can result from changes in reporting rates (as well as different flocks being sampled through time on non-nesting areas). For example, Tautin and Low (1975:339) plotted the percentages of geese banded in Utah and recovered in Utah by years, in 1952-72. They believed that, through time, hunters in southern California were killing progressively more of Utah's birds. Their point is inconclusive, however, because changes in band reporting rates would result in an apparent, but unreal, decline of Utah-banded geese shot in Utah (i.e., if Utah's reporting rates decreased and California's rate remained stable, or if Utah's rates declined faster than California's rates). Conversely, hunters in California could be killing more of the geese marked in Utah, and this greater kill could be the result of an increased harvest rate in California. However, if more Utah birds are now wintering in California than in the past, the number of Utah birds shot in California could increase over time even if California's harvest rate was stable. Changes through time in the recovery distributions of migratory game birds are seldom easily and completely explained.

"Who Reported" codes were established by FWS in 1957 to help determine what impact band collecting by conservation agencies has on band reporting rates. A compilation of recoveries from Canada geese banded in the Rocky Mountain Region according to bands reported by hunters and others showed considerable variation between reference areas but relatively little change through time in 1957-72 (Table 3). Of the 11,884 recoveries tabulated, 73% were reported by hunters and the rest by persons other than the hunter—mainly employees of conservation agencies. Without estimates of band reporting rates by year and reference area, it is impossible to determine whether band collecting by wildlife agencies has influenced the reporting of bands. Nevertheless, Table 3 clearly shows marked differences between reference areas in the reporting of bands by employees of wildlife agencies. Specifically, in 5 of the 15 reference areas (Western Wyoming, Western Arizona, and Nevada's three regions), over 40% of the bands were reported by persons other than the hunter.

Band Recovery Distributions

We next address the distribution patterns of recoveries reported by hunters according to reference area of banding and banding type (See Definitions and Methods). The distribution of the reported kill may not represent the distribution of wintering geese and thus

Table 3. *Percentage and (in parentheses) number of band recoveries from geese banded in the Intermountain Region at all times of the year (ages and sexes combined) according to "Who Reported" codes[a], years harvested, and reference areas.*

Reference area where harvested	1957-60		1961-64		1965-68		1969-72		Total	
	Hunter	Other	Hunter	Other	Hunter	Other	Hunter	Other	Hunter	Other
Southern Alberta	96.8 (180)	3.2 (6)	82.1 (220)	17.9 (48)	94.0 (78)	6.0 (5)	85.8 (145)	14.2 (24)	88.2 (623)	11.8 (83)
Central Montana	82.1 (101)	17.9 (22)	76.8 (179)	23.2 (54)	65.9 (85)	34.1 (44)	66.3 (53)	33.8 (27)	74.0 (418)	26.0 (147)
Southeastern Idaho	70.7 (394)	29.3 (163)	72.5 (590)	27.5 (224)	71.2 (309)	28.8 (125)	68.4 (201)	31.6 (93)	71.2 (1,494)	28.8 (605)
Western Wyoming	45.7 (74)	54.3 (88)	52.8 (66)	47.2 (59)	56.0 (56)	44.0 (44)	57.4 (35)	42.6 (26)	51.6 (231)	48.4 (217)
Central Wyoming	69.7 (46)	30.3 (20)	66.3 (55)	33.7 (28)	80.8 (59)	19.2 (14)	64.9 (72)	35.1 (39)	69.7 (232)	30.3 (101)
Northwestern Colorado	50.0 (1)	50.0 (1)	80.0 (16)	20.0 (4)	67.1 (47)	32.9 (23)	67.1 (53)	32.9 (26)	68.4 (117)	31.6 (54)
Northern Utah	71.9 (302)	28.1 (118)	78.8 (661)	21.2 (178)	78.4 (657)	21.6 (181)	69.5 (410)	30.5 (180)	75.5 (2,030)	24.5 (657)
Southern Utah	66.5 (165)	33.5 (83)	83.7 (297)	16.3 (58)	74.7 (219)	25.3 (74)	80.8 (177)	19.2 (42)	77.0 (858)	23.0 (257)
Northeastern Nevada	80.0 (4)	20.0 (1)	33.3 (7)	66.7 (14)	85.7 (6)	14.3 (1)	20.0 (1)	80.0 (4)	47.4 (18)	52.6 (20)
Northwestern Nevada	51.8 (159)	48.2 (148)	71.8 (74)	28.2 (29)	55.7 (34)	44.3 (27)	60.0 (33)	40.0 (22)	57.0 (300)	43.0 (226)
Southern Nevada	40.9 (9)	59.1 (13)	23.7 (22)	76.3 (71)	42.7 (56)	57.3 (75)	47.9 (23)	52.1 (25)	37.4 (110)	62.6 (184)
Central California	78.2 (79)	21.8 (22)	87.8 (108)	12.2 (15)	91.0 (61)	9.0 (6)	93.0 (80)	7.0 (6)	87.0 (328)	13.0 (49)
Southern California	79.6 (82)	20.4 (21)	65.7 (272)	34.3 (142)	81.8 (293)	18.2 (65)	80.7 (472)	19.3 (113)	76.6 (1,119)	23.4 (341)
Western Arizona	62.5 (15)	37.5 (9)	57.4 (97)	42.6 (72)	54.0 (115)	46.0 (98)	65.5 (116)	34.5 (61)	58.8 (343)	41.2 (240)
Eastern Arizona	83.2 (84)	16.8 (17)	79.5 (101)	20.5 (26)	88.1 (119)	11.9 (16)	84.0 (100)	16.0 (19)	83.8 (404)	16.2 (78)
Mean percentages	69.8	30.2	73.0	27.0	73.3	26.7	73.6	26.4	72.6	27.4
Total recoveries	1,695	732	2,765	1,022	2,194	798	1,971	707	8,625	3,259

[a]Hunter codes = 01,21; other codes = 02-04, 06-19, 22-19 (excluding 05,20).

care must be taken in data interpretation. Emphasis is placed on the geographic distributions of band recoveries, and special attention is given to determining wintering grounds used by geese nesting in individual reference areas. We also discuss the adequacy of bandings within reference areas, as related to determining the interrelations of breeding and wintering grounds. Furthermore, we document the data used to delineate the RMP and the 15 reference areas on the basis of nesting-wintering range affinities. Although the supporting data are not extensively cited, they are given in Figs. B-1 through B-33 of Appendix B (geographic distributions) and in Tables C-1 through C-18 of Appendix C (chronologic-geographic distributions).

We found a continuum in the breeding-wintering ground relations across the range of *B. c. moffitti*; however, birds inhabiting the western portion of the range (i.e., Pacific population [PP]), where winter weather is usually mild, were much less migratory than were geese from the eastern portion (i.e., RMP), where winter conditions are generally more severe. Given this gradient, there will always be some disagreement as to exactly where a line should be placed between the two populations of western Canada geese. We recognized this problem and tried to solve it by selecting the RMP's western border, primarily on the basis of (1) whether a flock was mainly resident (PP) or migratory (RMP), (2) whether a relatively low (RMP) or high (PP) percentage of indirect recoveries were taken in southern Canada, and (3) harvest distribution. Differences in the regularity and lengths of spring-fall migrations, as well as summer molt migrations, were presumed to result in the need for different management strategies.

Southern Alberta

Nesting area bandings are well represented in this region over the years, but they have poor geographic distribution. This recognized deficiency is being corrected by a joint Canadian-American banding project, the primary objective of which is to determine the boundary between RMP and HLP in southern Alberta (H. R. Weaver, personal communication).

The banding of goslings and adults in the vicinity of Lake Newell has been continuous since 1947. Recoveries from these bandings and others west of Lake Newell (Table 4) occurred mainly in southern Alberta (49%), southern Idaho (20%), western Nevada (7%), and Central California (16%). Relatively few birds banded in Southern Alberta were recovered in Central Montana (Figs. B-1 and B-2). We therefore conclude that most fall migrants from Southern Alberta fly nonstop over Central Montana. Overall, the data show that most geese nesting in Southern Alberta winter on and near American Falls Reservoir, Southeastern Idaho, and in the San Joaquin Valley, Central California.

A small concentration of molters captured on Bassano Reservoir, 1948-51, had essentially the same recovery pattern as local breeders. Although this reservoir is no longer used by large numbers of molters, it appears that in past years the geese molting here originated mainly from Southern Alberta and thus these data were pooled with those for the breeders.

Central Montana

Summer banding of geese on nesting areas was

Table 4. *Percentages of band recoveries (direct and indirect considered separately) from immature and adult Canada geese banded preseason on breeding areas in Southern Alberta, 1947-73. Total numbers of recoveries are shown in parentheses.*

Locality of recovery	Immature			Adult			All age groups		
	Direct (565)	Indirect (486)	Total (1,051)	Direct (152)	Indirect (229)	Total (381)	Direct (717)	Indirect (715)	Total (1,432)
Alberta	50.8	47.5	49.3	51.3	44.1	47.0	50.9	46.4	48.7
British Columbia	0.2	—	0.1	—	—	—	0.1	—	0.1
Saskatchewan	0.5	1.4	1.0	—	—	—	0.4	1.0	0.7
Oregon	—	0.2	0.1	1.3	0.9	1.0	0.3	0.4	0.3
Washington	—	0.2	0.1	0.7	0.4	0.5	0.1	0.3	0.2
Montana	2.5	2.3	2.4	5.9	1.3	3.1	3.2	2.0	2.6
Idaho	18.8	22.4	20.5	16.4	22.3	19.9	18.3	22.4	20.3
Wyoming	0.9	0.2	0.6	1.3	—	0.5	1.0	0.1	0.6
Colorado	1.6	2.7	2.1	—	0.4	0.3	1.3	2.0	1.6
Utah	0.4	1.0	0.7	0.7	1.3	1.0	0.4	1.1	0.8
Nevada	9.2	6.6	8.0	3.3	6.6	5.2	7.9	6.6	7.3
California	13.5	14.2	13.8	17.8	21.8	20.2	14.4	16.6	15.5
Arizona	0.4	0.2	0.3	0.7	—	0.3	0.4	0.1	0.3
Others	1.5	1.0	1.3	0.7	0.8	0.8	1.2	0.9	1.1

widely distributed over Central Montana. Unfortunately, most banded samples were small, resulting in few recoveries. Nevertheless, the wide geographical distribution of bandings permitted a preliminary boundary to be drawn between the nesting ranges of RMP and HLP. Recoveries of birds on the Stanley Dale Ranch, 4 miles east of Ryegate along the Musselshell River, showed that these geese belonged to RMP (seven direct recoveries along the Colorado River near the Colorado-Utah line). Numerous band recoveries from adults and goslings captured along the Yellowstone and Big Horn rivers showed these geese to belong to HLP. (Canada geese nesting along the Big Horn River in Wyoming, contrary to Rutherford [1965:14], are Rocky Mountain birds; see *Central Wyoming* [below] for an explanation of this apparent contradiction.) Recoveries from geese captured at Tiber Reservoir showed these birds to be members of RMP, whereas nesters some 100 miles to the east, near the town of Chinook, are Highline birds.

On the western side of Central Montana, limited recoveries from geese banded on the Warm Springs WMA, west of the Continental Divide, showed these birds to be more closely associated with RMP than with the Flathead-Bitterroot flock of PP.

Most recoveries from long-term banding of goslings and adults in the Canyon Ferry area, including Lake Helena, were taken on and near American Falls Reservoir in Southeastern Idaho. In comparison, more than 60% of the recoveries from breeders banded on Ennis Lake over a similar time period were reported shot locally.

These data indicate large variation in the contribution of Montana's individual nesting flocks to southern wintering and harvest areas. Overall, more than half of the recoveries (51%) from geese banded in Central Montana were taken in Montana (Table 5).

Molters captured on Lima Reservoir, 1961 and 1962, originated from nesting areas in several States. Both summer recaptures (45), and shot recoveries (Table 6), suggested that these geese were mainly from nesting areas in Southeastern Idaho and Northern Utah.

Southeastern Idaho

The banding of Canada geese in this region was widely distributed over space and, to a lesser degree, through time. Unfortunately, long-term banding on nesting areas was limited to one part of the reference area, Idaho's eastern border. More than half (56%) of the recoveries from geese banded in this area were harvested locally; the next were about equally divided (10-13% each) among Utah, California, and Arizona (Table 7). In the past, molters in Southeastern Idaho apparently originated in Northern Utah as well as locally (Table 8).

The boundary between Southeastern Idaho (i.e., RMP) and southwestern Idaho (i.e., PP) was fairly well delineated. Mormon Reservoir was the most western nesting area known to be used by Rocky Mountain geese. Most of the 124 geese recovered from bandings on Mormon and Magic reservoirs were shot in western Nevada and Central California; only 2 were reported taken in the American Falls area. In contrast, 39% of

Table 5. *Percentages of band recoveries (direct and indirect considered separately) from immature and adult Canada geese banded preseason on breeding areas in Central Montana, 1946-73. Total numbers of recoveries are shown in parentheses.*

Locality of recovery	Immature			Adult			All age groups		
	Direct (447)	Indirect (439)	Total (886)	Direct (70)	Indirect (123)	Total (193)	Direct (517)	Indirect (562)	Total (1,079)
Alberta	0.2	4.1	2.1	—	1.6	1.0	0.2	3.6	1.9
Saskatchewan	—	1.4	0.7	—	0.8	0.5	—	1.2	0.6
Washington	—	0.2	0.1	—	—	—	—	0.2	0.1
Montana	51.9	50.8	51.4	48.6	50.4	49.7	51.5	50.7	51.1
Idaho	39.4	33.5	36.5	35.7	37.4	36.8	38.9	34.3	36.5
Wyoming	—	—	—	—	0.8	0.5	—	0.2	0.1
Colorado	0.9	0.2	0.6	—	—	—	0.8	0.2	0.5
Utah	1.6	2.3	1.9	—	1.6	1.0	1.4	2.1	1.8
Nevada	2.0	3.6	2.8	5.7	5.7	5.7	2.5	4.1	3.3
California	3.1	2.7	2.9	7.1	1.6	3.6	3.7	2.5	3.1
Arizona	0.7	0.2	0.5	2.9	—	1.0	1.0	0.2	0.6
Others	0.2	0.9	0.5	—	—	—	0.2	0.8	0.5

the 107 recoveries from bandings on Minidoka NWR, some 70 miles southeast of Mormon and Magic reservoirs, occurred in the vicinity of American Falls Reservoir.

The most southern recoveries of geese banded in Southeastern Idaho west of longitude 113° W were reported primarily from Northwestern Nevada and Central California. In comparison, most southern recoveries from breeders and molters banded east of the 113th meridian in Southeastern Idaho were from Arizona, Utah, and Southern California. These data indicate an east-west gradient in the southern wintering areas used by Canada geese nesting across Southeastern Idaho.

Table 6. *Percentages of band recoveries (direct and indirect considered separately) from adult Canada geese banded preseason on molting areas in Central Montana (Lima Reservoir), 1961-62. Total numbers of recoveries are shown in parentheses.*

Locality of recovery	Direct (158)	Indirect (412)	Total (570)
Alberta	—	1.2	0.9
Saskatchewan	—	0.5	0.4
Montana	4.4	4.4	4.4
Idaho	29.7	29.6	29.6
Wyoming	—	0.5	0.4
Colorado	—	0.2	0.2
Utah	41.1	35.0	36.7
Nevada	5.7	7.8	7.2
California	13.3	16.7	15.8
Arizona	5.1	3.4	3.9
Others	0.6	0.6	0.8

Western Wyoming

Few Canada geese were banded on nesting areas in Wyoming. Almost all breeders banded west of the Continental Divide were limited to small samples captured on the Bear River near Cokeville and on Fontenelle Reservoir, about 40 miles east of Cokeville. Recoveries from these bandings showed that Bear River geese moved into the corner of southeastern Idaho and northeastern Utah before migrating south to the lower Colorado River (67 total recoveries), whereas the Fontenelle geese, captured across a mountain range from the Bear River, apparently migrated down the Green River into the lower Colorado (18 total recoveries). Overall, recoveries from the limited bandings done to date showed that most of the geese banded in Western Wyoming were shot outside the reference area (Table 9).

Recoveries from adults captured while molting on Turbid Lake, Yellowstone National Park, suggested that these geese were primarily from nesting areas in Southeastern Idaho and Western Wyoming (Table 10).

Central Wyoming

Available recoveries indicated that more than half of the harvest of this region's geese occurred within Wyoming (Table 11). Recoveries from breeders banded on the Ocean Lake WMA indicated that these birds wintered mainly in northeastern Utah (Brown's Park-Ouray NWR area) and along the lower Colorado River. Limited recoveries from breeders banded on the Yellowtail WMA, along Yellowtail Reservoir on the Big Horn River of northern Central Wyoming, showed that at least some of these birds may also winter in northeastern Utah (eight direct recoveries). Although

Table 7. *Percentages of band recoveries (direct and indirect considered separately) from immature and adult Canada geese banded preseason on breeding areas in Southeastern Idaho, 1947-73. Total numbers of recoveries are shown in parentheses.*

Locality of recovery	Immature			Adult			All age groups		
	Direct (752)	Indirect (845)	Total (1,597)	Direct (215)	Indirect (405)	Total (620)	Direct (967)	Indirect (1,250)	Total (2,217)
Alberta	0.1	4.9	2.6	—	2.5	1.6	0.1	4.1	2.3
Saskatchewan	—	3.4	1.8	—	1.5	1.0	—	2.8	1.6
Oregon	—	0.1	0.1	—	—	—	—	0.1	0.0
Washington	—	0.7	0.4	—	—	—	—	0.5	0.3
Montana	1.3	3.2	2.3	0.9	1.5	1.3	1.2	2.6	2.0
Idaho	62.4	52.8	57.3	54.4	52.3	53.1	60.6	52.6	56.1
Wyoming	0.8	1.7	1.3	2.8	2.0	2.3	1.2	1.8	1.5
Colorado	0.1	0.4	0.3	—	0.2	0.2	0.1	0.3	0.2
Utah	11.4	10.4	10.9	19.1	16.8	17.6	13.1	12.5	12.8
Nevada	2.7	1.9	2.3	1.9	2.2	2.1	2.5	2.0	2.2
California	9.8	9.3	9.6	13.0	10.6	11.5	10.5	9.8	10.1
Arizona	10.9	9.6	10.2	7.9	10.1	9.4	10.2	9.8	10.0
Others	0.3	1.6	1.2	—	0.2	0.2	0.3	1.2	0.6

Central Wyoming's breeding geese have not been sampled heavily enough to conclusively determine the wintering areas used by them, it is nevertheless clear that the birds that nest along the Wind-Big Horn drainage in Wyoming are Rocky Mountain geese. This affiliation is in contrast to geese nesting along the Big Horn River in Montana, which are HLP birds. The reason for this difference may be that Montana's geese occur naturally, whereas Wyoming's flock was established by transferring Rocky Mountain geese from Northern Utah and Western Wyoming to Ocean Lake. Geese from the Ocean Lake WMA, once they became established, were then transplanted down the Big Horn River as far as the Yellowtail WMA, near the Wyoming-Montana line.

Table 8. *Percentages of band recoveries (direct and indirect considered separately) from adult Canada geese banded preseason on molting areas in Southeastern Idaho, 1946-66. Total numbers of recoveries are shown in parentheses.*

Locality of recovery	Direct (243)	Indirect (426)	Total (669)
Alberta	—	2.1	1.3
Saskatchewan	—	0.2	0.1
Oregon	—	0.2	0.1
Montana	—	1.2	0.7
Idaho	24.3	20.7	22.0
Wyoming	3.7	3.8	3.7
Utah	33.7	33.8	33.8
Nevada	2.5	3.5	3.1
California	16.9	16.7	16.7
Arizona	17.7	15.7	16.4
Others	1.2	2.0	1.6

Table 9. *Percentages of band recoveries (direct and indirect considered separately) from immature and adult Canada geese banded preseason on breeding areas in Western Wyoming, 1958-69. Total numbers of recoveries are shown in parentheses.*

Locality of recovery	Immature			Adult			All age groups		
	Direct (30)	Indirect (42)	Total (72)	Direct (4)	Indirect (9)	Total (13)	Direct (34)	Indirect (51)	Total (85)
Alberta	—	4.8	2.8	—	—	—	—	3.9	2.4
Saskatchewan	—	4.8	2.8	—	—	—	—	3.9	2.4
Idaho	33.3	16.7	23.6	25.0	—	7.7	32.4	13.7	21.2
Wyoming	20.0	7.1	12.5	—	11.1	7.7	17.6	7.8	11.8
Colorado	—	2.4	1.4	—	—	—	—	2.0	1.2
Utah	16.7	23.8	20.8	25.0	44.4	38.5	17.6	27.5	23.5
Nevada	—	4.8	2.8	—	—	—	—	3.9	2.4
California	30.0	26.2	27.8	50.0	44.4	46.2	32.4	29.4	30.6
Arizona	—	4.8	2.8	—	—	—	—	3.9	2.4
Others	—	4.8	2.8	—	—	—	—	4.0	2.4

Table 10. *Percentage distribution of band recoveries (direct and indirect considered separately) from adult Canada geese banded preseason on molting areas in Western Wyoming (Turbid Lake), 1956-72. Total numbers of recoveries are shown in parentheses.*

Locality of recovery	Direct (287)	Indirect (566)	Total (853)
Alberta	—	0.3	0.2
Saskatchewan	—	0.5	0.4
Washington	—	0.2	0.1
Montana	2.1	2.3	2.2
Idaho	17.8	15.2	16.1
Wyoming	36.9	39.8	38.8
Colorado	—	0.7	0.5
Utah	9.1	11.7	10.8
Nevada	1.7	1.4	1.5
California	19.5	15.0	16.5
Arizona	11.9	12.7	12.4
Others	1.0	0.2	0.5

Molting adults banded on Pathfinder Reservoir, which no longer supports a major concentration of molters, originated from nesting areas in Wyoming and perhaps Utah. Geese that molt at Wheatland Reservoir, outside of the eastern edge of Central Wyoming, come from both the RMP and HLP. Judging by the number of recoveries from the vicinities of known nesting areas, most of the Wheatland Reservoir molters were Rocky Mountain geese from nesting areas in southern Central Wyoming (Medicine Bow, North Platte, and Little Snake rivers), eastern Northern Utah (Green River), and Northwestern Colorado (Green, Yampa, and Little Snake rivers). The reported harvest of molters from these two reservoirs combined was distributed among Arizona, California, Colorado, Utah, and Wyoming (Table 12).

Northwestern Colorado

Only a few geese were banded on nesting or wintering areas in Northwestern Colorado. Thus, there is little evidence to reveal where the breeding birds of this region winter, or to locate the nesting-area origins of the geese that winter there. However, breeders banded near Ryegate, Central Montana, and at the Ocean Lake WMA, Central Wyoming, were shot in this reference area, providing evidence that at least some of the geese wintering here nest in the central portions of Montana and Wyoming.

Canada geese moved from the Fort Collins area have become established nesters in North Park, north-central Colorado. The Fort Collins birds are a non-migratory segment of the HLP situated in the foothills on the east slope of the Rockies (Szymczak 1975). About 150 recoveries of birds transplanted to North Park showed these geese wintering within the ranges of both the RMP (Arizona, California) and HLP (Colorado, New Mexico). Because of this dual wintering distribution, North Park geese were excluded from the present study, even though most recoveries were taken along the lower Colorado River.

Northern Utah

Northern Utah geese, especially those nesting adjacent to Great Salt Lake, were more intensively banded than were birds in any other reference area. Two-thirds (67%) of the total recoveries were shot locally (Table 13). Most of those that did not winter locally were shot in Southern California (Figs. B-19, B-20), but others were recovered over an extensive area from

Table 11. *Percentages of band recoveries (direct and indirect considered separately) from immature and adult Canada geese banded preseason on breeding areas in Central Wyoming (Ocean Lake WMA), 1955-73. Total numbers of recoveries are shown in parentheses.*

	Immature			Adult			All age groups		
Locality of recovery	Direct (116)	Indirect (188)	Total (304)	Direct (15)	Indirect (33)	Total (48)	Direct (131)	Indirect (221)	Total (352)
Alberta	—	3.2	2.0	—	—	—	—	2.7	1.7
Saskatchewan	—	4.3	2.6	—	—	—	—	3.6	2.3
Oregon	—	0.5	0.3	—	—	—	—	0.5	0.3
Montana	0.9	5.3	3.6	—	—	—	0.8	4.5	3.1
Idaho	—	4.3	2.6	—	—	—	—	3.6	2.3
Wyoming	60.3	48.4	53.0	40.0	45.5	43.8	58.0	48.0	51.7
Colorado	2.6	4.8	3.9	—	9.1	6.3	2.3	5.4	4.3
Utah	23.3	20.7	21.7	40.0	30.3	33.3	25.2	22.2	23.3
Nevada	0.9	0.5	0.7	—	—	—	0.8	0.5	0.6
California	8.6	1.6	4.3	6.7	12.1	10.4	8.4	3.2	5.1
Arizona	3.4	1.1	2.0	13.3	3.0	6.3	4.6	1.4	2.6
Others	—	5.4	3.3	—	—	—	—	4.6	2.9

central Arizona through the San Joaquin Valley in California. Few geese banded in Northern Utah were reported shot in Northwestern Nevada. Apparently the Northern Utah geese move down the Colorado River into Southern California, their main wintering area, and then northwest into the Riverside area and over the Tehachapi Mountains into the San Joaquin Valley. This hypothesis could be tested with color-marked or radio-tagged geese.

Although sample sizes were too small to provide conclusive evidence, geese nesting on Cutler Reservoir, west of Logan, Utah, were apparently associated with the Great Salt Lake area (20 total recoveries). Geese banded only 45 miles southeast of Logan, on the Bear River near Randolph, Utah, were recovered mainly in southeastern Idaho and southwestern Wyoming (146 total recoveries). Adults banded on Neponset Reservoir near Randolph, most of which were molters, came from nesting areas in southeastern Idaho, southwestern Wyoming, and northeastern Utah (most probably Bear River birds; Table 14). Evidently there is much interchange between the geese nesting on the Bear River in Idaho, Utah, and Wyoming.

Table 12. *Percentages of band recoveries (direct and indirect considered separately) from adult Canada geese banded preseason on molting areas in Central Wyoming (Pathfinder and Wheatland reservoirs), 1952-73. Total numbers of recoveries are shown in parentheses.*

Locality of recovery	Direct (533)	Indirect (1,048)	Total (1,581)
Alberta	—	0.5	0.3
Saskatchewan	—	1.5	1.0
Montana	0.6	1.0	0.8
Idaho	0.2	0.8	0.6
Wyoming	13.1	13.7	13.5
Colorado	13.9	13.5	13.6
Utah	20.3	16.9	18.0
Nevada	0.2	0.3	0.3
California	21.6	20.8	21.1
Arizona	28.1	29.5	29.0
Others	2.1	1.7	1.9

Southern Utah

Breeding geese and their offspring were banded on nine areas, mostly reservoirs, in the central portion of Southern Utah. The most southerly recoveries were from Arizona and California (Table 15). Some geese banded at the Desert Lake WMA, originally transplanted from Great Salt Lake marshes, apparently returned in the fall to Great Salt Lake before migrating south (seven direct recoveries).

Northeastern Nevada

Banding in this reference area was limited to Ruby Lake NWR and adjacent Franklin Lake. Direct recoveries indicated a northeastern migration into Idaho; additional bandings are needed to determine whether this pattern is typical. Both direct and indirect recoveries suggested that breeding geese from Ruby Lake

Table 13. *Percentages of band recoveries (direct and indirect considered separately) from immature and adult Canada geese banded preseason on breeding areas in Northern Utah, 1938-73. Total numbers of recoveries are shown in parentheses.*[a]

	Immature			Adult			All age groups		
Locality of recovery	Direct (2,848)	Indirect (2,812)	Total (5,660)	Direct (622)	Indirect (865)	Total (1,487)	Direct (3,470)	Indirect (3,677)	Total (7,147)
Alberta	T	5.1	2.5	—	1.0	0.6	T	4.1	2.1
British Columbia	—	T	T	—	—	—	—	T	T
Saskatchewan	0.1	2.6	1.3	—	0.1	0.1	0.1	2.0	1.1
Oregon	—	0.4	0.2	—	0.1	0.1	—	0.4	0.2
Washington	—	0.2	0.1	—	—	—	—	0.1	0.1
Montana	—	1.5	0.8	—	0.7	0.4	—	1.3	0.7
Idaho	2.5	6.5	4.5	3.5	5.1	4.4	2.7	6.2	4.5
Wyoming	0.1	0.5	0.3	1.8	0.3	0.9	0.4	0.5	0.4
Colorado	0.1	0.6	0.4	—	0.1	0.1	0.1	0.5	0.3
Utah	76.3	58.5	67.5	67.8	64.3	65.8	74.8	59.9	67.1
Nevada	4.0	3.7	3.9	3.7	3.9	3.8	3.9	3.8	3.8
California	13.5	14.4	14.0	17.7	18.7	18.3	14.2	15.4	14.9
Arizona	3.0	4.3	3.6	4.8	5.1	5.0	3.3	4.5	3.9
Others	0.3	1.3	1.0	0.7	0.4	0.5	0.3	1.2	0.9

[a]T = trace (one band only).

Table 14. *Percentages of band recoveries (direct and indirect considered separately) from adult Canada geese banded preseason on molting areas in Northern Utah (Neponset Reservoir), 1953-73. Total numbers of recoveries are shown in parentheses.*

Locality of recovery	Direct (249)	Indirect (299)	Total (548)
Alberta	—	0.7	0.4
Saskatchewan	—	0.3	0.2
Oregon	—	0.3	0.2
Montana	—	0.3	0.2
Idaho	10.0	12.4	11.3
Wyoming	8.0	7.4	7.7
Utah	32.5	26.1	29.0
Nevada	0.4	1.3	0.9
California	37.3	35.8	36.5
Arizona	11.2	14.0	12.8
Others	0.4	1.3	0.9

and vicinity wintered in Northeastern Nevada and Central California (Table 16). Fall-spring migrants captured on Ruby Lake NWR were shot mainly in southern Idaho and Central California (23 out of 26 recoveries).

Northwestern Nevada

Goslings and adults banded in this region were largely nonmigratory; almost 90% of all recoveries were taken in Nevada (Table 17). Similarly, molters caught on and near the Stillwater WMA were also resident geese (Table 18).

Adults molting on Pyramid Lake were associated mainly with nesting areas in northern California, especially with Honey Lake, some 40 miles west of Pyramid Lake in Lassen County, California. The Canada geese of Lassen County, including most of the Pyramid Lake molters, are a semiresident flock in the

Table 15. *Percentages of band recoveries (direct and indirect considered separately) from immature and adult Canada geese banded preseason on breeding areas in Southern Utah, 1955-73. Total numbers of recoveries are shown in parentheses.*

	Immature			Adult			All age groups		
Locality of recovery	Direct (221)	Indirect (203)	Total (424)	Direct (33)	Indirect (44)	Total (77)	Direct (254)	Indirect (247)	Total (501)
Alberta	—	8.9	4.2	—	—	—	—	7.3	3.6
Saskatchewan	—	5.9	2.8	—	2.3	1.3	—	5.3	2.6
Oregon	—	1.0	0.5	—	—	—	—	0.8	0.4
Montana	—	1.0	0.5	—	—	—	—	0.8	0.4
Idaho	2.3	7.9	5.0	—	2.3	1.3	2.0	6.9	4.4
Wyoming	—	0.5	0.2	—	—	—	—	0.4	0.2
Colorado	—	1.5	0.7	—	—	—	—	1.2	0.6
Utah	50.7	36.9	44.1	75.8	56.8	64.9	53.9	40.5	47.3
Nevada	2.7	0.5	1.7	—	2.3	1.3	2.4	0.8	1.6
California	21.7	24.1	22.9	15.2	22.7	19.5	20.9	23.9	22.4
Arizona	22.2	9.4	16.0	9.1	13.6	11.7	20.5	10.1	15.4
Others	0.5	2.5	1.4	—	—	—	0.4	2.0	1.2

Table 16. *Percentages of band recoveries (direct and indirect considered separately) from immature and adult Canada geese banded preseason on breeding areas in Northeastern Nevada (Ruby Lake NWR), 1959-68. Total numbers of recoveries are shown in parentheses.*

	Immature			Adult			All age groups		
Locality of recovery	Direct (18)	Indirect (23)	Total (41)	Direct (3)	Indirect (5)	Total (8)	Direct (21)	Indirect (28)	Total (49)
Saskatchewan	—	26.1	14.6	—	—	—	—	21.4	12.2
Oregon	11.1	8.7	9.8	—	—	—	9.5	7.1	8.2
Idaho	16.7	34.8	26.8	—	20.0	12.5	14.3	32.1	24.5
Colorado	—	4.3	2.4	—	—	—	—	3.6	2.0
Utah	5.6	4.3	4.9	33.3	—	12.5	9.5	3.6	6.1
Nevada	11.1	—	4.9	33.3	—	12.5	14.3	—	6.1
California	55.6	21.7	36.6	33.3	80.0	62.5	52.4	32.1	40.8

Table 17. *Percentages of band recoveries (direct and indirect considered separately) from immature and adult Canada geese banded preseason on breeding areas in Northwestern Nevada, 1954-69. Total numbers of recoveries are shown in parentheses.*

Locality of recovery	Immature			Adult			All age groups		
	Direct (186)	Indirect (214)	Total (400)	Direct (24)	Indirect (34)	Total (58)	Direct (210)	Indirect (248)	Total (458)
Nevada	93.0	82.2	87.2	91.7	91.1	94.8	92.9	84.3	88.2
California	7.0	12.6	10.0	8.3	2.9	5.2	7.1	11.3	9.4
Other	—	5.1	2.8	—	—	—	—	4.4	2.4

Table 18. *Percentage distribution of band recoveries (direct and indirect considered separately) from adult Canada geese banded preseason on molting areas in Northwestern Nevada, 1955-72. Total numbers of recoveries are shown in parentheses.*

State where recovered	Direct (22)	Indirect (39)	Total (61)
Nevada	86.4	97.4	93.4
California	13.6	2.6	6.6

transition region between the Pacific and Rocky Mountain populations (W. C. Rienecker, personal communication). We note the difficulty in assigning Lassen County geese to either the PP or the RMP, since these two populations are not completely distinct. However, by the time the hunting season opens, the Nevada and California birds have returned to their respective nesting areas and are largely harvested within their respective States.

We used the following general criteria for distinguishing PP and RMP geese: (1) PP geese are more resident than RMP; (2) more indirect recoveries from PP geese are taken in Canada than RMP; and (3) a goose flock classified as PP or RMP must be mostly harvested within its respective population unit. We include geese from Northwestern Nevada in the RMP because, although this flock is resident, (1) few molters from this reference area molt in Canada (Krohn and Bizeau 1979) and (2) the large Canada geese shot in Northwestern Nevada originated locally as well as in Northeastern Nevada, Southeastern Idaho, and Southern Alberta (see Appendix B).

Southern Nevada

Migrating and wintering geese banded on Overton WMA on Lake Mead originated mainly from Northern Utah and Southeastern Idaho (Nevada, Utah, and Idaho accounted for 59 out of 74 recoveries). The use of Overton WMA by geese from these two reference areas was supported by recovery locations of breeders banded in Southeastern Idaho (Figs. B-7, B-8) and Northern Utah (Figs. B-19, B-20).

Central California

Recoveries from geese banded in this wintering area were too few to determine breeding ground origins (W. C. Rienecker, personal communication). However, as indicated by the maps in Appendix B, Central California is an important wintering ground for Rocky Mountain geese originating from an extensive area that includes Southern Alberta, Southeastern Idaho, and Northwestern Nevada.

Southern California

Breeding-ground recoveries from wintering geese banded at the Salton Sea NWR were reported shot mainly in Southeastern Idaho and Northern Utah (California, Idaho, and Utah accounted for 59 out of 73 recoveries). It is not clear whether Colorado and Wyoming contribute significant numbers of geese to this reference area. However, on the basis of available evidence from molters, some geese from Wyoming winter on areas along the Colorado River in west-central Colorado, Southern California, and Western Arizona.

Western Arizona

No wintering geese were banded along the Colorado River or adjacent wintering areas in Arizona. Judging by recoveries from geese banded on northern nesting areas, birds wintering in this region were from Southeastern Idaho, Northern Utah, Southern Utah, Western Wyoming, Central Wyoming, and north-central Colorado (i.e., North Park transplants).

Eastern Arizona

No wintering and few breeding Canada geese were banded in central Arizona. However, recoveries from bandings on northern nesting and molting areas indicate that the geese wintering here are from the same breeding areas as those that winter in Western Arizona (i.e., Southeastern Idaho, Central Wyoming, Western Wyoming, Northern Utah, Southern Utah, and north-central Colorado).

General Band Recovery Patterns

A number of noteworthy patterns emerged from the distributions of more than 19,000 recovered bands. We next discuss five general patterns that occurred in most or all of the reference areas.

Dispersion of Nesting Flocks on Wintering Areas

The scattered distribution of recoveries indicated that geese from any one nesting flock were not always wintering together. MacInnes (1966:536) found that neckbanded Canada geese "from one nesting locality spread throughout the migration range and mix freely with birds from other nesting areas." In contrast, Raveling (1969, 1978) concluded that subgroups on specific wintering sites are from different nesting areas. Future research should be directed toward clarifying the relations between individual nesting and wintering areas, since important management implications are involved (see *Management Recommendations*).

Postmolt Movement of Yearlings

Indirect recoveries from summer bandings are more scattered, both latitudinally and longitudinally, than direct recoveries. Raveling (1976*a*), in a study of *B. c. maxima* in Manitoba, also found indirect recoveries to be spread over a greater area than direct recoveries, and attributed this difference to more widespread movements of yearlings than of older geese. In the present study, indirect band recoveries of Rocky Mountain birds banded in the United States and shot in Southern Alberta and Saskatchewan were interpreted as molt-migrants returning from northern Canada (see *Molt Migration*). Molters were of both sexes and many ages (Table 19). However, most were probably yearlings (Krohn and Bizeau 1979), and thus it is likely that the scattered distribution of indirect recoveries is largely the result of postmolt migrational movement by yearlings (also see Raveling 1976*b*).

Table 19. *Number of indirect recoveries of Canada geese banded as breeders and molters during May through July in the Rocky Mountain Region south of Canada and shot in southern Canada as returning molt-migrants, 1938-73.*

	Life stage at banding	
Sex	Gosling	Adult
Male	161	37
Female	182	37
Unknown	118	20
Total	461	94

Lack of Fidelity to Specific Molting Areas

The widespread distribution of indirect recoveries was noted from geese banded on southern molting areas as well as nesting areas. Although the proportion of indirect recoveries from southern Canada was lower for southern molters than for breeders, the fact that some geese banded on molting areas in the United States were taken in southern Canada as indirect recoveries suggests that over the years individual geese do not always return to the same area to molt.

Recovery Axes

Indirect recoveries from geese banded on nesting areas, in addition to being scattered, tended to form straight recovery axes. The meaning of these recovery axes is unclear, but they suggest that individual goose flocks navigate in fixed directions (Krohn and Bizeau 1979:Fig. 2). The only major exception to a straight line was the pattern formed by the indirect recoveries from bandings in Southern Alberta which were shot in an arc from Southeastern Idaho to Central California. Perhaps Southern California, lying in a line with Southeastern Idaho and Southern Alberta, was the original wintering region for Canada geese nesting in Southern Alberta, and which now winter, in part, in Central California.

East-West Gradient in Breeding-Wintering Area Relations

There were indications, both across southern Idaho and throughout the Region, of an east-west gradient in the relations between nesting and wintering areas. Geese nesting along the western edge of the breeding range of the RMP wintered mainly in Northern California, Central California, and Southwestern Idaho, whereas birds nesting in the eastern part of the Region wintered primarily in Southern California and Arizona. Utah geese, from the center of the RMP's range, wintered throughout Arizona and California but, judging by the total number of recoveries, tended to concentrate along the lower Colorado River across the Salton Sea area to the reservoirs in the vicinity of Riverside, California. More band recoveries are needed from geese marked on nesting areas in Central Montana, Central Wyoming, and Western Wyoming before this cline is fully documented.

Molt Migration

Most Canada geese migrate from their summer to their winter ranges in fall and make a return trip during the spring. Less well known than these spring-fall migrations is a late spring to early fall movement known as the molt migration. A general

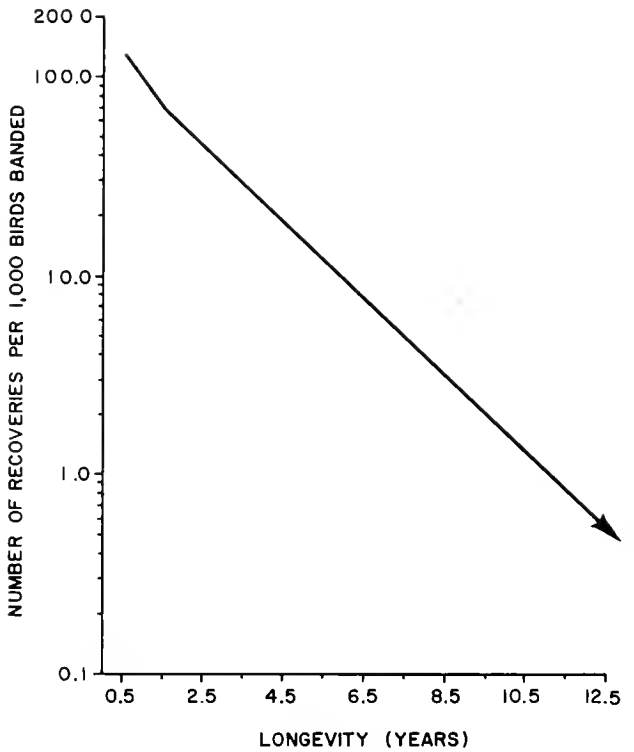


Fig. 2. Average number of recoveries per thousand Canada geese banded as immatures on the three major breeding-ground reference areas of the Rocky Mountain population, 1947-62 (N=4,190 recoveries).

treatment of the movement of *moffitti* to and from molting areas follows. A more detailed discussion of the molt migration of the western Canada goose, giving special emphasis to the RMP, was presented by Krohn and Bizeau (1979).

In the early 1970's, the RMP annually consisted of about 37,000 molters (see *Population Size and Regulation*). Inasmuch as only 12,000 to 18,000 geese use molting areas within the Rocky Mountain Region (Krohn and Bizeau 1979), and appreciable numbers of indirect recoveries are taken in southern Canada (Appendix B), it is apparent that most molters must be migrating north of the RMP's nesting range. Where do these molters go?

No evidence was found to support the contention that thousands of western Canada geese molt in southern Canada. For example, the Peace-Athabasca Delta in northeastern Alberta is known to be a major area for nesting, molting, and staging waterfowl. Nevertheless, no molting Canada geese were found there during extensive waterfowl studies in 1969 and 1970 (Nieman and Dirschl 1973:19-20). Similarly, we found no published references to the occurrence of molting areas now used by large numbers of western Canada geese in Saskatchewan, although molters—mainly HLP but including some RMP geese—were banded in 1953 and 1954 on or near Cypress Lake in southwest Saskatchewan (Bird Banding Laboratory, unpublished data). We do not know the present status of this molting area, but past bandings indicate that it was used by a maximum of only a few hundred Canada geese. Finally, the known numbers of molters in southern Alberta during the early 1970's (300-400) did not account for the anticipated number of molters from this reference area (more than 2,000), nor all the other *moffitti* which apparently migrate north of the United States to molt (some 22,000 RMP molters, plus PP birds).

The north ends of recovery axes formed by indirect recoveries from Canada geese banded on breeding areas across the western United States all point to the Northwest Territories (Krohn and Bizeau 1979:Fig. 2). Assuming that the recovery axes show migrational directions, it appears that the *moffitti* shot in the southern portions of Alberta and Saskatchewan are molters returning from northern Canada.

There is direct evidence that large Canada geese molt in subarctic Canada. The Thelon River, especially that section flowing through the Mackenzie-Keewatin boundary, has long been known as a molting region for large Canada geese (Hanson 1965:78-80; Kuyt 1966). Sterling and Dzubin (1967) estimated that the number of large Canada geese molting in the basins of the Thelon, Back, Dubawnt, Kazan, and Quoick rivers (the region between latitude 60° to 66° N and longitude 96° to 106° W) approached 30,000. From 1963 to 1966, these biologists trapped over 3,600 Canada geese in the Aberdeen-Beverley lakes area of this region. Most of the 154 previously banded geese caught during this trapping operation had been banded in the mid-continental nesting range of the giant Canada goose, *B. c. maxima*, and a few were banded in *moffitti*'s range (Sterling and Dzubin 1967). Band recoveries from the molters tagged at Aberdeen-Beverley lakes were taken mainly within the range of *maxima*, although a few were shot in the western United States (R. T. Sterling, personal communication). Thus, although some *moffitti* molt in the area of Aberdeen-Beverley lakes, we conclude that most molt elsewhere. Since geese were banded in only part of one of the five river basins known to be used by molters, it still is possible that large numbers of western Canada geese molt within this region, especially southwest of the Aberdeen-Beverley lakes area (R. T. Sterling, personal communication).

The percentage of indirect recoveries from Canada geese banded in the western United States which were encountered in southern Canada was markedly higher for the PP than the RMP. Krohn and Bizeau (1979:135)

reported that 7.7% (number recovered, 368) of the RMP geese banded as immatures, and 2% (30) of the adults banded on nesting areas south of Canada, were recovered as indirect recoveries in Alberta and Saskatchewan. In contrast, comparable figures for PP birds from northeastern California were 17.7% (269) for immatures and 7.6% (24) for adults (W. C. Rienecker, personal communication). The higher indirect recovery rate of returning molt-migrants could be higher in the PP than the RMP due to (1) differential survival (i.e., PP geese live longer and thus there is a higher chance of molting in northern Canada), or to (2) habitat differences (i.e., more molting habitat within the RMP's nesting range and hence few geese go to northern Canada to molt). However, survival rates of Canada geese from northeastern California (W. C. Rienecker, personal communication) were almost identical to the overall survival rates of RMP geese found in this study. Additionally, the locations of few molting areas are known within the nesting range of the PP relative to the RMP. Thus, it appears likely that a higher fraction of *B. c. moffitti* from the PP than from the RMP leave the United States each summer to molt in Canada's Northwest Territories.

A number of biologists have speculated on the adaptive significance of waterfowl molt migrations. Milne (1965) felt that, because of their vulnerability during the flightless period, waterfowl gained a survival advantage by moving to a relatively safe place while molting. Sterling and Dzubin (1967) made a similar proposal and added that this behavior would reduce possible competition for food between breeders and nonbreeders. Salomonsen (1968) postulated that heredity was involved, since Canada geese introduced into Great Britain make molt migrations. The ultimate cause of molt migrations, according to Salomonsen (1968), is to move some birds away from the breeding grounds and thus avoid food shortages. Whatever the exact selective advantage, it seems obvious that molt migrations are of adaptive value to the population; otherwise these regular and often long-distance movements would have been eliminated by natural selection.

Breeding Biology and Productivity

We document and evaluate here what is known about the breeding biology and productivity of *B. c. moffitti*. Since few differences in breeding biology were found among western Canada geese from various geographical areas, data from the RMP and PP were combined. Tables in this section are limited to information concerning *moffitti* obtained before 1976. However, data on *maxima* and other races are discussed when relevant.

More nesting studies of *moffitti* have been done than for all other Canada goose subspecies combined, primarily because of the relative accessibility of *moffitti*'s nesting range. However, although nesting in the western Canada goose has been extensively studied, it has yet to be intensively researched. Biologists have generally described this subspecies' breeding biology throughout its range, but they have yet to probe and understand the causes of reproductive variation. Knowing *why* the number of geese produced each year fluctuates would allow managers to increase the population's size by taking advantage of cause-and-effect relations.

Nesting Chronology

Some Canada geese spend the winter in the vicinity of the same areas they use for nesting, whereas others—including most birds in the RMP—regularly move between wintering and nesting areas. Generally, Canada geese are early spring migrants; most birds are on their nesting areas in the Rocky Mountain Region by the middle or end of March. Williams (1967:30) wrote "the time of nesting is highly variable, and is correlated with latitude, altitude, and local variations in climate." Available data support this statement, with the minor exception that latitude causes little variation. Data on nesting phenology as related to latitude and elevations from 23 observations, including those in three areas studied more than once, are shown in Table 20. The week of peak nest initiation was considered the dependent variable and analyzed in terms of Julian dates (i.e., third week of March = 82, fourth week of March = 89, first week of April = 96, second week of April = 103, and third week of April = 110). The first independent variable, latitude, was rounded to the nearest 0.1° (i.e., 40°10′ = 40.2°, 40°20′ = 40.3°, etc.). The second independent variable, altitude, was recorded in feet above mean sea level, rounded to the nearest 10 feet. The range of latitude occupied by the western Canada goose was not correlated with start of egg laying ($P > 0.05$); altitude was significantly related ($P < 0.01$) and accounted for 50% of the observed variation ($r^2 = 0.50$, simple linear regression). Thus, although altitude correlated with nest initiations, the data were so variable that other unanalyzed variables were suggested. Hanson and Eberhardt (1971:16), in their long-term study on the Hanford Atomic Energy Reservation in east-central Washington, found that most Canada goose nests started by the third week of March. However, they noted that the nesting phenology shifted between years in response to mean daily temperatures (Hanson and Eberhardt 1971:20). Consequently much of the variation unaccounted for in the

Table 20. *Peak of nesting (i.e., egg laying) in the western Canada goose, according to latitude and altitude.*

Location and years	North latitude		Altitude (feet above msl)	Time of peak nest initiation		Source
	Degrees	Minutes		Week	Month	
Honey Lake Valley, California, 1939-40	40	10	3,980	2	April	Dow (1943:7)
Honey Lake Refuge, California, 1951	40	10	3,980	1	April	Naylor (1953:87)
Susan River and Honey Lake Refuge, California, 1952	40	10	3,980	1	April	Naylor and Hunt (1954:11-12)
Jackson Hole, Western Wyoming, 1947	43	40	6,500	3	April	Craighead and Craighead (1949:55)
Jackson Hole, Western Wyoming, 1962-64	43	40	6,500	3	April	Dimmick (1968:29)
Gray's Lake, Southeastern Idaho, 1950-51	43	00	6,390	3	April	Steel et al. (1957:38-39)
Bear Lake NWR, Southeastern Idaho, 1952-53	42	10	5,920	2	April	Reeves (1954:112)
Tule Lake and Lower Klamath NWR's, California, 1952	41	50	4,000	1	April	Miller and Collins (1953:394)
Tule Lake and Lower Klamath NWR's, California, 1957	41	50	4,000	4	March	Rienecker and Anderson (1960:487)
Flathead Valley, western Montana, 1953-54	47	30	3,000	4	March	Geis (1956:411)
Hanford Reservation, Washington, 1953-70	46	30	360	3	March	Hanson and Eberhardt (1971:16)
Ogden Bay, Northern Utah, 1956-58	41	10	4,200	3	March	Martin (1964:14)
Brown's Park (Green River), Northwestern Colorado, 1956-59	40	40	5,410	2	April	Grieb et al. (1969:139)
Yampa River, Northwestern Colorado, 1956-59	40	20	5,500	2	April	Grieb et al. (1961:139)
Malheur NWR, Oregon, 1964	42	20	4,400	1	April	Jarvis and Harris (1967:46-47)
Snake River, Washington, 1966-68	46	30	720	4	March	Culbertson et al. (1971:231)
Lake Newell, Southern Alberta, 1968	50	20	2,500	1	April	Vermeer (1970:236)
Bear River, Western Wyoming, 1968	42	00	6,250	1	April	Appel (1969:27-30)
Brown's Park (Green River), Northern Utah-Northwestern Colorado, 1969	40	40	5,410	1	April	Utah Div. Wildl. Resour. (personal communication)
Bitterroot Valley, western Montana, 1969-70	46	20	3,630	4	March	Flath (1970:16-17)
Madison River, Central Montana, 1970-71	45	20	4,830	4	March	Childress (1971:10)
Freezeout Lake WMA, Central Montana, 1971	47	40	3,780	4	March	Hook (1973:9)
South Fork Snake River, Southeastern Idaho, 1972	43	20	5,250	1	April	Merrill and Bizeau (1972:7)

Table 21. *Percentage of spring flocks of western Canada geese consisting of breeding birds.*

Locations and years	Total geese	Percent breeders	Source
Columbia River, Washington, 1950	2,582	59	Hansen and Oliver (1951:5)
Columbia River, Washington, 1950-70	7,754	55	Hanson and Eberhardt (1971:14-15, 33)
Gray's Lake, Southeastern Idaho, 1950-51	1,800	61	Steel et al. (1957:38-41)
Flathead Valley, western Montana, 1953-54	1,877	44	Geis (1956:411)
Ocean Lake WMA, Central Wyoming, 1954-55	226	28	Ballou (1955:60)
Green River, Western Wyoming, 1954-55	231	39	Ballou (1955:60)
Jackson Hole, 1965, Western Wyoming, 1962-63	667	43	Dimmick (1968:64)
Snake River, Washington, 1967-69	427	41	Gibson and Buss (1972:316)
Bitterroot Valley, western Montana, 1969-70	350	34	Flath (1970:15-16)
Green River, Northern Utah–Northwestern Colorado, 1970-75	4,433	30	Utah Div. Wildl. Resour. (personal communication)
Yampa and Little Snake Rivers, Northwestern Colorado, 1975	480	25	Colorado Div. Wildl. (personal communication)
Freezeout Lake WMA, Central Montana, 1971-72	451	54	Hook (1973:8)
Total sample size	21,278	46	

present analysis was presumed to be the result of differences in weather, both between years and between areas.

The period between nest initiation and hatching is about 5 weeks; the first week is spent laying eggs and the next 4 weeks incubating them. More specifically, Canada geese lay eggs at the rate of one per 1.5 days (Kossack 1950:639; Brakhage 1965:758), and incubation lasts 26 to 28 days (Kossack 1950:642; Collias and Jahn 1959:493; Brakhage 1965:761).

Spring Population Composition

The goose population on nesting areas in the spring consists of birds of various breeding potentials: (1) those too young to nest, (2) those old enough, but unable to nest, and (3) those that nest. This last group is termed the breeders and the first two groups, collectively, make up the nonbreeders.

What percentage of the spring population consists of breeders and how variable is this figure? An adequate answer to this question is required before a realistic population model can be developed for Canada geese. Unfortunately, present knowledge of the age-structure and age-specific breeding biology of geese is too meager to enable us to answer this question accurately. An empirical estimate, however, is available from 12 studies, 7 of which were done in the Rocky Mountain Region (Table 21). The weighted mean of these investigations showed that breeders made up 46% of the spring population (range, 25 to 61%; Table 21). This variation was in part biological and partly the result of different methodology. Thus, this average must be viewed cautiously and considered as tentative, since none of the methods employed were completely satisfactory.

The mean age structure of the RMP was estimated in an attempt to obtain a more reliable approximation of the population's spring age composition. Data from birds banded as goslings, 1947-62, in the three major breeding-ground areas were used (Table 22). In this analysis, we assumed that known-age geese were recovered in direct proportion to their abundance. However, since immatures were known to be more vulnerable than adults to gunning (see Table 31), direct recoveries were reduced by being divided by the appropriate relative recovery rates. Recoveries from birds banded as goslings were converted to recoveries per thousand bandings to obtain the frequency distributions for known-age Canada geese from the three major nesting areas. Each of the reference areas used contained nesting flocks of roughly the same size (Table 38). Thus, data were not weighted but merely averaged, since frequency distributions were presumably based on enough recoveries to adequately represent the reference areas. Results were almost identical when the mean number of known age recoveries per thousand banded birds was compared with values calculated from annual survival rates (Table 22).

The mean numbers of recoveries per thousand bandings were plotted on semilogarithmic paper and a line was fitted by inspection to show the average rate of recovery for known-age geese (Fig. 2). We then used this curve to obtain adjusted frequencies and age structures for two times of the year (Table 23). Thus, the RMP was estimated to consist of a mean of 40% immatures and 60% adults before the hunting season opened in 1947-62 (Table 23). These values compare with 46% first-year and 54% older birds in the Dusky Canada goose (*B. c. occidentalis*) population, 1952-59

Table 22. *Recoveries of Canada geese banded as immatures on the three major breeding-ground reference areas of the Rocky Mountain population, 1947-62.*

Reference area and adjusted number of recoveries	Recoveries per 1,000 birds banded, arranged by years after banding when shot												
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	>12
Southern Alberta, 624	123.0[a]	71.0	40.0	31.5	15.0	12.0	8.5	5.0	2.5	2.0	0.5	0.0	1.0
Southeastern Idaho, 1,029	102.7[a]	65.6	42.4	25.2	18.7	14.4	6.2	6.8	4.0	2.0	1.4	0.6	1.1
Northern Utah, 2,537	155.5[a]	69.0	41.9	26.4	19.3	11.7	6.3	4.7	2.2	1.6	1.9	0.7	0.8
Mean	127.1	68.5	41.4	27.7	17.7	12.7	7.0	5.5	2.9	1.9	1.3	0.4	1.0
Check[b]	127.1	67.4	43.1	27.6	17.7	11.3	7.2	4.6	3.0	1.9	1.2	0.8	0.5[c]

[a]Adjusted number of direct recoveries per 1,000 goslings banded, obtained by dividing unadjusted figures by relative recovery rates: Southern Alberta = 1.56; Southeastern Idaho = 1.57; and Northern Utah = 1.16.
[b]Calculated from the following mean annual survival rates: immature = 0.53, adult = 0.64 (Table 34).
[c]Not cumulative.

(Chapman et al. 1969:28, 31), and 40% immatures and 60% adults in the western segment of the Shortgrass Prairie population, 1950-64 (Grieb 1970:39-40.).

The prehunting and posthunting age structures in Table 23 were used to approximate the percentages of breeders and nonbreeders in the spring population (Table 24). Although Tables 21 and 24 suggest a spring population of 46 and 48% breeders, respectively, these percentages could be too high. Table 24, our best estimate of the breeder-nonbreeder composition of the spring population, is based on the unrealistic assumption that all geese 3 or more years old breed. Because some Canada geese 3 years old or older do not nest (as discussed later), the percentage of spring breeders might be substantially less than 48%. Also, calculations based on reliable production estimates suggest that, given a RMP averaging 40% immatures in the fall (Table 23), the preceding spring's population must consist of only about 39% breeders. Unfortunately, the reliability of our fall age-structure

Table 23. *Estimated average age structures of the Rocky Mountain population of Canada geese in fall and spring, based on adjusted recovery frequencies of Canada geese banded as immatures on the three major breeding-ground reference areas, 1947-62.*

Age (years)	Adjusted frequency[a]	Prehunting age structure (%)	Age (years)	Adjusted frequency[a]	Posthunting age structure (%)
0.5	127.0	40.2	1	90.0	37.1
1.5	69.0	21.8	2	55.0	22.7
2.5	42.0	13.3	3	35.0	14.4
3.5	28.0	8.9	4	22.0	9.1
4.5	18.0	5.7	5	14.0	5.8
5.5	12.0	3.8	6	9.0	3.7
6.5	7.2	2.3	7	6.9	2.8
7.5	4.7	1.5	8	4.6	1.9
8.5	3.0	0.9	9	2.4	1.0
9.5	1.9	0.6	10	1.5	0.6
10.5	1.2	0.4	11	1.0	0.4
11.5	0.8	0.3	12	0.6	0.3
12.5	0.5	0.2	13	0.4	0.1
13.5	0.3	0.1	14	0.2	0.1
14.5	0.2		15+	0.1	
15.5+	0.1				
Totals	315.9			242.7	

[a]From Fig. 2.

Table 24. *Estimates of the percentages of breeders and nonbreeders in the Rocky Mountain population during the spring.*

Fall ages (years)	Spring ages (years)	Fall age structure (%)		Survival rates[b]		No. of 100 fall birds[c] surviving	Spring age structure (%)	Breeders and nonbreeders[d]
Method I (Prehunting ages)								
0.5	—	40.2[a]	×	0.53	=	21.3	35.7	Nonbreeders = 52%
1.5	—	21.8[a]	×	0.64	=	14.0	23.5	Breeders = 48%
2.5+	—	38.0[a]	×	0.64	=	24.3	40.8	
Total		100.0				59.6	100.0	
Method II (Posthunting ages)								
	1						37.1[a]	Nonbreeders = 52%
	2						22.7[a]	Breeders = 48%
	3+						40.2[a]	
Total							100.0	

[a]From Table 23.
[b]Rates from Table 34.
[c]Assuming all mortality occurs between fall (start) and spring (end) migrations.
[d]Assuming no yearlings nest, one-third of the 2-year-olds nest, and all birds 3 or more years old nest (Martin 1964:15).

estimate is unknown. If the data had been available, the fall age structure could have been checked against the age composition of hunter-killed geese adjusted for differential vulnerability. It might be possible to directly estimate the percentage of available breeders in the spring with refined censuses. This direct approach, along with more research on age-specific nesting rates and age structures, could eventually provide the data required for a thorough understanding of the RMP's age composition in the spring.

Breeding Age and Nonbreeders

Craighead and Stockstad (1964), who studied marked geese of known ages in the Flathead Valley of Montana to determine what proportions of the 1-, 2-, and 3-year-old birds nested, found that none of the geese approaching the end of their first year of life nested, 27 to 36% of the 2-year-olds established nests, and all of the 3-year-olds nested. Martin (1964:15), in his studies of marked geese at Ogden Bay, Utah, concluded that 33% of the 2-year-old females, and practically all 3-year-olds, nested. Compared with the preceding percentages, captive flocks consistently showed lower fractions of known-age nesters (e.g., Craighead and Stockstad 1964; Kossack 1950). Thus, age-specific nesting rates are not inherently fixed, but are variable and probably influenced by a number of factors including density of nesting pairs. If density of breeders is a major factor, the percentages of 2-year-olds nesting might be higher in flocks where hunting markedly reduces the number of adults than in flocks where adults are lightly harvested. Craighead and Stockstad (1964) and Martin (1964) considered their respective flocks in Montana and Utah to be heavily hunted. Thus, the assumption in Table 24 that one-third of the 2-year-olds and all of the older birds nest could be invalid since in lightly hunted flocks lower proportions might be nesting because of the greater population densities and greater intraspecific competition for nesting sites and food.

Estimating the productivity of Canada geese is not only complicated by the need to determine age-specific nesting rates for flocks of different densities, but also by nonbreeding in birds old enough to nest. Brakhage (1965), studying *B. c. maxima* in Missouri, reported that not all geese, even those 3 or more years old, attempted nesting. More specifically, Brakhage (1965:756) found that 6% of the males and 18% of the females 3 years old and older did not nest. Intensive studies of small, tundra-nesting Canada geese (*B. c. hutchinsii-parvipes* complex) at the mouth of the McConnell River, Northwest Territories, revealed that adults known to have nested sometimes failed to nest in later years (MacInnes et al. 1974). Although MacInnes et al. (1974) found that the percentage of adult nonbreeders was difficult to estimate (minima of 6 to 22% to maxima of 18 to 41%), they concluded that nonbreeding in geese old enough to nest significantly reduced production, and that the fraction of adult nonbreeders varied greatly between years. Nonbreeding in adults could be caused by a number of factors, including insufficient energy reserves (MacInnes et al. 1974), injuries, or perhaps even old age.

No specific studies have been made of *B. c. moffitti*

to determine whether all adults nest each year. Nevertheless, since this phenomenon has been observed in Canada geese nesting in both arctic (MacInnes et al. 1974) and temperate (Brakhage 1965, and others) regions, there is ample reason to suspect that not all adult western Canada geese nest. However, if inadequate energy supplies are the main cause of adult nonbreeding, the percentage of adult nonbreeders would possibly be lower, and perhaps less variable, in the RMP and PP, where the temperate climate allows for a longer nesting season, and thus more time for feeding before nesting (also a function of a shorter spring migration), than in geese nesting in arctic and subarctic regions.

Clutch Size

More data have been collected on the clutch size of the western Canada goose than on any other aspect of *moffitti*'s breeding biology. We tabulated information by complete and successful clutches according to three habitat categories (Table 25). Complete clutches were the number of eggs in nests when birds started to incubate, and a successful clutch was the number of eggs hatched from a nest in which at least one egg hatched. Over 4,900 complete clutches that were examined were distributed by the following habitat types: lakes and reservoirs, 467; marshes and impoundments, 1,730; and rivers and bottomlands, 2,747 (Table 25). Successful clutches totaled nearly 13,000 and were distributed as follows: lakes and reservoirs, 2,598; marshes and impoundments, 1,554; and rivers and bottomlands, 8,844 (Table 25). Although the weighted mean clutch sizes, both complete and successful, of the first two habitat categories were similar, the mean sizes of complete and successful clutches from river-bottomland habitats were larger. The larger mean clutches from river-bottomland habitats may have been due to the predominance of clutches from the Columbia River in Washington and the Snake River in southwestern Idaho. Clutches from these two regions are consistently larger than those anywhere else in *moffitti*'s range, perhaps because of the more moderate climate and its favorable effect on the birds' food resources, including availability during the critical late winter-early spring period. Additionally, Canada geese nesting in these two regions are essentially resident flocks, and thus can spend more time feeding and may use less energy flying than do geese of more migratory flocks.

As an overall weighted average, successful clutches were 9.9% smaller than complete clutches (successful plus unsuccessful nests)—5.45 vs. 4.91 (from Table 25). MacInnes and Misra (1972) showed that human disturbance of Canada goose nests in the McConnell River region was the major factor causing egg loss to predators. It is not known how much, if any, of the difference between complete and successful clutch sizes in the western Canada goose was due to man-induced predation.

MacInnes et al. (1974) reported that year-to-year changes in mean sizes of complete clutches were due to changes in the frequency distributions of clutches and not to shifts in the mean of a common distribution. MacInnes et al. (1974), using the original data of W. C. Hanson (Hanson and Eberhardt 1971), also saw shifts in the underlying distributions of clutches from the Hanford Reservation in Washington. Available data on the frequency distribution of more than 1,300 complete clutches of western Canada geese showed that nests with five or six eggs constituted more than 63% of the total eggs (869 out of 1,362; from Table 26). The heterogeneity of variances of these data was not tested, since clutches came from so many different nesting areas over various years. However, future investigators of *moffitti* should pay particular attention to yearly shifts in the frequency distributions of clutches and possible causes of such shifts.

Lack (1967, 1968:222-237) postulated that clutch sizes in waterfowl were determined by food and energy reserves available when females start laying. The conclusions of MacInnes et al. (1974) support this contention and point out the need to know more about relations between geese and their habitats from the time birds leave their wintering areas through rearing of broods. Observations in the Rocky Mountain Region have indicated that sites free of snow early in the spring and supporting low vegetation, such as grasses or sedges, were heavily used by geese for spring feeding, often supported dense nesting, and sometimes were later used as brood rearing sites. Obviously, a better understanding is required of the relations between food availability, condition of females, location of nesting sites, and brood survival so that "goose pastures" can be more soundly managed. Managers of goose habitat should be aware of the pioneering research of Owen (1973, 1975) on the management of grasslands for wintering white-fronted geese (*Anser albifrons*) in Great Britain.

Nesting Success

Nesting success—as used here, the percentage of total nests examined in which at least one egg hatched—has been determined for 18,200 nests of *moffitti* (Table 27). The distribution of nests by habitat types was as follows: lakes and reservoirs, 3,673; marshes and impoundments, 2,303; and rivers and bottomlands,12,255 (Table 27). Mean nesting success was 72% for lake-reservoir and marsh-impoundment habitats and 73% for river-bottomland habitats; overall nesting success was 73% (13,302 ÷ 18,231;

Table 25. *Mean clutch sizes of the western Canada goose according to habitat types.*

Locations and years	Complete clutches[a] No. eggs	Complete clutches[a] No. clutches	Successful clutches[b] No. eggs hatched	Successful clutches[b] No. clutches	Eggs to young (%)	Source
Principal habitat type: Lake						
Flathead Valley, western Montana, 1953-54	5.34	358	4.91	220	-8.1	Geis (1956:413)
Blackfoot, Island Park, and Mud Lake Reservoirs, Southeastern Idaho						
1952-55	—	—	4.54	456	—	Salter (1956:193)
1959-75	—	—	4.46	1,705	—	Idaho Dep. Fish Game (personal communication)
Hartson Reservoir, California, 1963	—	—	4.04	92	—	Anderson (1965:11)
Lake Newell, Southern Alberta, 1968	5.80	41	4.95	39	-14.7	Vermeer (1970:238-239)
Neponset Reservoir, Northern Utah, 1969	—	—	4.44	18	—	Arneson (1970:42)
Freezout Lake WMA, Central Montana, 1971-72	5.44	68	5.06	68	-7.0	Hook (1973:14-15)
Weighted means	5.40	467	4.52	2,598	-16.3	
Principal habitat type: Marsh						
Honey Lake Valley, California, 1940	5.48	127	5.11	127	-6.8	Dow (1943:17)
Honey Lake Refuge, California, 1951	5.54	330	4.58	246	-17.3	Naylor (1953:90)
Susan River and Honey Lake Refuge, California, 1952	5.21	83	4.31	83	-17.3	Naylor and Hunt (1954:12-13)
Gray's Lake, Southeastern Idaho, 1949-51	5.14	364	4.41	285	-14.2	Steel et al. (1957:40-41)
Bear Lake NWR, Southeastern Idaho, 1952-53	5.44	154	4.38	130	-19.5	Reeves (1954:113,117,119)
Tule Lake and Lower Klamath NWR's, California						
1952	5.13	158	4.46	158	-13.1	Miller and Collins (1953:393)
1957	5.46	210	4.77	210	-12.6	Rienecker and Anderson (1960:486)
Ogden Bay, Northern Utah						
1956-58	5.57	202	5.08	164	-8.8	Martin (1964:42,47)
1959-60	5.31	102	4.78	102	-10.0	Dey (1964:20)
Malheur NWR, Oregon, 1964	—	—	4.49	49	—	Jarvis and Harris (1967:47)
Weighted means	5.37	1,730	4.64	1,554	-13.6	
Principal habitat type: Stream						
Columbia River, Washington, 1953-70	5.50	2,688	4.88	2,688	-11.3	Hanson and Eberhardt (1971:29)
Snake River, Washington, 1954-70	—	—	5.50	220	—	Gibson and Buss (1972:306)
Snake River, southwestern Idaho						
1952-55	—	—	5.05	614	—	Salter (1956:193)
1959-75	—	—	5.17	3,081	—	Idaho Dep. Fish Game (personal communication)

Table 25. Continued.

Locations and years	Complete clutches[a] No. eggs	Complete clutches[a] No. clutches	Successful clutches[b] No. eggs hatched	Successful clutches[b] No. clutches	Eggs to young (%)	Source
North Fork Snake River, Southeastern Idaho						
1954-55	—	—	4.51	55	—	Salter (1956:193)
1959-75	—	—	4.57	358	—	Idaho Dep. Fish Game (personal communication)
Green and Yampa rivers, Northwestern Colorado, 1956-59	—	—	5.18	57	—	Grieb et al. (1961:140)
Payette River, southwestern Idaho, 1959-75	—	—	5.23	1,373	—	Idaho Dep. Fish Game (personal communication)
Bear River and Saletratus Creek, Northern Utah-Western Wyoming, 1969	—	—	5.06	18	—	Arneson (1970:42)
Madison River, Central Montana, 1971	5.64	59	5.31	48	-5.9	Childress (1971:13-15)
South Fork Snake River, Southeastern Idaho, 1972	—	—	5.11	95	—	Merrill and Bizeau (1972:8)
Snake River, Oregon and southwestern Idaho, 1974-75	—	—	5.25	237	—	D. A. Asherin (personal communication)
Weighted means	5.50	2,747	5.07	8,844	-7.8	

[a]Complete clutches are eggs in nests which are being incubated (can include clutches from successful or unsuccessful nests).
[b]A successful clutch comes from a nest in which at least one egg hatched.

from Table 27).

The causes of nest failures (Table 27) must be viewed with caution because they may not be completely accurate. A destroyed nest could have been deserted before it was destroyed. In turn, the nest may have been deserted because the eggs froze and thus the "cause" of failure was incorrectly recorded and almost impossible to determine. These data are presented only to show that desertion and destruction, no matter what the underlying cause, account for most nest losses. This observation has important management implications, since desertion can be minimized in areas with much human activity by regulating fishing seasons and access during the nesting season (Brakhage 1965:764).

Characteristics of the geese themselves can influence nesting success. Munro (1960:548), who studied goose nesting islands in southern British Columbia where nest densities exceeded 30 per acre, found desertion rates to be density dependent. Similarly, Ewaschuk and Boag (1972) reported that on an island in Dowling Lake, Alberta, the percentage of successful nests increased as the number of nests per acre decreased between years. However, with the possible exception of Southern Alberta, the densities of most nesting areas within the range of the RMP are well below levels considered to be overcrowded.

Under some conditions Canada geese renest if the first nest is lost (e.g., Geis 1956; Atwater 1959; Brakhage 1965). Geese that were still laying eggs (not yet incubating) at the time of nest destruction were much more likely to establish a second nest than were those already incubating eggs (Brakhage 1965:766). Because goose renesting has not been thoroughly studied in the western Canada goose, the importance of this factor to overall production of the RMP is unclear.

Influence of Nesting Structures

Yocom (1952) demonstrated that *B. c. moffitti* readily nests in articial structures, and believed that elevated platforms increased the size of a goose flock near the British Columbia-Washington border. Craighead and Stockstad (1961), who evaluated goose nesting platforms by trying to determine whether the number of geese nesting in the Flathead Valley increased when man-made platforms were installed, found that an increased use of platforms corresponded to a decrease in ground nests, and that the total number of nesters remained roughly the same. A net gain in goslings hatched was recorded and these biologists concluded that structures were a positive management tech-

Table 26. *Frequency distribution of numbers of eggs in 1,362 clutches of the western Canada goose nesting in different areas.*

Locations and years	Number of nests by clutch size											$\bar{X} \pm SD$	Source
	1	2	3	4	5	6	7	8	9	10	11		
Bear River Refuge, Northern Utah, 1937[a]	0	4	3	21	*32*[d]	20	3	1	0	0	0	4.88±1.14	Williams and Marshall (1937:82)
Tule Lake and Lower Klamath NWR's, California[b]													
1952	1	4	14	23	*53*	47	11	3	1	1	0	5.13±1.35	Miller and Collins (1953:394)
1957	2	1	8	34	61	*70*	24	5	2	1	2	5.36±1.38	Rienecker and Anderson (1960:487)
Lake Lenore, Washington[c]													
1952	0	1	0	4	*6*	5	1	0	0	0	0	5.00±1.14	Yocom et al. (1956:15)
1953	0	0	0	3	3	*6*	2	1	0	0	0	5.67±1.14	Yocom et al. (1956:15)
Bear Lake NWR, Southeastern Idaho[a]													
1952	0	1	0	13	43	*47*	9	3	0	0	0	5.50±0.94	Reeves (1954:113)
1953	0	0	1	7	*14*	13	3	0	0	0	0	5.26±0.94	Reeves (1954:113)
Flathead Valley, western Montana[c]													
1953	0	2	11	21	*53*	47	18	12	3	2	0	5.54±1.46	Geis (1956:413)
1954	0	2	16	39	*61*	50	19	3	1	0	0	5.16±1.19	Geis (1956:413)
Ogden Bay, Northern Utah[c]													
1956	0	1	3	4	*12*	10	2	2	0	0	0	5.21±1.32	Martin (1964:42)
1957	0	1	1	11	13	*29*	9	2	0	0	0	5.56±1.14	Martin (1964:42)
1958	0	2	4	11	13	*45*	20	3	0	0	0	5.70±1.23	Martin (1964:42)
Lake Newell, Southern Alberta, 1968[c]	0	0	0	3	13	*19*	4	1	0	0	1	5.80±1.17	Vermeer (1970:238)
Madison River, Central Montana[c]													
1970	0	0	2	0	5	*8*	6	0	0	0	0	5.76±1.15	Childress (1971:13)
1971	0	0	0	5	11	*18*	4	0	0	0	0	5.55±0.85	Childress (1971:13)
Freezout Lake WMA, Central Montana[b]													
1971	0	0	4	3	*12*	5	3	0	0	0	0	5.00±1.16	Hook (1973:15)
1972	0	0	4	2	5	*20*	10	0	0	0	0	5.73±1.17	Hook (1973:15)
Total	3	17	71	204	410	*459*	148	36	7	4	3	5.38±1.27	

[a]Clutches assumed to be complete.
[b]Successful nests only (nests in which at least one egg hatched).
[c]Nests being incubated (inclusion of both successful and unsuccessful nests is assumed).
[d]Italicized numbers are peak numbers of nests.

nique, provided they were maintained annually and located in areas remote from people.

Since these early studies, nesting platforms have been widely used in the Rocky Mountain Region, especially in Idaho and Wyoming. In the early 1970's, more than 1,500 artificial nesting structures were located on nesting areas used by the RMP. Most of these structures were platforms placed on mainlands (1,118), although islands (79) and floating platforms (15) were also used. About 330 man-made islands have also been constructed, all on State and Federal wildlife areas. Southeastern Idaho had the largest number of artificial structures (431), followed by Central Wyoming (396) and Western Wyoming (337). The remaining 381 structures were in Northwestern Colorado (140), Central Montana (135), Northern Utah (90), Southern Utah (8), and Eastern Arizona (8).

Increasing the number of secure nesting sites can increase goose production. Available comparisons of elevated and ground nests on six areas in the western United States indicated that geese nesting on structures have both a higher nesting success and hatching rate than do geese nesting on the ground (Table 28). A mean of 91% of the 687 elevated nests hatched one or more eggs, compared with 69% of 2,178 ground nests ($P < 0.01$, Chi-square; Table 28). The mean number of eggs hatched was 5.2 in 425 elevated nests compared with 4.7 in 1,032 ground nests (Table 28; the data

Table 27. *Percentage and (in parentheses) number of successful and unsuccessful nests of the western Canada goose according to habitat types.*

Locations and years	Successful (hatched)	Unsuccessful				Source
		Deserted	Destroyed	Flooded	Other[a]	
Principal habitat type: Lake (total nests, 3,673)						
Flathead Valley, western Montana, 1953-54	62 (260)	14 (59)	22 (94)	2 (10)	0	Geis (1956:414)
Blackfoot, Island Park, and Mud Lake reservoirs; Southeastern Idaho						
1952-55	69 (456)	—	—	—	—	Salter (1956:193)
1959-75	76 (1,705)	—	—	—	—	Idaho Dep. Fish Game (personal communication)
Harston Reservoir, California, 1963	69 (92)	20 (26)	3 (4)	0	8 (11)	Anderson (1965:11)
Lake Newell, southern Alberta, 1968	80 (39)	14 (7)	4 (2)	0	2 (1)	Vermeer (1970:238)
Neponset Reservoir, Northern Utah, 1969	75 (18)	13 (3)	13 (3)	0	0	Arneson (1970:42)
Freezout Lake WMA, Central Montana, 1971-72	71 (86)	6 (8)	23 (28)	0	0	Hook (1973:11)
Weighted means	72 (2,656)	13 (98)	18 (136)	1 (10)	1 (12)	
Principal habitat type: Marsh (total nests, 2,303)						
Honey Lake Valley, California, 1939-40	57 (238)	7 (29)	20 (83)	9 (37)	7 (31)	Dow (1943:13-15)
Honey Lake Refuge, California, 1951	68 (246)	24 (86)	6 (22)	2 (6)	0	Naylor (1953:91)
Susan River and Honey Lake Refuge, California, 1952	72 (83)	11 (13)	11 (13)	0	5 (6)	Naylor and Hunt (1954:12-13)
Gray's Lake, Southeastern Idaho, 1949-51	80 (287)	15 (54)	0	4 (15)	1 (5)	Steel et al. (1957:40)
Bear Lake NWR, Southeastern Idaho, 1952-53	75 (130)	17 (29)	7 (12)	0	1 (2)	Reeves (1954:116,120)
Tule Lake and Lower Klamath NWR's, California, 1952	79 (158)	11 (23)	3 (5)	5 (10)	3 (5)	Miller and Collins (1953:392)
Tule Lake and Lower Klamath NWR's, California, 1957	79 (210)	13 (34)	7 (19)	2 (4)	0	Rienecker and Anderson (1960:486)
Ogden Bay, Northern Utah, 1956-58	80 (164)	11 (24)	7 (14)	1 (2)	1 (2)	Martin (1964:47)
Ogden Bay, Northern Utah, 1959-60	82 (102)	13 (16)	5 (6)	0	0	Dey (1964:20)
Malheur NWR, Oregon, 1964	63 (49)	35 (27)	0	1 (1)	1 (1)	Jarvis and Harris (1967:47-48)
Weighted means	72 (1,667)	15 (335)	8 (174)	3 (75)	2 (52)	
Principal habitat type: Stream (total nests, 12,255)						
Columbia River, Washington, 1953-70	70 (2,688)	14 (535)	12 (459)	2 (77)	1 (38)	Hanson and Eberhardt (1971:25)
Snake River, Washington, 1954-70	70 (220)	12 (38)	18 (56)	0	0	Gibson and Bliss (1972:306)
Snake River, Western Wyoming, 1947	24 (21)	0	15 (13)	10 (9)	51 (45)	Craighead and Craighead (1949:59)
Snake River, Western Wyoming, 1962-64	62 (114)	3 (4)	18 (24)	4 (5)	13 (18)	Dimmick (1968:46)
Snake River, southwestern Idaho, 1952-55	64 (614)	—	—	—	—	Salter (1956:193)

Table 27. Continued.

Locations and years	Successful (hatched)	Unsuccessful				Source
		Deserted	Destroyed	Flooded	Other[a]	
Snake River, southwestern Idaho, 1959-75	77 (3,081)	—	—	—	—	Idaho Dep. Fish Game (personal communication)
North Fork Snake River, Southeastern Idaho, 1954-55	78 (55)	—	—	—	—	Salter (1956:193)
North Fork Snake River, Southeastern Idaho, 1949-75	85 (358)	—	—	—	—	Idaho Dep. Fish Game (personal communication)
Green and Yampa Rivers, Northwestern Colorado, 1956-59	84 (57)	0	1 (1)	9 (6)	6 (4)	Grieb et al. (1961:142)
Payette River, southwestern Idaho, 1959-75	73 (1,373)	—	—	—	—	Idaho Dep. Fish Game (personal communication)
Bear River and Saleratus Creek, Northern Utah-Western Wyoming, 1969	50 (18)	14 (5)	36 (13)	0	0	Arneson (1970:42)
Madison River, Central Montana, 1971	80 (48)	8 (5)	8 (5)	0	3 (2)	Childress (1971:14)
South Fork Snake River, Southeastern Idaho, 1972	88 (95)	6 (6)	4 (4)	2 (2)	1 (1)	Merrill and Bizeau (1972:18)
Snake River, Oregon-southwestern Idaho, 1974-75	81 (237)	—	—	—	—	D. A. Asherin (personal communication)
Weighted means	73 (8,979)	12 (593)	12 (575)	2 (99)	2 (108)	

[a]Undetermined and miscellaneous causes.

could not be tested statistically). The question of whether extensive use of man-made platforms increases local goose flocks is still unanswered, although the data show that elevated platforms can increase gosling production and thus are a useful management tool—especially in areas where spring floods or ground predators are problems.

The acceptance of nesting platforms by Canada geese appears to be related to the availability of other safe nesting sites, and to the imprinting of goslings to platforms. In a flock with limited nesting sites, on the Boundary County WMA in northern Idaho, almost all structures were used and many platforms were occupied the same spring they were installed (R. C. Norell, personal communication). Canada geese have not nested on structures in all areas where they have been tried. Two areas where nesting structures have had little use are the Great Salt Lake marshes and the lower Columbia River. In areas that are generally snow-covered in spring, platforms are among the first sites from which snow melts, and thus they tend to attract nesting geese. Both the lower Columbia River and the Great Salt Lake marshes in Utah are normally snow-free in the spring, thus giving geese little incentive to use platforms; these areas are also liberally supplied with natural nesting sites. In California, the use of platforms tended to increase gradually over 2 to 4 years after construction, up to 53% by the end of this period (Rienecker 1971:122). In areas where geese do not readily accept platforms, goslings can be imprinted to use platforms by slowly moving ground nests onto structures before the eggs hatch (Gore 1973).

Gosling Survival

Table 29 summarizes what is known about the mortality of young *moffitti* between hatching and fledging. Generally, one of two methods was used in estimating gosling mortality: (1) regression of mean brood size on time, or (2) the difference between the number of eggs hatched and the number of young reaching flight age. The first technique is often invalid and must be viewed with caution because individual broods group and some entire broods are lost. The second method, although requiring more time, results in more reliable estimates.

Table 28. *Comparison of the reproductive performance of the western Canada goose on elevated versus ground nesting sites in different areas: percentage of successful nests and mean clutch size.*

Location and years	Successful nests, by nesting area				Mean clutch size, by nesting area				Source
	Elevated		Ground		Elevated		Ground		
	Percent successful	No. nests observed	Percent successful	No. nests observed	No. eggs	No. nests observed	No. eggs	No. nests observed	
Hartson Reservoir and adjacent ponds, California									
1951	—	—	68.3	360	—	—	—	—	Naylor (1953:93)
1963	—	—	69.2	130	—	—	—	—	Anderson (1965:11)
1966-70	98.1	104	—	—	—	—	—	—	Rienecker (1971: 123)
Flathead Valley, western Montana									
1953-58	—	—	65.3	1,163	—	—	4.49	759	Craighead and Stockstad (1961:368-369)
1954-58	71.4	49	—	—	4.91	35	—	—	
Bear River, Northern Utah and Western Wyoming, 1968	90.9	11	81.8	33	5.30	10	4.33	27	Appel (1969: 41, 48)
Brown's Park NWR, Northwestern Colorado, 1969-74	87.3	110	72.5	178	—	—	—	—	Utah Div. Wildl. Resour. (personal communication)
Ocean Lake WMA, Central Wyoming, 1971-75	92.1	394	80.1	151	5.21	363	4.60	121	Wyoming Game Fish Dep. (personal communication)
National Bison Range and Ninepipe NWR, western Montana, 1972-76	89.5	19	76.7	163	6.29	17	5.93	125	USFWS Refuge records (personal communication)
Weighted means	90.7		69.2		5.2		4.7		
Totals		687		2,178		425		1,032	

Geis (1956:417-418), using the second method, found gosling mortality to vary from 33% in the Polson Bay area of Flathead Lake to 7.5% in the western and northern portions of the lake. She attributed the high mortality of the Polson Bay goslings to long-distance movements from nesting to brooding sites, especially over land, where young geese were vulnerable to predation. Overall gosling mortality in the Western Canada goose is 5.1% (Table 29). Additionally, the difference between the weighted mean size of successful clutches (4.91, from Table 25) and the weighted mean brood size (4.65, Table 29) is 0.26 or 5.3%. Both figures probably underestimate gosling mortality because many of the broods recorded in Table 29 were observed well before fledging. Also, studies tended to be done in open habitats supporting concentrations of geese where mortality was likely to be low compared with that in more heavily vegetated sites with scattered families. The unweighted average of the means (Table 29) indicates a gosling mortality rate of almost 8%. This figure, since it gives each mean equal weight regardless of the number of broods studied, is probably high; thus it appears that RMP gosling mortality is in the range of 5 to 8%.

Whatever the exact rate of gosling mortality in the RMP, it appears that mortality of flightless young is small compared with nest losses. Consequently, management measures applied toward increasing the hatching success of nests should be more productive than measures applied toward reducing the mortality of the young.

Table 29. *Brood size and gosling mortality of the western Canada goose.*

Locations and years	Mean No. per brood	No. of broods	Gosling mortality (%)	Basis of mortality estimate	Source
Jackson Hole, Western Wyoming, 1947	4.48	21	—	Ages of goslings unspecified.	Craighead and Craighead (1949:56)
Jackson Hole, Western Wyoming, 1962-64	4.67	61	-10.9	Mean sizes of complete clutches and broods compared; ages of goslings unspecified.	Dimmick (1968:52)
Gray's Lake, Southeastern Idaho, 1949-51	4.22	41	-4.3	Mean sizes of hatched clutches and broods compared; goslings were two-thirds grown.	Steel et al. (1957:41)
Honey Lake Valley, California, 1952	4.12	70	-4.4	Mean sizes of hatched clutches and broods compared; goslings were 1 week old.	Naylor and Hunt (1954:14)
Hanford Reservation, Washington, 1953-70	4.74	434	-2.9	Mean sizes of hatched clutches and broods compared; goslings were 1 to 4 weeks old.	Hanson and Eberhardt (1971:29,33)
Flathead Valley, western Montana, 1953-54	—	—	-18.7	Total number eggs hatched compared with number goslings counted at season end; mortality varied between areas.	Geis (1956:417,418)
Ogden Bay, Northern Utah, 1956-58	4.71	190	-7.3	Number eggs hatched compared with number goslings counted at end of brood season; felt 5% was closer to real mortality.	Martin (1964:47,49-52)
Neponset Reservoir, Bear River, and Saleratus Creek, Northern Utah-Western Wyoming, 1969	4.77	47	-1.7	Mean sizes of complete clutches and broods compared; ages of goslings unspecified.	Arneson (1970:42)
Madison River, Central Montana, 1971	4.99	?	-6.0	Compared mean sizes of hatched clutches and broods at end of season.	Childress (1971:16)
Freezout Lake WMA, Central Montana, 1972	4.63	46	-13.3	As above.	Hook (1973:16)
Weighted means	4.65		-5.1		

Harvest Characteristics

Distribution and Size

Waterfowl hunters in the United States, 16 years old or older, are required by law to purchase a Federal waterfowl hunting stamp; persons younger than 16 years who have proper State licenses can hunt waterfowl without a Federal waterfowl hunting stamp. In Canada a similar permit is needed before any person can hunt migratory game birds. Not all stamp buyers hunt, and not all waterfowl hunters are successful in killing Canada geese. The percentage of stamp buyers that kill geese, or even hunt, may vary between reference areas. Duck hunters make up a large majority of stamp buyers and most of these hunters shoot a goose if the opportunity arises. With these limitations in mind, we can say that the number of Federal waterfowl hunting stamps sold in the United States during 1962 and 1970 provides a measure of the distribution of waterfowl hunting, including that for Canada geese, in the Rocky Mountain Region (Table 30).

The human population within the range of the RMP grew more than 26% between 1960 and 1970 (Table 2). In comparison, waterfowl stamp buyers increased by more than 64% from 1962 to 1970 (Table 30). The rate of increase in waterfowl hunters was faster than that

Table 30. *Distribution of waterfowl hunters and RMP Canada goose harvest (unretrieved kill excluded) arranged by reference areas.*

Reference area	Waterfowl hunting stamp sales[a]			No. of Canada geese harvested, 2-year mean, 1962 and 1970[b]	
	1962	1970	Percent increase, 1962-70	Mean	Percent of total harvest
Southern Alberta	—	—	—	14,800[c]	27.6
Central Montana	9,090	12,029	32.3	1,467	2.7
Southeastern Idaho	10,365	13,029	25.7	9,574	17.9
Western Wyoming	867	1,533	76.8	1,341	2.5
Central Wyoming	1,562	1,884	20.6	342	0.6
Northwestern Colorado	1,423	2,371	66.6	236	0.4
Northern Utah	16,761	31,374	87.2	7,104	13.3
Southern Utah	1,562	2,401	53.7	1,619	3.0
Northeastern Nevada	868	1,470	69.4	357	0.7
Northwestern Nevada	3,500	8,322	137.8	3,664	6.8
Southern Nevada	1,039	3,038	192.4	1,029	1.9
Central California	46,882	74,822	59.6	2,875[d]	5.4
Southern California	19,906	34,081	71.2	7,054	13.2
Western Arizona	886	1,586	79.0	1,088	2.0
Eastern Arizona	6,220	10,763	73.0	1,036	1.9
Total	120,931	198,703	64.3	53,586	

[a]Data from Schroeder et al. (1974).
[b]Data from Carney et al. (1975), Alberta Fish and Wildlife Division (1975:18).
[c]Assumed only 40% of kill of 37,000 consisted of RMP geese (see text for discussion).
[d]Assumed only 15% of kill of 19,164 was RMP geese (see text for discussion).

in the general population in all reference areas, including Alberta. The total number of migratory bird hunting stamps sold in Alberta rose 25% from 53,602 in 1969 to 67,012 in 1973 (Alberta Fish and Wildlife Division 1975:18). Inasmuch as the number of stamp buyers is increasing at a rate of almost 2.5 times the rate of population growth, it is clear that waterfowl hunting is a rapidly growing recreational activity throughout the Rocky Mountain Region.

Southern Alberta is a major harvest area for the RMP (Table 30). Almost 37,000 large Canada geese were killed and retrieved in Alberta each year in 1969-73 (Alberta Fish and Wildlife Division 1975:18). However, many of the large Canada geese shot in Alberta were molt-migrants from the PP, as well as locally produced birds belonging to the HLP. Consequently, it is impossible to determine exactly what proportion of the 37,000 birds bagged were Rocky Mountain geese. Although nesting geese of the RMP occupy only a small area of Alberta, these birds use much of the high-density nesting habitat in the Province. Rocky Mountain geese, including molt-migrants from the United States, could constitute as much as 40% of the harvest. Using the arbitrary figure of 40%, we calculated that 14,800 of the 37,000 large Canada geese bagged in Alberta belonged to the RMP (Table 30).

Not all Canada geese wintering and harvested in Central California belong to the RMP. For example, during January 1972-76 a mean of 53,931 Canada geese per year censused in Central California were classified as follows: 70% cackling geese (*B. c. minima*), 15% western Canada geese, and 15% lesser geese—subspecific status uncertain (F. M. Kozlik, personal communication). Assuming that 15% of all Canada geese in Central California are Rocky Mountain birds, and that the vulnerability of large Canada geese to hunting is the same as for smaller Canada geese, only 2,875 of the Canada geese bagged in this reference area were Rocky Mountain birds (Table 30).

Craighead and Stockstad (1956) found that hunters in the Flathead Valley killed, in 1953-55, a minimum of 2,052 geese, of which at least 310 were unretrieved. Thus, the minimum crippling rate was 15%. In a study of the Dusky Canada goose in western Oregon, Chapman et al. (1969:40) observed 251 geese shot down, of which 36 were unretrieved, yielding a crippling loss of 14%. Grieb (1970:25), who worked with the Shortgrass Prairie Population wintering in southeastern Colorado, estimated an unretrieved kill for the

period 1954-66 of 42,603 birds (15%) from a total kill of 281,973. Although the crippling rate in the RMP probably varies among areas, it seems doubtful that, overall, it exceeds 15%. Assuming a crippling loss of 15%, the unretrieved kill of Rocky Mountain geese would be 9,456 birds, giving a total mean annual kill of 63,042 geese (9,456+53,586).

Over 84% of the RMP's retrieved harvest occurred in only 6 of the 15 reference areas (Table 30). The main harvest areas for the RMP (Table 30) were Southern Alberta (27.6%), Southeastern Idaho (17.9%), Northern Utah (13.3%), and Southern California (13.2%). Central California (5.4%) and Northwestern Nevada (6.8%) were of moderate importance and the remaining nine reference areas combined accounted for less than 16% of the kill (Table 30).

Recovery and Survival Rates

Relative recovery rates were calculated to test the hypothesis that immature Canada geese were more vulnerable than adults to hunting (Table 31). Overall direct recovery rates for Rocky Mountain geese banded on nesting areas were 12.2% for adults (9,307 banded) and 15.7% for immatures (32,953). Available data showed immatures to be, overall, 1.29 times more likely to be shot than adults ($P < 0.01$); relative recovery rates varied from 1.5 in Southern Alberta and Central Montana to 1.4 in Southeastern Idaho and 1.2 in Northern Utah (Table 31). Unfortunately, few or no data were available from Colorado, Nevada, and Wyoming. Immature males in the RMP were shot at a slightly, but significantly ($P = 0.05$, Chi-square), greater rate than immature females (Table 31). However, there were no indications of sex differences in vulnerability to hunting of adults banded on nesting areas (Table 31). Similarly, the direct recovery rates of 2,104 adult male and 2,227 adult female molters were not significantly different (13.4 and 13.6%, respectively; $P > 0.05$, Chi-square). Consequently, males and females appeared to be of similar vulnerability within age classes, although young of the year were 21 to 54% more vulnerable to sport hunting than were older geese ($\bar{X} = 29\%$; Table 31).

Total recovery rates were tabulated to determine the percentages of banded geese encountered and reported during hunting seasons. Although relative recovery rates were calculated only from first-hunting-season recoveries of geese reported shot, total recovery rates included all recoveries (regardless of years after banding when encountered) that were reported either shot or found dead. Of the 42,279 Rocky Mountain geese banded on nesting areas, a total of 13,267 (31.4%) were reported recovered through the 1973-74 hunting season (Table 32). Similarly, of the 15,861 molters banded within the population's range, a total of 4,256 (26.8%) were reported shot or found dead. Combining both sets of data yields an overall total recovery rate of 30.1% (17,523/58,140) which, considering that more recoveries from the most recent bandings will still be reported, suggests that about one out of every three Rocky Mountain geese banded is reported recovered as a result of hunting.

Table 31. *Relative recovery rates of Canada geese banded preseason on nesting areas in the Rocky Mountain Region.*

Reference area	Years of banding	Relative recovery rates[a]			Total number of direct recoveries (shot)
		Immature/ adult	Immature males/ immature females	Adult males/ adult females	
Southern Alberta	1947-73	1.54*	0.99	0.96	717
Central Montana	1946-73	1.53*	1.09	0.80	516
Southeastern Idaho	1947-73	1.38*	1.16	1.20	962
Western Wyoming	1958-69	2.24	—[b]	—[b]	34
Central Wyoming	1955-73	1.20	—[b]	—[b]	131
Northern Utah	1938-73	1.21*	1.07	1.02	3,467
Southern Utah	1955-73	1.10	0.96	0.61	254
Northeastern Nevada	1959-68	0.74	—[b]	—[b]	21
Northwestern Nevada	1954-69	1.04	—[b]	—[b]	210
Total		1.29*	1.06[c]	1.02	6,312

[a]Chi-square tests (2 × 2) used to evaluate differences between ages, and age-sex classes, in terms of number of bands recovered vs. number unrecovered during the first hunting season after banding. Asterisk = $P < 0.01$; no asterisk = no significance.

[b]Sexes undetermined.

[c]$X^2_{cal.} = X^2_{tab.} = 3.84$ ($P = 0.05$).

Table 32. *Total recovery rates of Canada geese banded preseason on nesting areas in the Rocky Mountain Region.*

Reference area	Years of banding	Total recovery rates (%)[a]			Total number of recoveries (shot or found dead)
		Immatures	Adults	Combined	
Southern Alberta	1947-73	29.4	25.6	28.3	1,421
Central Montana	1947-73	30.2	27.7	29.7	1,077
Southeastern Idaho	1947-73	32.9	32.4	32.8	2,210
Western Wyoming	1958-69	37.7	22.8	34.3	85
Central Wyoming	1955-73	22.4	23.0	22.4	350
Northern Utah	1938-73	32.9	32.7	32.9	7,118
Southern Utah	1955-73	25.4	28.3	25.8	499
Northeastern Nevada	1959-68	31.3	50.0	33.3	49
Northwestern Nevada	1954-69	34.0	36.9	34.3	458
Total		31.5	30.9	31.4	13,267

[a]Recoveries for the most recent years of banding are incomplete, since the data cover only the period up to the 1973-74 hunting season.

Survival rates for adult Canada geese banded on molting areas were calculated by the models of the Adult Method. Model 2 (or M_2, see Brownie et al. 1978:13-55) in which constant annual survival and year-specific recovery rates are assumed, was adequate for describing the available data (Table 33). Most of the estimates in Table 33 were based on only moderate-sized samples and thus cannot be construed as convincing evidence of decreasing natural mortality with increasing hunting mortality. Additionally, Chi-square values of M_2 versus M_1 (see Brownie et al. 1978:13-55) when summed over regions and years, were significant ($P < 0.05$)—thus indicating M_1 to be more appropriate than M_2 (i.e., survival as well as recovery rates were year-specific). Anderson (1975:8-9) gives a fairly detailed discussion of problems in determining the appropriateness of M_2.

Chi-square values indicated that adult and young Canada geese banded on nesting areas had different survival and recovery rates ($P < 0.01$). Therefore, it was appropriate to analyze these data with the models of the Young-adult Method. The results of these calculations yielded an average of mean annual adult survival rates ($\bar{X} \pm$ SE) of 64 ± 1% (Table 34) compared with 70 ± 1% (Table 33). Since Table 33 was based on data from molters, mainly subadults, whereas adults in Table 34 were mostly 3 or more years old, these data might mean that subadults survived at a slightly higher rate than adults. However, Chi-square tests of H_2 versus H_3 (see Brownie et al. 1978:89-90) indicated that survival and recovery rates were not age-dependent for 2 or more years after banding ($P < 0.01$). Possibly the higher survival rates of adult molters compared with adult breeders relates to nesting status and not to age-dependent factors. Specifically, molters, mainly non-nesters, may survive at a slightly higher rate than nesters, since they do not undergo the stresses of territorial and family defense, and perhaps geese in large flocks are not as vulnerable to predation as are isolated families. We conclude that subadults do not appear to survive at a higher rate than adults; distinguishing these two age classes when banding would provide the data needed for a strong test of this hypothesis (i.e., use of the Young-adult Method to test for age-specific survival).

The sexes of most molters, and many breeders and their offspring, were not determined at the time of banding. Therefore, the possibility of survival differences between sexes could not be adequately tested.

Habitat Characteristics

This major section is divided into two parts. The first part concerns the estimated amounts and types of habitats known to be used by Canada geese in each of the 15 individual reference areas during the early 1970's (Tables 35-37). The second part summarizes the data from the 15 reference areas and the overall status of breeding, molting, and wintering habitats within the range of the RMP (Tables 38, 39; Fig. 3).

Table 33. *Mean annual survival rates ($\bar{X} \pm SE$)[a] for adult Canada geese banded on molting areas according to reference areas and years of banding.*

Reference area	Years of banding	Mean annual survival rates (%)	Mean number of geese banded per year
Southeastern Idaho	1946-51	68.8 ± 2.6	229
Western Wyoming	1956-58	68.1 ± 2.1	283
Western Wyoming	1962-72	69.9 ± 1.8	179
Central Wyoming	1958-61	74.1 ± 2.0	151
Central Wyoming	1963-73	75.0 ± 1.3	554
Northern Utah	1963-65	66.2 ± 2.1	257
$\bar{\bar{X}} \pm SE$		70.4 ± 0.8	

[a]Based on Model 2 (M_2) (see Brownie et al. 1978:13-55). Also, see Anderson (1975:8-9) for a discussion of the complexities of determining the appropriateness of M_2, in which constant survival and year-specification recovery rates are assumed.

Reference Area Patterns

Southern Alberta

The more than 1,700 estimated pairs nesting in Southern Alberta use five of the six recognized types of habitats (Table 35). Both in terms of habitat amounts and number of nesters, reservoirs and lakes are the most important breeding areas in Southern Alberta. Numerous irrigation reservoirs have been built in this reference area during the last four decades and therefore it is likely that the breeding flock has been at its present high level only in recent times. The region's single most significant nesting area is Lake Newell, near the east-central edge of the reference area; it supports more than 300 pairs. Rivers are also used by nesters in Southern Alberta; major drainages used, from north to south, are those of the Red Deer, Bow, and Oldman rivers. Marshes and impoundments, especially around the Lousana Lakes east of Lake Newell, are heavily used by nesting Canada geese.

Ducks Unlimited (Canada) has developed, and is continuing to develop, waterfowl habitats in the Lousana Lakes region. These nesting areas are considered to be safely protected from drainage; their numbers and total acreages will continue to increase. Reservoirs and lakes, mostly managed by government and private agricultural interests to provide irrigation water, are also capable of supporting geese well into the future. Almost all breeding areas in Southern Alberta are surrounded by grasslands and grainfields. With such extensive nesting, brooding, and feeding sites, this reference area can support more geese, especially if a large-scale program is initiated to increase the number of secure nesting sites (i.e., construction of islands, holes in cliffs, and artificial structures). However, too many Canada geese could result in crop depredation; therefore, man's tolerance of this species will probably set the upper limit on Alberta's nesting flocks.

The only two molting areas known to be regularly used are on the Knight Ranch and at Ross Lake, both near the Canada-United States border. Each of these molting areas receives annual use by less than 150 molters. Only a scattered few wintering geese occur in this reference area.

Table 34. *Mean annual survival rates ($\bar{X} \pm SE$; average number of bandings per year shown in parentheses)[a] for adult and immature Canada geese banded on nesting areas, according to reference areas where banded.*

Reference areas and years	Most appropriate model[b]	Adult rates (%)	Immature rates (%)
Southern Alberta, 1958-64	H_{02}	63.4 ± 2.3 (44)	48.6 ± 4.6 (247)
Central Montana, 1957-73	H_{02}	61.8 ± 2.0 (48)	50.9 ± 4.6 (201)
Southeastern Idaho, 1951-68	H_1	64.9 ± 2.3 (98)	56.4 ± 4.6 (228)
Northern Utah, 1953-72	H_1	64.1 ± 1.5 (160)	55.4 ± 2.6 (618)
$\bar{\bar{X}} \pm SE$		63.6 ± 1.0	52.8 ± 2.1

[a]The survival rates in this table are similar to those for all of Utah presented by Tautin (1976:33).

[b]Model H_{02} assumes that (1) young and adults have different survival and recovery rates, (2) survival rates are otherwise constant from year to year, and (3) recovery rates are year-specific. Model H_1 assumes that (1) annual survival and recovery rates are year-specific and (2) young have different survival and recovery rates than adults.

Table 35. *Estimated amounts of breeding habitats and mean number of pairs using each habitat type within the breeding range of the Rocky Mountain goose population during the early 1970's, by reference area.*

	Breeding habitat											
	Flooded bottomland		Stream		Lake		Reservoir		Marsh		Waterfowl impoundment	
Reference area	Miles	Pairs	Miles	Pairs	Acres	Pairs	Acres	Pairs	Acres	Pairs	Acres	Pairs
Southern Alberta			391	88	19,558	263	55,550	1,189	4,489	110	2,380	58
Central Montana			632	427	1,139	12	84,170	225	4,420	20	19,903	116
Southeastern Idaho	284	397	346	426	1,257	5	65,955	371	66,333	297	32,297	421
Western Wyoming	188	471	466	218	518	3	11,670	12	300	4	150	4
Central Wyoming	16	4	745	164	1,474	37	52,452	121	58	5	555	15
Northwestern Colorado			414	132							716	34
Northern Utah	58	50	113	15	10,000	10	5,274	64	155,500	389	179,111	594
Southern Utah							24,416	75	1,200	7	26,763	39
Northeastern Nevada	122	89					6,710	28	11,000	40	11,000	36
Northwestern Nevada	78	82	13	17	20,700	166	52,850	69	870	55	45,050	24
Southern Nevada											1,950	36
Eastern Arizona							177	6				
Totals	746	1,093	3,120	1,487	54,646	496	359,224	2,160	244,170	927	319,875	1,377

Central Montana

The three most important types of breeding habitats in Central Montana are rivers, reservoirs, and impoundments; more than half of the region's 800 pairs are associated with streams (Table 35). The area's major drainage is the Missouri River; tributaries of importance to nesters are the Marias River in the north and the Madison, Gallatin, and Jefferson rivers in the south. Numerous small reservoirs are used by nesting geese throughout Central Montana and undoubtedly the amounts and use of these areas were underestimated in our inventory. Among the largest reservoirs used by nesters are Tiber in the northern half of the reference area and Canyon Ferry in the south. Freezout Lake WMA and Benton Lake NWR, both north of Great Falls, and Canyon Ferry WMA, southeast of Helena, are the major waterfowl impoundments.

Nesting habitats in this region have been, and are being, drastically altered by man. River valleys are mostly owned and managed by private farmers and ranchers, whereas the reservoirs are primarily controlled by the Federal Government (Water and Power Resources Service and Army Corps of Engineers). Control of reservoir waters influences river flows and hence affects geese, especially during the spring when birds are nesting. The future capabilities of Central Montana's rivers and reservoirs to support Canada geese are difficult to judge because of the conflicting water uses. In contrast, nesters on managed areas have a brighter future. For example, the flock at Freezout Lake increased from essentially no birds in the late 1950's to more than 70 breeding pairs in the early 1970's. Nesting geese were established recently at the Benton Lake and Canyon Ferry impoundments. If properly managed, these flocks should expand.

Lima Reservoir, near the south-central edge of Central Montana, is a major molting area, supporting an average of 3,500 molting geese (Table 36). This isolated area, sometimes used by up to 10,000 birds, should continue to be the main molting area within the range of the RMP. No appreciable numbers of Canada geese winter in Central Montana.

Southeastern Idaho

More than 1,900 breeding pairs occupy this region's six types of habitats (Table 35). Only lakes are of minor significance to nesters; pairs are about evenly distributed among the remaining five habitat types. Major nesting areas include the marshes of Gray's Lake and Bear Lake NWR's, islands in the North and South forks of the Snake River, and islands in reservoirs such as Blackfoot and Island Park. Flooded bottomlands are important to nesters, especially in the region's southeastern corner between Gray's Lake and Bear Lake. These bottomlands are vulnerable to degradation from the anticipated mining of phosphate. Depredation by geese and greater sandhill cranes (*Grus canadensis tabida*) in unharvested grainfields is occurring adjacent to several major production areas. Overall, Southeastern Idaho will continue to be a major production area, although a significant increase in nesters is unlikely because the human population is expanding and breeding areas are slowly but steadily being lost.

Table 36. *Estimated acreages of molting habitat and mean numbers of molting geese encountered in each habitat type within the range of the Rocky Mountain goose population during the early 1970's, by reference area.*

	Lakes		Reservoirs		Waterfowl impoundments	
Reference area	Acres	Geese	Acres	Geese	Acres	Geese
Southern Alberta			484	300		
Central Montana			6,180	3,500		
Western Wyoming[a]	6,040	690	3,000	300		
Central Wyoming			37,500	2,200		
Northern Utah	20,000	2,000	1,040	600		
Northern Nevada	156,800	1,535	16,000	530	650	390
Totals	182,840	4,225	64,204	7,430	650	390

[a] Includes Yellowstone National Park.

Blackfoot Reservoir was a major molting point in the 1950's, but few molters have used this reservoir in recent years. In the past, molters sporadically used a number of places in the reference area, including Island Park Reservoir. Molters have been noted at American Falls Reservoir in recent years, but it remains to be seen whether this area becomes used regularly. There is much recreational use of the region's reservoirs and this disturbance, plus annual banding operations on some areas, may prevent molters from becoming accustomed to specific areas. Human use of the reservoirs will inevitably increase in the future and thus this reference area will not harbor large numbers of molters (except perhaps at American Falls Reservoir, where shallow areas exclude most boaters).

In the early 1970's, more than 14,300 Canada geese wintered in the rivers and reservoirs of Southeastern Idaho (Table 37). American Falls Reservoir, situated near the region's center, supports most of these birds. The reservoir, adjacent mud flats, and nearby agricultural fields will continue to be the RMP's most northern significant wintering area. The wintering goose population has been increasing here in recent years. By 1979, the wintering flock increased to 22,000 (R. Norell, personal communication). The area can support more wintering geese because the reservoir is large, the adjacent croplands are extensive, and hunting access is limited. Furthermore, it appears unlikely that crop depredation will become a major problem, because most geese arrive after the crops have been harvested.

Western Wyoming

Although all six habitat types occur here, almost all of the region's estimated 712 breeding pairs nest in bottomlands and streams (Table 35). Nesting geese use the Snake River—especially the portion that flows through Jackson Hole—and the Green River, in southern Western Wyoming. The Bear River, situated along the region's southwestern edge, supports the reference area's largest single breeding flock, consisting of some 350 pairs. Most areas can support more nesters because land use is not intensive in this region. An exception occurs along the Bear River near Cokeville, where depredation of standing grain during late summer is a problem. Greater sandhill cranes, as well as Canada geese, feed in the grainfields, and there is growing concern about the numbers of cranes and geese in the Cokeville area. Depredation by geese and cranes also occurs along the Salt River west of Afton.

Turbid Lake and the southeastern arm of Yellowstone Lake are used by about 700 molters (Table 36). As both areas are in Yellowstone National Park and thus are seldom disturbed, these lakes will probably continue to be used by concentrations of molters. Big Sandy and Eden Valley reservoirs are used by about 300 molters.

An average of 740 Canada geese winter on the rivers of Western Wyoming (Table 37). Most of these are associated with warm springs, which occur along Flat Creek in Jackson Hole, the Salt River, and the Madison River. The upper Madison River drainage in Yellowstone Park is the most heavily used of the three. Since no major habitat changes are anticipated, this reference area can continue supporting a small flock of wintering geese. As judged by use of wintering areas in the late 1950's and early 1960's, the region could winter at least double the present number.

Central Wyoming

Most of the 350 pairs nesting in this reference area use rivers and reservoirs (Table 35). Major breeding areas include Ocean Lake and adjacent marshes, and the Big Horn and North Platte drainages. The number of geese nesting in the Big Horn drainage has in-

Table 37. *Estimated amounts of wintering habitat and mean numbers of geese occupying each habitat type within the wintering range of the Rocky Mountain goose population during the early 1970's, by reference area.*

	Stream		Lake		Reservoir		Marsh		Waterfowl impoundment	
Reference area	Miles	Geese	Acres	Geese	Acres	Geese	Acres	Geese	Acres	Geese
Southeastern Idaho	458	4,500			143,426	9,860				
Western Wyoming	108[a]	740								
Northwestern Colorado	244	1,386			174	102				
Northern Utah							[b]	1,888		
Southern Utah					[b]	522				
Northwestern Nevada			42,700	365	25,480	1,130			39,850	1,230
Southern Nevada					1,500	440			3,050	630
Central California	10	300			150,164	6,810			140,485[c]	1,480
Southern California					12,775	11,440			11,200	4,510
Western Arizona	96	605			24,217	280	1,200	100	300	50
Eastern Arizona	76	60			34,400	1,820				
Totals	992	7,591	42,700	365	392,136	32,404	1,200	1,988	194,885	7,900

[a]Excluding habitat in Yellowstone National Park; also excludes 100 birds from Western Wyoming which cannot be assigned to specific wintering areas.
[b]Canada geese wintering in Utah are mobile and cannot be assigned to specific wintering areas.
[c]Includes a complex mixture of impoundments, marshes, reservoirs, and rivers.

creased during the last 20 years. For example, at Ocean Lake in the upper part of the drainage the number of nests found has steadily grown from 17 in 1955 to 128 in 1975. Few detrimental changes are anticipated and thus the prospects for this region to sustain more nesters are excellent.

Two minor molting areas, each used by less than 100 geese, are in Central Wyoming, and a major molting reservoir is situated on the southeastern boundary of the reference area. These three reservoirs account for a total of about 2,200 molters. Wheatland Reservoir, the major molting area, is used by an unknown proportion of Highline geese. Nevertheless, the larger reservoir can be used by more molting geese, especially where human use is limited.

The Big Horn Basin winters an average of only 100 geese, scattered throughout the drainage. Central Wyoming, especially the farmed portions of the Big Horn Basin at lower elevations, could winter more geese. However, this reference area will probably continue to remain of minor importance as a wintering ground because the winter weather is relatively severe.

Northwestern Colorado

The small flock nesting here, averaging less than 170 pairs, uses rivers and impoundments (Table 35). Nesting now occurs primarily along the Little Snake, Yampa, and Green rivers. The Green River, from Brown's Park NWR through Dinosaur National Monument, is the region's single most important breeding area. This area is secure from development, although the Flaming Gorge Dam has reduced flooding, and consequently island vegetation is increasing (a similar situation occurs on islands in the Snake River in Idaho). It remains to be proved, however, whether dense vegetation reduces the number of suitable nesting sites. In the future, more nesting is expected along the larger rivers in the southern half of this reference area.

No molting areas have been found here and the region's wintering flock, averaging almost 1,500 is slowly growing. Agricultural lands along the Colorado, Gunnison, and Uncompahgre rivers can winter more geese. Winters in these river bottoms are mild, with little snowfall, compared with adjacent land at higher elevations.

Northern Utah

Almost 1,000 of the estimated 1,122 pairs nesting here use impoundments and marshes; the rest nest at reservoirs, bottomlands, rivers, and lakes (Table 35). Most nesting occurs in the extensive marshes, both managed and natural, along the eastern and northern edges of Great Salt Lake. Other important nesting locations in Northern Utah include the Bear and Green rivers. The potential of this region to support nesters, varies with changing water levels and the consequent abundance and distribution of vegetation in Great Salt Lake. However, due to the vastness of these marshes, this major production region can probably support even more geese than it now does.

Neponset Reservoir, near the southwest corner of Wyoming, is used by an average of 600 molters (Table 36). In recent years, a concentration of about

2,000 molters has been noted along the northeastern edge of Great Salt Lake, at Bear River Bay. Due to the isolation of Neponset and the vastness of Great Salt Lake, these areas will probably continue to support molters.

An average of almost 1,900 Canada geese winter in this reference area (Table 37). The number and locations of wintering geese vary greatly, depending on weather conditions. Generally, winter weather is severe enough to keep Northern Utah a minor wintering ground, although more geese wintered there in the past than in recent years.

Southern Utah

An average of about 120 pairs are known to nest in this reference area (Table 35), primarily at reservoirs in the drainages of the Beaver, Fremont, San Pitch, and Sevier rivers. The Fish Springs NWR, where 30 to 50 pairs nest, has the single largest nesting flock in Southern Utah. This refuge and the reservoirs are safe from commercial development, although production from these areas varies greatly because of fluctuations in runoff.

Southern Utah supports no concentrations of molters. On the average, only about 500 geese winter here, mostly on reservoirs (Table 37). Although this reference area is expected to remain only a minor wintering region, it could probably winter additional geese.

Northeastern Nevada

Bottomlands, reservoirs, marshes, and impoundments are used by about 200 nesting pairs in Northeastern Nevada (Table 35). Most nesters use Franklin Lake and adjacent Ruby Lake NWR, although some use the upper Humboldt and Owyhee rivers. These habitats are secure and are expected to continue supporting geese.

This region has no molting areas and few Canada geese are found here during January.

Northwestern Nevada

Lakes and bottomlands are used by most of the area's estimated 413 pairs (Table 35). Major nesting locations include Washoe Lake (Scripps WMA), Humboldt River, Lahontan Valley, and Sheldon NWR. Nevada's largest marshes are in the Lahontan Valley, including Carson Lake and the Stillwater WMA (joint State-Federal management). Most of the water in these marshes is irrigation runoff from the Truckee River. Litigation over Truckee River water could result in reduced flows to the Lahontan Valley, which would cause drastic reductions in the production of waterfowl, including Canada geese (Saake 1975).

Two major and four minor molting areas are in Northwestern Nevada (Table 36). Stillwater Point Reservoir has been used by molters in the past. The six molting areas now used support a mean of almost 2,500 geese; most of these birds are at Pyramid Lake ($\bar{X}$ = 1,000) and Rye Patch Reservoir ($\bar{X}$ = 530). This reference area should continue to provide adequate habitat for molters.

An average of nearly 3,000 Canada geese winter in Northwestern Nevada each year, primarily on impoundments and reservoirs (Table 37). Major wintering locations are the Lahontan, Lovelock, and Mason valleys. These valleys are intensively farmed and probably can support more Canada geese than now winter there.

Southern Nevada

The estimated 36 pairs are divided between Kirch WMA and Railroad Valley WMA (Table 35). The impoundments on these areas are safe from commercial development. Since so little surface water is available, however, it is unlikely that the nesting flock in Southern Nevada will increase significantly.

About 1,000 Canada geese winter on State and Federal management areas. The Overton WMA, on the west side of Lake Mead near Nevada's southern tip, is the most heavily used wintering area. This region could accommodate an increase in wintering geese because safe resting sites have been provided by management agencies, and adequate areas of irrigated farmlands are nearby.

Central California

The large Canada goose population wintering here uses mainly reservoirs; waterfowl impoundments are of secondary importance (Table 37). The waterfowl impoundments include private as well as State and Federal areas. Major wintering locations are reservoirs and adjacent grasslands on the west slope of the Sierra Nevada, and impoundments and farmlands in the San Joaquin Valley west of these mountains.

About 8,000 large Canada geese winter west of the Sierras, and 300 to 500 birds winter east of the mountains, largely in Owens Valley. The large number of reservoirs, Federal and State waterfowl areas, extensive farmlands and grasslands, and mild climate west of the Sierras ensure that this reference area will remain a major wintering region with a high potential for supporting more Canada geese.

Southern California

About 16,000 geese winter in this important wintering ground for the RMP (Table 37). Goose concentrations in this reference area use reservoirs in the vicinity of Los Angeles and Riverside, and waterfowl impoundments on the north and south ends of the Salton Sea. Managed impoundments adjacent to the north

end of the Salton Sea are privately owned; those in the Imperial Valley, at the south end of the Sea, are controlled by the California Department of Fish and Game (Imperial WMA), FWS (Salton Sea NWR), and private duck-hunting clubs. Present impoundments could be inundated by salt water if the Salton Sea continues rising. Nevertheless, considering the number and sizes of reservoirs in Southern California, this reference area will continue to be a major wintering ground that can potentially sustain more geese.

Western Arizona

A mean of about 1,000 Canada geese winter in Western Arizona; rivers and reservoirs are the major types of wintering habitats, and marshes and impoundments are of secondary importance (Table 37). Damming and channeling of the lower Colorado River have increased the rate of plant succession in backwater marshes (Ohmart et al. 1975). Only some 30 miles of the lower Colorado River remain unaltered, and plans exist to channelize even this section. To compensate for these destroyed wildlife habitats, the Federal government established three NWR's (Havasu, Cibola, and Imperial) along the Colorado River between Arizona and California. Though the geese wintering along the lower Colorado will become increasingly more dependent on managed areas, Western Arizona can support more birds, given the amounts of agricultural lands adjacent to the river and the safe resting sites provided by the refuges.

Eastern Arizona

Three reservoirs in this reference area, each less than 100 acres, now support only six breeding pairs (Table 35). Suitable habitat for nesting geese is so limited that Eastern Arizona will remain an insignificant production area.

Eastern Arizona winters more than 1,800 geese (Table 37). Major wintering areas, in order of importance, are Roosevelt Lake Reservoir on the Salt River and the Gila River from San Carlos Reservoir upstream to the town of Safford. Minor wintering areas include the Verde River northeast of Phoenix and the Gila River west of Phoenix. Greater use of these wintering areas in past years, especially Roosevelt Reservoir, indicates that this region can support more wintering Canada geese.

General Habitat Patterns

Breeding Areas

Canada geese now nest in 12 of the RMP's 15 reference areas; only 3 reference areas—2 in California and 1 in Western Arizona—do not support breeding flocks (Table 38). The widespread distribution of

Table 38. *Estimated total amounts and use of breeding areas occupied by the Rocky Mountain Canada goose population in different reference areas during the early 1970's.*

Reference areas	Habitat amounts		Pairs of geese using habitat	
	Nonflowing waters (acres)	Stream (miles)	Mean	Maximum[a]
Southern Alberta	81,977	391	1,708	1,785
Central Montana	109,632	632	800	1,046
Southeastern Idaho	165,842	630	1,917	2,870
Western Wyoming	12,638	654	712	983
Central Wyoming	54,539	761	346	566
Northwestern Colorado	716	414	166	224
Northern Utah	349,885	171	1,122	1,536
Southern Utah	52,379	—	121	187
Northeastern Nevada	28,710	122	193	311
Northwestern Nevada	119,470	91	413	685
Southern Nevada	1,950	—	36	46
Central California	—	—	—	—
Southern California	—	—	—	—
Western Arizona	—	—	—	—
Eastern Arizona	177	—	6	6
Totals	977,915	3,866	7,540	10,245

[a]Highest number of pairs ever recorded on individual areas.

nesting geese, from southern Alberta through southern Utah, and from western Nevada to western Colorado, is of management significance. Although birds originating in one or more reference areas may be overharvested in any given year, it is highly unlikely that this would be a rangewide phenomenon.

The three major production areas are Southern Alberta, Southeastern Idaho, and Northern Utah (Table 38). Considering the amounts of favorable habitat available, it appears that Alberta, Central Montana, and Northern Utah have the greatest potentials for increasing the RMP.

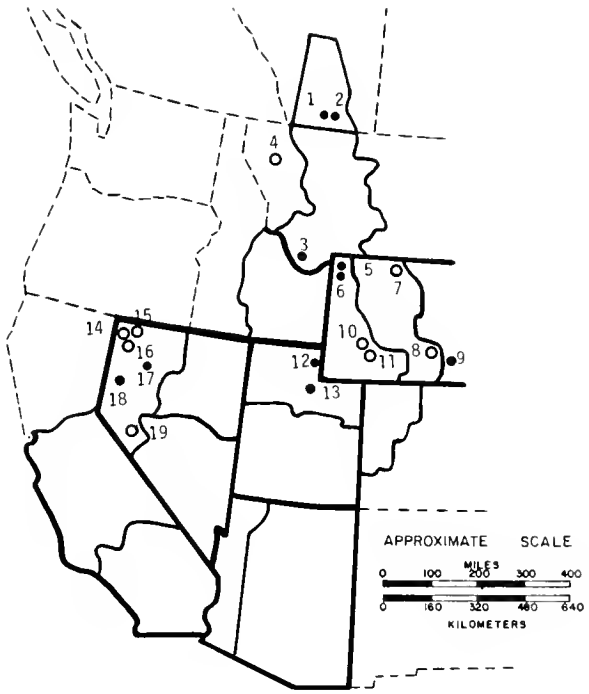
Molting Areas

Figure 3 shows the locations of areas used by concentrations of molting RMP geese during the early 1970's. Wheatland Reservoir in eastern Wyoming is used by Highline as well as Rocky Mountain geese (Figs. B-17, B-18; Szymczak 1975:35) but 16 of the remaining molting areas are used only by RMP Geese (Pablo and Pyramid used by PP as well as RMP). The remaining 17 molting areas are used only by RMP geese. The number of molters on the 19 areas on Fig. 3 averaged about 12,000 and reached a maximum of 18,750. Since we estimated that the RMP has about 37,000 molters, it appears that considerably less than half of the population's molters stay within the Intermountain Region to molt. The sizable number of indirect recoveries taken in southern Canada (Appendix B) confirms the conclusion that a substantial segment of molters from the RMP molt outside of the population's nesting range.

The migration of so many of the RMP's yearling and older birds from the Region during the summer and fall complicates management. Molt migrants include geese from many breeding flocks, and thus the precise control of hunting pressure on molters from specific production regions is virtually impossible, short of prohibiting all goose hunting. On the positive side, molting habitats will probably never limit the RMP, given the number of extensive water bodies within the Region and the high mobility of molters. Nevertheless, to more closely control the harvest of geese from individual breeding regions, managers should consider encouraging geese to molt within the region where they hatched. This could be done by restricting recreational use and banding on lakes and reservoirs used by molters during July and August. A lack of disturbance seems especially critical to molters that are just starting to use an area.

Wintering Areas

Canada geese winter in all 15 of the RMP's reference areas; the 3 most heavily used are Southern California, Southeastern Idaho, and Central California (Table 39).



LEGEND

• = Minor Area; $\bar{X}$ < 150 Molters
= Major Area; $\bar{X}$ > 150 Molters

1=Knight Ranch Reservoir
2=Ross Lake
3=Lima Reservoir
4=Pablo NWR
5=Turbid Lake
6=Yellowstone Lake (Southeast Arm)
7=Yellowtail Reservoir
8=Pathfinder Reservoir
9=Wheatland Reservoir
10=Big Sandy Reservoir
11=Eden Valley Reservoir
12=Neponset Reservoir
13=Great Salt Lake (Bear River Bay)
14=New Year Lake
15=Swan Lake Reservoir
16=Massacre Lake
17=Rye Patch Reservoir
18=Pyramid Lake
19=Walker Lake

Fig. 3. Locations of known Canada goose molting areas in the Intermountain Region during the early 1970's.

Reservoirs and adjacent farmlands supported almost two-thirds (64%) of the known wintering population; waterfowl impoundments and rivers were of equal but secondary importance (16%) each. The rest of the known wintering population used marshes (4%) and lakes (trace). The importance of reservoirs and, to a lesser degree, waterfowl impoundments shows the dependency of the RMP on man-made, and man-maintained, wintering areas. Assessing the prospects of wintering areas is difficult, given the adaptability of Canada geese and the influences of agriculture and weather on wintering geese. However, the feeding and resting sites in the three major wintering areas are so extensive that more geese can winter in these, and to a lesser extent, in the other reference areas.

Thirty-five State and 24 Federal waterfowl areas were situated within the range of the RMP (Fig. 4). Of the State areas, 17 were completely open to Canada goose hunting, 12 were partly open, and 6 were com-

Table 39. *Estimated total amounts and use of wintering areas occupied by the Rocky Mountain Canada goose population in different reference areas during the early 1970's.*

Reference areas	Habitat amounts		Number of geese using habitat	
	Nonflowing waters (acres)	Stream (miles)	Mean	Maximum[a]
Southeastern Idaho	143,426	458	14,360	23,910
Western Wyoming	—	108	740	1,195
Central Wyoming	—	—	100	200
Northwestern Colorado	174	244	1,488	2,392
Northern Utah	—	—	1,888	2,894
Southern Utah	—	—	522	904
Northwestern Nevada	108,030	—	2,725	9,070
Southern Nevada	4,550	—	1,070	1,950
Central California	290,649	10	8,590	20,115
Southern California	23,975	—	15,950	29,810
Western Arizona	25,717	96	1,035	3,155
Eastern Arizona	34,400	76	1,880	4,910
Totals	630,921	992	50,348	100,505

[a]Aggregate of highest number of geese ever recorded for individual flocks within each reference area.

pletely closed during the 1975-76 season. In comparison, 1 Federal area was totally open to goose hunting (Seedskadee NWR), 15 were partly open, and 8 were closed. Six waterfowl areas in Central California—three State and three Federal—were closed to protect the endangered Aleutian Canada goose (*B. c. leucopareia*). In addition to the protection afforded by State and Federal WMA's, the RMP is not hunted on numerous other areas, including certain lakes and rivers in Alberta, private sanctuaries, and National Parks and Monuments (e.g., Yellowstone National Park, Dinosaur National Monument). Similarly, many reservoirs in California, especially those near Los Angeles, are closed to hunting and are heavily used by wintering Canada geese.

Hunting closures on wintering areas, whether intentional or not, influence the distribution and harvest of geese. Wildlife agencies must try to maintain maximum dispersal of wintering geese and thus lessen the chances of overharvest or transmission of disease.

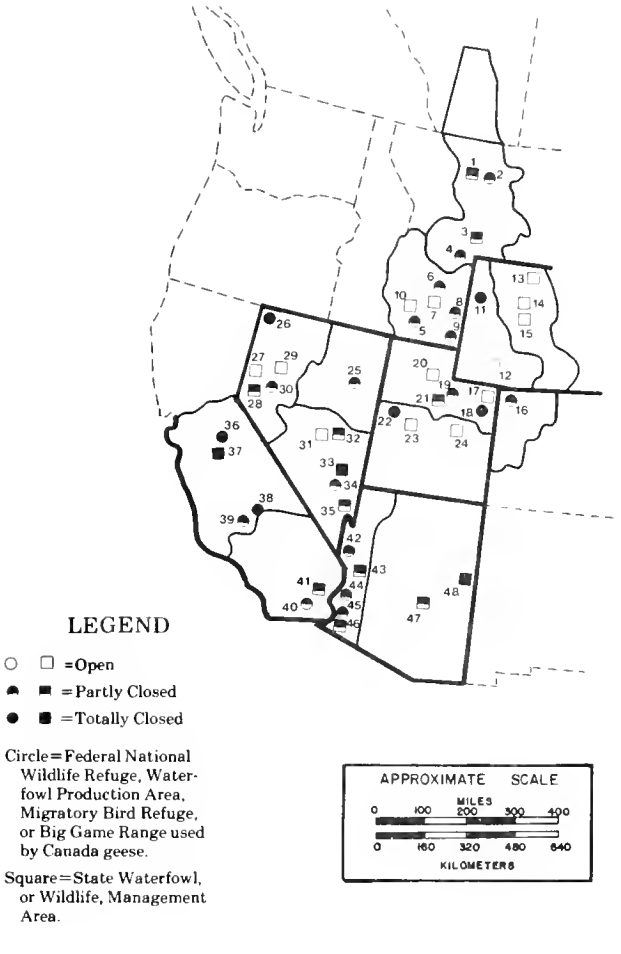
Discussion

Population Delineation

In the past, Canada geese of the Intermountain Region were often referred to as Great Basin birds. Unfortunately, the distribution of these birds was inadequately defined and it was not clear whether Great Basin geese constituted a population or a subspecies, or both. A major contribution of the present study has been a more accurate delineation of the distribution of Canada geese inhabiting the Rocky Mountain Region, recognizing that this present delimitation of the RMP is imperfect (Fig. 5). We now discuss the major weaknesses that future studies should address.

It is not known how far north geese of the RMP nest. Our illustrations (Figs. 1, 3, 4, 5) show only an arbitrary boundary as the population's northern limit. Although it appears that the small Canada geese nesting in northern Alberta belong to the Shortgrass Prairie Population (Grieb 1970:12-16), the population and taxonomic affinities of breeders from the Grande Prairie region of west-central Alberta are only partially known. In 1978, 219 Canada geese banded in the Grande Prairie area resulted in 17 direct recoveries which indicated that these geese winter within the PP's southern range (H. P. Weaver, personal communication). Unfortunately, the population status of other large and medium-sized Canada geese in central Alberta is unknown.

In eastern Southern Alberta, the boundary between the nesting ranges of large Canada geese in the RMP and HLP ranges is relatively distinct in the south (Taber area) but there is an overlapping zone in the



LEGEND

Central Montana
1=Freezout Lake WMA
2=Benton Lake NWR
3=Canyon Ferry WMA
4=Red Rocks NWR

Southeastern Idaho
5=Minidoka NWR
6=Camas NWR
7=Market Lake WMA
7=Mud Lake WMA
8=Gray's Lake NWR
9=Bear Lake NWR
10=Sand Creek WMA
10=Sterling WMA
10=Carey Lake WMA

Western Wyoming
11=National Elk Range
12=Seedskadee NWR

Central Wyoming
13=Yellowtail WMA
14=Ocean Lake WMA
15=Lake Cameawhait
15=N Pavillion
15=Kinnear Pond
15=Lower, Middle, & Upper Depression Ponds

Northwestern Colorado
16=Browns Park NWR

Northern Utah
17=Brown's Park WMA
18=Ouray NWR
19=Bear River MBR
20=Locomotive Springs WMA
20=Salt Creek WMA
20=Public Shooting Grounds
21=Harold Crane WMA
21=Howard Slough WMA
21=Ogden Bay WMA
21=Farmington Bay WMA

Southern Utah
22=Fish Springs NWR
23=Clear Lake WMA
24=Desert Lake WMA

Northeastern Nevada
25=Ruby Lake NWR

Northwestern Nevada
26=Sheldon NWR
27=Alkali Ck. WMA
27=Fernley WMA
28=Scripps WMA
28=Mason Valley WMA
29=Humboldt WMA
30=Stillwater WMA (Federal-State)

Southern Nevada
31=Railroad Valley WMA
32=Kirch WMA
33=Key Pittman WMA
34=Pahranagat NWR
35=Overton WMA

Central California
36=Kesterson NWR
36=San Luis NWR
36=Merced NWR
37=Volta WMA
37=Los Banos WMA
37=Mendota WMA
38=Pixley NWR
39=Kern NWR

Southern California
40=Salton Sea NWR
41=Imperial WMA

Western Arizona
42=Havasu NWR
43=Alamo Lake WMA
44=Cibola NWR
45=Imperial NWR
46=Mittrey Lake WMA

Eastern Arizona
47=Roosevelt Lake WMA
48=Becker Lake WMA

Fig. 4. Hunting of Canada geese on Federal and State waterfowl management areas (national wildlife refuges, NWR, and wildlife management areas, WMA) in the Rocky Mountain Region during the 1975-76 hunting season (some symbols denote more than one management area).

north (Stettler area). The RMP/HLP transition zone in the Stettler area consists of breeding areas used by both populations and is about 40 miles wide (H. R. Weaver, personal communication). Although the border between these two populations in Alberta is fairly well known, additional bandings along the south Saskatchewan and Red Deer rivers would be useful. Additionally, the population affinities of large Canada geese along the Missouri and Musselshell rivers in Montana, and along the North Platte River in Wyoming, need clarification.

The remaining range of *B. c. moffitti* lies west of the RMP. We suggest that the geese nesting in west-central Alberta, central and southern British Columbia, western Montana, northern Idaho, southwestern Idaho, Washington, Oregon, and northern California be designated as the Pacific Population (PP) of the western Canada goose (see *Population Nomenclature and Subcommittees*). We recognized an east-west gradient in the breeding-wintering ground relations across the entire range of *B. c. moffitti* (and even across the RMP's nesting range). Thus, although we recommend that *B. c. moffitti* be viewed as two distinct populations, the RMP and PP, we are aware that these two units are dynamic and merely the ends of a continuum. The primary criteria for separation of the RMP and PP was that in terms of nesting-wintering range relations, the RMP was migratory whereas the PP was, with the exception of those geese nesting in Alberta and British Columbia, relatively nonmigratory. Implicit in the recognition of these two populations is a recommendation that they require district

management, especially as related to the need for subunit or even flock management in the relatively sedentary PP.

Hanson and Eberhardt (1971:36) found that central Washington geese migrated only "down to the junction of the Sacramento and San Joaquin rivers in central California." In the present study, Canada geese from Southern Alberta were found to winter mainly at American Falls Reservoir of Southeastern Idaho and in the San Joaquin Valley of Central California. Few geese from Southern Alberta were recovered north of the San Joaquin River in the Sacramento River Valley. However, the confluence of the Sacramento and San Joaquin rivers should not be considered as an exact demarcation point between wintering geese of the RMP and PP. Canada geese that wintered as far south as the Stockton-Modesto-San Francisco area nested in northern California (W. C. Rienecker, personal communication) and south-central Oregon (C. E. Kebbe and E. L. McLaury, personal communication). A detailed examination of recoveries taken in northern Central California may show that most of the RMP uses reservoirs in the Sierra foothills, whereas birds of the PP winter farther west.

Recent field work in Owyhee County of southwestern Idaho indicates the presence of more nesting Canada geese than previously thought to exist there (R. C. Norell, personal communication). These birds might belong to either the PP or RMP, or both (i.e., this area may be a transition zone between the two populations). Future bandings should be designed to determine the population affinity or affinities of Owyhee County's Canada geese.

Almost all geese in the RMP now winter within the borders of the United States. Continued expansion of agriculture and the construction of more dams and reservoirs in Mexico could alter the present distribution of wintering Canada geese, although there is no indication that such a shift is occurring.

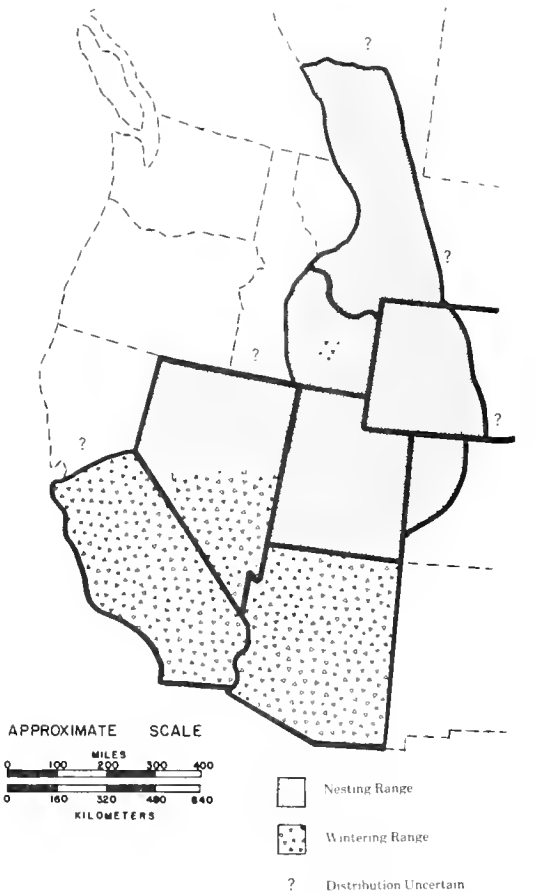


Fig. 5. Generalized nesting and wintering ranges of the Rocky Mountain Canada goose population.

Taxonomy and Evolution

Rutherford (1965) and Grieb (1968) considered the HLP to consist of *B. c. moffitti*. Nelson (1962:2-3), on the basis of personal communications with C. S. Williams—later published (Williams 1967:6-7)—even considered some of the Canada geese ranging as far east as the Dakotas, part of the Western Prairie population, as *moffitti*. In contrast, Hanson (1965:43-77) considered the area within southern Canada and the continental United States occupied by the Western Prairie and Highline populations to be within the nesting range of *B. c. maxima*. More recently, studies by Szymczak (1975:29-30) suggested that Highline geese, if indeed a pure strain, are more nearly *maxima* than *moffitti*. Geese banded on nesting areas in the Rocky Mountain Region, presumably *moffitti*, were occasionally shot on Highline nesting and wintering areas (see indirect recoveries of breeders, Appendix B). Perhaps some of these birds were molt-migrants that joined Highline birds in Canada and migrated south into Colorado and New Mexico. Possibly some of these Rocky Mountain geese pair and breed with Highline birds, thus resulting in genetic interchange between the two populations.

Evidence of genetic similarity comes from an electrophoretic study of blood serum from 22 southern Alberta goslings. In summer 1976, one of us (WBK) took blood from 12 Rocky Mountain goslings at Saint Mary's Reservoir, near the foothills of the Rockies, and from 10 Highline goslings on Seven Person Lake near the Saskatchewan border. The serum protein patterns of these two samples were indistinguishable (R. P. Morgan, personal communication). Additionally, Morgan et al. (1977) found that *maxima* and

moffitti had the most similar blood serums of the nine subspecies of Canada geese examined. Thus, contrary to Hanson (1965:56), it appears that all Rocky Mountain geese should be considered *moffitti*, whereas Highline birds, in agreement with Szymczak (1975:43), should be termed the *maxima-moffitti* complex (an intergrade).

What is the evolutionary history of *B. c. moffitti* and the RMP? Following are two of many possible scenarios regarding the evolution of the western Canada goose.

Palmer (1976:197) considered *moffitti* and *maxima* to be one subspecies. On the basis of the data presented in the present study, three lines of evidence support Palmer's thesis:

- Apparently both *maxima* and *moffitti* make similar long-distance migrations to molt in the Northwest Territories. This migration could represent vestigial behavior from a common ancestor.
- Blood protein patterns of *maxima* and *moffitti* are very similar.
- Indirect recoveries suggest some interchange between the RMP (presumably *moffitti*) and HLP (presumably *maxima*).

Thus, there is evidence to support Palmer's contention that *moffitti* and *maxima* are consubspecific. However, Palmer (1976:197-198) based his argument on assumed evolutionary relations and the existence of relatively little physical difference, and on the presumption that glaciers receded from the Intermountain Region after the ice retreated from the mid-continent. Thus, Palmer (1976:198) wrote that "presumably at least much of the intermountain environment became usable goose habitat relatively late and the Canadas that occupied it are not yet differentiated at the subspecies level from the present prairie birds."

To counter Palmer's argument that the Canada geese of the Intermountain Region only recently split from the larger birds of the mid-continent, one needs only to consider the extensive marshlands associated with the thousands of Pleistocene lakes of the Great Basin. These marshes could have been the habitats from which *moffitti*, and later the RMP, arose. If so, the nesting of *B. c. moffitti* east of the Rocky Mountains could be of relatively recent origin. It is almost certain that *moffitti* and *maxima*, if they are indeed two races, originated from a common ancestor. Evidence includes only clinal differences in body size and color, the similar molt migrations, and the similar blood serum proteins. Given the complex social structure of Canada geese and the traditional use of habitats by geese, two groups of common stock could have been isolated long enough by the Rocky Mountains to at least start the process of divergence. Early Caucasian settlement, accompanied by unregulated hunting and habitat destruction, evidently eliminated *maxima* from much of its original range, especially along the outer limits (Hanson 1965:43-77). However, after the control of hunting and the development of agriculture, including reservoir construction, *moffitti* was able to pioneer east of the Rockies into Alberta's grasslands. The *moffitti* that pioneered into the western edge of *maxima's* former range could have been molt-migrants. Thus, while already distinct subspecies are in the act of diverging, man's alterations of the landscape and its living resources probably resulted in today's close association between Canada geese of the prairie and Rocky Mountain environments.

Population Size and Regulation

Following is a synthesis of available management information concerning the RMP (Table 40). The purposes of this synthesis are to (1) evaluate how well, or poorly, these data fit together and (2) estimate the sizes of the population's major components. The figures discussed below should not be considered statistical estimates but merely crude approximations.

Table 40 presents two models of the population made by calculating changes in numbers of geese from prenesting through posthunting (Method I), and from the hunting season back through nesting (Method II). The various limitations of the basic data in these calculations were discussed throughout this report. Method I starts with the 7,540 nesting pairs estimated from the habitat inventory (Table 38). The prehunting population, about 55,000 birds, was too small to sustain the estimated annual kill of some 63,000 geese. Assuming that the harvest (based mainly on the Federal survey minus geese not in the RMP) and the posthunting population (from the Midwinter Waterfowl Inventory) were of the proper magnitude, Method II suggests a nesting population of 14,000 to 17,000 pairs (Table 24). The mean of these two figures is more than double the number of breeding pairs inventoried. However, the inventoried number of nesting pairs was known to be low, because data were unavailable for many minor nesting areas, and the extent to which nesters from central Alberta contribute to the RMP is unknown. The contribution to the RMP of geese nesting north of Southern Alberta could be significant, since this region supports a substantial goose harvest (H. R. Weaver, personal communication).

Method II of Table 40 suggests a spring population of some 70,500 Canada geese (33,800 breeders; 36,700 nonbreeders) resulting in a fall flight of about 113,400 geese (68,000 adults; 45,400 immatures). However, these figures are only approximations at best, since cross-checking of estimates shows a poor fit. For

Table 40. *Comparative simulations of the Rocky Mountain Canada goose population based on existing management information.*

	Method I (breeders to harvest)	
A.	Nesting pairs (Table 38)	7,540
B.	Breeders (A × 2)	15,080
C.	Subadults (0.52 × B/0.48; Table 24)	16,337
D.	Spring population (B + C)	31,417
E.	Successful nests (A × 0.73; Table 27)	5,504
F.	Gosling hatches per successful nest (E × 4.9; from Table 25)	26,970
G.	Goslings dying before fall (F × 0.07, p. 33)	1,888
H.	Goslings surviving to fall (F - G)	25,082
I.	Spring population dying before fall (D × 0.035; assumed rate)	1,100
J.	Spring population surviving to fall (D - I)	30,317
K.	Prehunting population (H + J)	55,399
M.	Hunting kill (including crippling loss)	63,042
N.	Calculated posthunting population (K - M, p. 36)	-7,643
O.	Censused posthunting population (Table 39)	50,348
	Method II (harvest to breeders)	
a.	Hunting kill (M)	63,042
b.	Posthunting population (O)	50,348
c.	Prehunting population (a + b)	113,390
d.	Adults and subadults in fall (c × 0.60; Table 23)	68,034
e.	Goslings in fall (c × 0.40; Table 23)	45,356
f.	Adults and subadults dying before fall (d × 0.035/0.965)	2,468
g.	Goslings dying before fall (e × 0.07/0.93)	3,414
h.	Spring population (d + f)	70,502
i.	Goslings (e + g)	48,770
j.	Successful nests (i/4.9; from Table 25)	9,953
k.	Unsuccessful nests (j × 0.27/0.73)	3,681
m.	Total nests (j + k)	13,634
n.	Breeders (h × 0.48; Table 24)	33,841
o.	Breeding pairs (n/2)	16,920
p.	Mean nesting pairs ([m + o]/2)	15,277
q.	Nonbreeders (h × 0.52; Table 24)	36,661

example, under the production and mortality rates of Method I, the following relation exists between the compositions of spring and fall populations:

Percent breeders in spring population	Percent immatures in fall population
45	44
40	41
39	40
35	38
30	34

Our earlier estimate of the percentage of breeders in the spring (48%, Table 24) obviously does not correspond with the earlier estimate of immatures in the fall (40%, Table 23), when compared with the above percentages. Additionally, the hunting kill presented in Table 40 appears excessive in light of the annual survival rates of Table 33, even though these rates seem applicable to the population (Table 22). A prehunting population of 113,400 geese consisting of 40% immatures and 60% adults (Table 23) has only 45,818 total deaths per year based on average rates from Table 34, compared with some 63,000 hunting deaths in Table 40 (inclusion of natural mortality would make this figure even higher). Thus, until more is known about the accuracy and precision of the population variables given in Table 40, it will be impossible to soundly model the RMP.

What factors regulate the size of the RMP? Three major factors are worthy of consideration: (1) available habitats, (2) population productivity, and (3) sport hunting.

There are no indications, in terms of high nest desertion rates or overgrazing of brooding sites, that nesting areas are saturated with Canada geese (some areas in Southern Alberta may be exceptions). Similarly, considering the large number of wintering areas available and that the wintering population is dispersed over an area almost as large as the nesting range (Fig. 5), we conclude that wintering habitat is adequate. Furthermore, many nesting and wintering areas are known to have been used by more geese in the past, even though most of these areas have not changed appreciably since the higher use was recorded. Abundance and distribution of molting areas are also believed to be adequate. We conclude that available habitats do not appear to be limiting the population.

Since Canada geese do not reproduce until 2 or more years of age, and prebreeders make up a substantial fraction of the population, changes in annual production and survival could cause variable age structures and hence yearly changes in the population's size. However, both the productivity and survival rates of the RMP appear to be high and relatively stable (see *Breeding Biology and Productivity* and Recovery and survival rates). Nevertheless, available information does not conclusively eliminate the possibility that annual variations in reproduction and survival have significant impacts on the prehunting size of the RMP through shifting of the spring population's age structure.

Total band-recovery rates of Canada geese banded on nesting and molting areas within the range of the RMP averaged about 33% (see Recovery and survival rates). Martinson and McCann (1966) reported a band reporting rate for geese of 36%, 1962-65. This estimate was based on mail questionnaire data and could be biased toward an underestimate (see Henny and Burnham 1976:10). Additionally, reporting rates prob-

ably were higher before 1962 and decreased since 1965 (Martinson and McCann 1966; Henny and Burnham 1976). Thus, no one band reporting rate is adequate for adjusting recovery rates but, considering the years of banding encountered in this study, a range in reporting rates of 35 to 45% seems plausible. Using this assumed range of rates, a minimum of 73 to 94% of the goose deaths were caused by hunting (0.33/0.45 to 0.33/0.35). If one adjusts these percentages for banded geese killed by hunters but unretrieved (15%), it is clear that hunting is the major mortality factor of fledged geese in the RMP (minimum, 86%; 0.73 x 1.18).

Even though sport hunting is the major mortality factor, it does not necessarily follow that hunting controls the population. Much mortality occurs before young geese can fly, especially before hatching. Additionally, the question of determining to what extent natural mortality is reduced by an increasing hunting mortality is complex and unanswered. However, there are indications that hunting does directly influence the RMP. For example, in the 1950's a decreasing population led to reductions in daily bag and possession limits and, in some areas, shorter hunting seasons. These restrictions on hunting were believed to be responsible for an increase in the population (Nagel and Wrakestraw 1968:117-118). Additionally, Anderson and Burnham (1976:41) reasoned that the point at which hunting mortality becomes additive to nonhunting mortality would be lower in long-lived species (such as Canada geese) than in the relatively short-lived mallard (*Anas platyrhynchos*).

Management Recommendations

Population Nomenclature and Subcommittees

We recommend that, because of past confusion regarding what constituted the range of the Great Basin Canada goose, the GBCGS be renamed the Rocky Mountain Canada Goose Subcommittee (RMCGS). We also recommend that the wildlife agencies in those States and Provinces within the range of the PP form a second subcommittee concerned with the preservation and controlled use of *B. c. moffitti*. Inasmuch as the PP is more sedentary than the RMP, it may not be necessary for the Pacific Canada Goose Subcommittee to meet each year. Nevertheless, birds of the PP do cross State, Provincial, and National borders, and closer communication between the waterfowl specialists of Alberta, British Columbia, California, Idaho, Montana, Oregon, and Washington would be useful in improving Canada goose management.

Breeding-ground Surveys

Annual information on the number of nesting pairs, and their production, is required to make reasonable predictions of fall flights. In the Rocky Mountain Region, breeding pair surveys are conducted in April and May and production surveys in June and July. Unfortunately, it is doubtful that accurate and precise measures of nesting Canada geese and their young can be directly obtained solely with surveys made from fixed-wing aircraft. Thus, existing surveys should be viewed as providing, at best, only relative measurements of the breeding population and its production.

The present coverage of breeding-ground surveys in the Rocky Mountain Region should be improved. Also, there is a need for standardization of breeding-ground surveys, especially in the census of breeding pairs. For example, most western States use indicated breeding pairs as an index to the size of the nesting population. As used here, indicated breeding pair means the number of pairs counted from the air, plus the number of single geese observed. Geese in distinct groups of three or more birds are counted as "grouped birds." Unfortunately, not all wildlife agencies within the range of the RMP apply this definition to their survey method in the field.

Aerial surveys of nesting Canada geese from fixed-wing aircraft have two major sources of error: (1) not all birds counted as breeders actually nest, and (2) not all birds present are seen. Air-ground comparisons could be used to correct for the first problem. For example, on 5 areas in Idaho and 11 in Wyoming the respective agencies conduct both aerial and ground censuses each year. Although dual counts were not designed for air-ground comparisons, they do indicate the feasibility of using such comparisons to determine what fraction of indicated breeding pairs seen from the air nest (see Table 1). Though estimating the proportion of geese present but not counted during surveys with fixed-wing aircraft is difficult, it is critical because nonbreeders (especially prebreeders) make up a substantial and perhaps variable fraction of each year's fall flight. Comparisons of counts made from fixed-wing and rotary-wing aircraft should be tested as a means to determine visibility differences according to habitat types. Ideally, visibility factors should be obtained annually; however, the cost of flying both types of aircraft each year for such comparisons is prohibitive.

Breeding pair surveys should be given priority over air-ground censuses of goslings. The average reproductive success of pairs of large Canada geese nesting in the continental United States and southern Canada is fairly constant between years. Without great annual fluctuations in production there is little justification for emphasizing yearly measurements of gosling

production. However, weather and other factors can have immediate, negative impacts on reproduction, which should be monitored by management agencies when possible. For example, areas searched from the ground during air-ground comparisons can be easily rechecked after the eggs have hatched to determine the success of each nest located earlier. Also, on some areas, such as the marshes along Great Salt Lake in Northern Utah, a production survey may be the only index of the breeding population that is feasible to obtain.

Finally, to determine annual trends in breeding populations, or production, only data from nesting areas censused with similar methods during all years being compared should be used. For example, if an area was censused in 1975 but not in 1976, data for this area should be excluded in determining the 1975-76 trend (assuming a nonrandom survey).

Wintering-ground Surveys

Aerial counts of Canada geese are taken throughout the Rocky Mountain Region in early January. Additionally, counts are made once or twice monthly by some wildlife agencies throughout the fall and winter on major concentration areas. In terms of population management, these fall and winter counts are less useful than the January census. The fall or early-winter counts are difficult to interpret because geese are migrating and much of the hunting mortality is yet to occur. In contrast, by January most Canada geese are on their wintering grounds and are relatively sedentary. Also, most hunting for the fall-winter period is over, and most birds surviving in January will return to the breeding grounds in spring. However, January counts may not yield accurate estimates of trends in numbers of breeders, since the age structure of the population could change greatly between years, as could natural mortality between January and April. Thus, even with good January counts there is a real need for spring estimates of yearly trends in breeding pairs.

January counts appear to be the most appropriate means for evaluating population trends since (in addition to the reasons cited above) these counts include a larger proportion of the population than do breeding-ground surveys. Unfortunately, January counts are not of equal reliability on all wintering areas. Geese concentrate on some wintering areas while the hunting season is open and are easier to find and count than after hunting stops and the birds disperse. In such situations, consideration should be given to censusing Canada geese in late December, as soon as possible after the hunting season, but as close as practical to the January count.

Wildlife agencies must try to obtain the most reliable posthunting figures feasible. If bad weather causes a poor count, especially incomplete coverage, another census should be taken as soon as practical. The posthunting inventory should cover all known Canada goose wintering areas and thus sample as large a fraction of the population as possible. In making yearly comparisons, trends must be based only on data from the wintering areas censused in all years being compared. Additionally, small Canada geese counted must be eliminated when the status of the RMP is evaluated. This is especially true for Central California, although some small Canada geese also occur in Northwestern Nevada and Eastern Arizona, as well as perhaps in Western Arizona and Southern California.

Given the importance of these posthunting censuses, efforts should be made to determine both the accuracy and precision of aerial counts of Canada geese on wintering areas. Unfortunately, improving the accuracy of one-time aerial counts of Canada goose concentrations will be difficult (see Caughley et al. 1976).

Data from wintering-ground as well as breeding-ground surveys should be summarized yearly by the RMCGS. In this annual report, care should be taken to show trends based on strictly comparable data. Also, we suggest that the arrangement of the information according to the reference areas that we have defined would help standardize data presentation and interpretation.

Banding Programs

The present study has shown, based on band-recovery distributions, the relations between breeding and wintering grounds on a reference area basis. However, since the wintering areas of all nesting flocks have not been determined conclusively, preseason banding is needed on specific nesting areas. Geese should be banded in central Alberta to delineate the population's northern limits, and on selected nesting areas in Alberta, Montana, and Wyoming to clarify the boundary between the RMP and HLP. The boundary between the RMP and the PP can be better understood if additional geese are banded on nesting areas in southwestern Idaho and throughout Nevada.

We have calculated the number and distribution of banded geese needed to measure annual survival and recovery rates of Rocky Mountain geese (unpublished data). Discussions with the appropriate wildlife officials lead us to conclude that it is not feasible to obtain the required samples. For this and other reasons, we concur with Raveling (1978:223) where he suggests that "Serious consideration should be given to exchanging routine agency banding programs for color-marking programs and the assignment of a biologist

to 'live' with each population subunit of interest to obtain consistency in records of marked individuals . . . the information gathered would be of more use, and would not necessarily cost that much more, if such a marking program were a substitute for traditional banding. . . ." A coordinated color-marking program is especially critical to assess the rapid increase in wintering geese at American Falls Reservoir in southeastern Idaho. The buildup at American Falls could be caused by over-harvest of those flocks which traditionally migrate to the most southerly wintering areas (see Raveling 1978). To more fully evaluate the American Falls situation, geese would need to be color-marked throughout southern Alberta, Central Montana, and Southeastern Idaho. However, we caution against any large-scale color-marking program until the possibility of mortality from neck-collars (Greenwood and Bair 1974) is evaluated.

Regardless of when Canada geese are banded or color-marked, we recommend that all birds be aged and sexed. Obviously, it is impossible to test for differences between age and sex classes unless the basic data are available. Thus, consideration must be given to determining the sex of each goose and to classifying preseason captures as follows (modified from Hanson 1965:116-124): (1) hatching-year (HY), (2) second-year (SY), and (3) after-second-year (ASY); and postseason captures as (1) SY, (2) third-year (TY), and (3) after-third year (ATY). The preseason age classes apply to geese captured on breeding (classes 1, 2, 3) and molting (2,3) areas, as well as to inseason captures (1-3). By convention, 1 January is the dividing point between preseason and postseason age classifications.

Management Objectives

Canada geese nesting in the Arctic are most closely associated with man during the winter and migration periods. In contrast, many western Canada geese live in proximity to humans throughout the year. For the RMP, the juxtaposition of man and birds is both detrimental and beneficial. On the negative side, man has decreased, and continues to decrease, the ability of areas to sustain Canada geese, and sport hunting is the major cause of mortality in fledged Rocky Mountain geese. Conversely, geese do adapt to many agricultural practices, and there can be no doubt that the overall capacity of the Rocky Mountain Region to support geese increased greatly with Caucasian settlement, agricultural development, and controlled hunting. Development of management objectives requires that attention be given to anticipated changes.

In the past, the GBCGS tried to maintain the population at a posthunting count of 50,000 geese. This guideline was in effect for more than 20 years; its net purpose was to maintain a stable population. However, considering the quantities of habitats now known to be available, and the ability of Canada geese to live in fairly dense units, consideration must be given to managing for an increasing population. Increased crop depredation, with a few local exceptions in Alberta, California, and Wyoming, would not be a major problem if the RMP were larger. Eventually an increasing human population, with the attendant problems of more intensive agriculture, energy development, and water allocation could significantly degrade the population's habitat base. However, until such time it is in the best interest of Canada geese, and those persons who enjoy this resource, to increase the RMP to a level commensurate with available habitats.

Members of the RMCGS generally recognize that present breeding- and wintering-ground surveys detect, at best, only long-term trends, and thus survey results cannot be viewed as statistically reliable measures of population levels. With these limitations in mind, it is the consensus of the RMCGS that the population should be allowed to slowly increase. We suggest using two indices to gauge this increase: (1) trends in posthunting populations obtained with January aerial counts, and (2) where available, trends in breeding pairs based on spring aerial counts. Trends in numbers of breeding pairs will be used to pinpoint reference areas where breeding populations are stable, increasing, or decreasing. The January counts will be used to judge the RMP's overall welfare, based on the most recent 3-year means, and may lead to the following management measures:

January count	*Management response*
Under 50,000	Consider imposing hunting restrictions
50,000 to 70,000	Optimum size, no action; especially if survey trends are upward
Over 70,000	Consider reducing hunting restrictions.

The RMP, based on the 1973-79 January counts, appears to be slowly increasing. Thus, present hunting regulations do not seem to be preventing population growth. However, we realize that the number of Federal migratory bird hunting stamps (Table 30), and thus probably the number of goose hunters, are increasing in the Rocky Mountain Region. Consequently, at some future time restrictions on sport hunting will probably be required to maintain an increasing population. For the present, current regulations seem to be in accord with the objective of allowing the RMP to gradually expand. When restrictions on the harvest are required, they should be most strin-

gent in reference areas in which the most birds are now shot (see Table 30) and where the effect of the restrictions can be evaluated. Hunting restrictions should be applied only to the specific reference areas in which the goose populations are known to be interrelated.

The RMCGS recognizes that care must be taken to ensure that geese making the longest fall-spring migrations, which are generally subjected to more hunting than short-distance migrants, are not overharvested—especially in terminal wintering areas (see Raveling 1978). If geese using the most southerly wintering grounds have higher total mortality rates than geese wintering to the north, the use of traditional areas on the southern terminus could decrease and eventually be eliminated. This would be a serious management blunder; although flocks can be reintroduced on nesting areas, there are now no proven methods for reestablishing wintering flocks in specific areas. As stated by Raveling (1978:222), "The best chance to obtain the desired distribution of geese, especially in the south, is to protect the remnant . . . subunits from harvest before they reach their winter terminals. This will require the capture and identification of these . . . subunits and an extraordinary degree of cooperation among political units. . . ."

The anticipated development of various natural resources, and an expanding human population, will cause relatively rapid environmental and technological changes throughout the Rocky Mountain Region. Thus, the management guidelines we have offered should be reviewed and updated whenever circumstances warrant.

Summary

This study, and the band recovery patterns of Canada geese examined by other biologists, showed that the western Canada goose should be managed as two populations, the Rocky Mountain (RMP) and Pacific (PP). The RMP is highly migratory, whereas the PP is more sedentary and often winters on or near the nesting areas (excepting PP birds from Canada which migrate annually). This report is concerned mainly with the RMP—specifically, the population's distribution, habitats, and management.

The range of the RMP includes the Rocky Mountain States west of central Colorado, along with southwestern Alberta, Arizona, Utah, and California south of Sacramento. The geographical distribution of over 19,000 recoveries from Canada geese banded in Alberta and the western States in 1938-73 was examined to define the population and the geographical units within the population occupied by geese with similar breeding-ground and wintering-ground affinities. Fifteen units, termed reference areas, were recognized. Only 1 of the 15 reference areas was used by a relatively nonmigratory flock; this flock nests and winters in Northwestern Nevada and is considered part of the RMP.

The present delineation of the RMP has two major shortcomings: (1) the population's northern border in Alberta is incompletely known, and (2) the boundary between the wintering ranges of the RMP and the PP in central California is not completely known. The locations of these borders can be clarified by future banding or color-marking projects in selected areas.

The evolutionary history of the western Canada goose is unclear, but *moffitti* is apparently closely related to the giant Canada goose. The taxonomy of these two subspecies is in a state of flux. However, *moffitti* and *maxima* are similar in terms of blood serum proteins and long-distance molt migrations. Also, *moffitti* and *maxima* show only clinal differences in coloration (light to dark) and body size (large to larger). We speculate that the expansion of the nesting range of *moffitti* east of the Rocky Mountains, evidently the western edge of the original range of *maxima*, occurred only since Caucasian settlement and the attendant alterations of Alberta's grasslands.

The western Canada goose, including members of both populations, commonly make postspring and prefall movements from nesting to molting areas and return. These molt migrations consist mainly of prebreeders and unsuccessful nesters. Over half of the molters in the RMP apparently go to subarctic Canada each year to grow new flight feathers. The specific locations of molting areas used by western Canada geese in northern Canada are unknown, although band recovery axes and previous studies by Canadian biologists suggest the Northwest Territories between latitude 60° and 66° N and longitude 96°and 106° W.

The breeding biology of the western Canada goose has been extensively studied. Data were summarized on nesting chronology, breeding age, clutch size, nesting success, and other aspects of their breeding biology. Despite the numerous studies spanning over three decades, factors causing reproductive variation in *moffitti* are poorly understood. We suggest that future researchers investigate the feeding ecology of geese on wintering and nesting areas as related to physical condition and variations in clutch size, nesting success, and gosling survival. The locations of nesting and brooding sites as related to food resources, reproductive success, and survival also deserve study. Artificial nesting platforms were found to increase goose production in terms of somewhat larger clutches and significantly higher nesting success ($P < 0.01$).

In addition to examining banding and breeding data, we conducted an inventory of Canada goose habitats in the Intermountain Region. The habitat inventory

was limited to nesting, molting, and wintering areas known to be used by Canada geese in the early 1970's. The known distribution of Rocky Mountain geese indicated that about one-third of the nesters each used flooded bottomlands and rivers (33%), lakes and reservoirs (36%), and marshes and waterfowl impoundments (31%). Nesting birds were roughly divided evenly within the three habitat combinations, except on lakes and reservoirs where a higher percentage of the known nesters used reservoirs (7% lake use vs. 29% reservoir use). Geese nested in all but the three most southern of the RMP's 15 reference areas. Major breeding grounds were in three reference areas: Southern Alberta, Southeastern Idaho, and Northern Utah.

More than half of the RMP's estimated 37,000 molters (about 22,000 birds) migrated outside the Intermountain Region to molt. Most of the rest remained in the region, where they used 19 known molting areas in the early 1970's. Of the molters staying within the region to molt, about three-quarters used reservoirs and the rest lakes. In general, large bodies of open water relatively free of human disturbance were the preferred habitats for Canada geese molting within the population's nesting range.

Geographically, the population's most heavily used wintering regions were, in order of mean use during the early 1970's, Southern California, Southeastern Idaho, and Central California. Reservoirs and adjacent farmlands supported 64% of the known wintering population; waterfowl impoundments and rivers were of equal but secondary importance (16% each). The importance of reservoirs and waterfowl impoundments pointed up the dependency of the RMP on man-made wintering areas.

State and Federal wildlife areas were important to both nesting and wintering Rocky Mountain geese. Within the RMP's range there were 35 State and 24 Federal management areas used by Canada geese; many of these areas provided sanctuary for geese during the hunting season and fostered dispersal of the wintering population.

Although available information was inadequate for modeling the RMP, we approximated the population as consisting of some 70,500 birds (33,800 breeders and 36,700 nonbreeders) in the spring and 113,400 (68,000 adults and 45,400 immatures) in the fall, before the hunting season. Mean annual survival rates averaged 53 $\pm$ 2% ($\bar{\bar{X}} \pm$ SE) for immatures and 64 $\pm$ 1% for adults, for Rocky Mountain geese banded on nesting areas. Mean annual survival rates of adults banded on molting areas averaged 70 $\pm$ 1%. Molters, most of which are yearlings, probably survive at a slightly higher rate than breeders, most of which are 3 or more years old; this difference in survival rates may be related to hazards encountered during nesting and brood rearing. Immatures were 1.3 times more vulnerable to gunning than were adults. Hunting accounted for more than 86% of the deaths of fledged birds in the RMP.

There were no indications that available habitats were limiting the population. Rather, Canada geese readily adapt to many agricultural practices and thus the overall capacity of the Rocky Mountain Region to support geese has been greatly increased since the development of agriculture and reservoir construction. Given the amounts of available habitat, and the goose's ability to live in dense units, we conclude that the RMP could be larger.

We consider annual aerial counts during late winter the most feasible means for assessing the RMP's status in the immediate future. These counts cannot be considered as accurate censuses but merely as relative measures of trends in the posthunting population. Since aerial winter counts are subject to errors of undetermined direction or size, no single year's information should be used to judge the population's welfare. Instead, the most recent 3-year mean should be used to assess population status within the following guidelines:

- A mean of less than 50,000 birds will result in consideration of restrictions on sport hunting.
- A mean of 50,000 to 70,000 geese will be viewed as optimum, especially if the trends of winter counts and spring breeding-pair surveys are upward.
- A mean of more than 70,000 birds will lead to consideration of liberalized hunting regulations.

Spring aerial surveys will be conducted annually to monitor breeding population levels. Air–ground comparisons could be used to estimate more accurately the number of nesters. Estimating the total spring population would also probably require refinement in aerial counting methods, including adjustment factors for visibility differences among habitats.

The preceding management guidelines and techniques must be reviewed and changed as future conditions warrant.

Acknowledgments

This project would have been impossible without the help of many cooperators, a number of whom collected many of the data we have used. All of the following persons, as well as other personnel of their agencies, worked many hours on the Rocky Mountain Canada Goose Study and deserve special recognition: H. R. Weaver, Alberta Fish and Wildlife Division; D. R. Berlinski, Arizona Game and Fish Department; F. M. Kozlik, California Department of Fish and Game; M. R. Szymczak, Colorado Division of Wildlife; R. C.

Norell, Idaho Department of Fish and Game; D. W. Witt, Montana Fish and Game Department; L. W. Barngrover, Nevada Department of Fish and Game; J. E. Chattin, U.S. Fish and Wildlife Service; A. F. Regenthal, Utah Division of Wildlife Resources; and L. J. Serdiuk, Wyoming Game and Fish Department.

Many individuals assisted in this investigation by completing habitat forms, guiding one of us (WBK) on field trips, and providing stimulating discussions of goose biology. Individuals who were especially helpful, and their affiliations, include the following: D. Cole, Alberta Fish and Wildlife Division; L. W. Goehring, G. I. Gould, J. R. LeDonne, and W. C. Rienecker, California Department of Fish and Game; F. DeShon, C. Jensen, P. Johnson, and K. A. MacKenzie, Idaho Department of Fish and Game; D. A. Childress and G. Salinas, Montana Fish and Game Department; F. N. Folks and F. C. Jensen, Utah Division of Wildlife Resources; G. F. Wrakestraw, Wyoming Game and Fish Department; and FWS employees J. D. Hill (Minidoka NWR), M. K. Haderlie and M. R. Kaschke (National Bison Range), K. D. Norman (Portland, Oregon), L. A. Stemmerman (Benton Lake NWR), R. C. Twist (Ravalli NWR), and D. V. Tiller and S. Vehrs (Salton Sea NWR).

B. A. Schrader, University of Idaho, plotted band recoveries, tabulated the habitat inventory, and proofread tables. C. E. Kebbe, Oregon Department of Fish and Game, and E. L. McLaury, FWS, provided band recovery data on Oregon's Canada geese. W. C. Rienecker, California Department of Fish and Game, and I. J. Ball, Washington State University, provided us with copies of preliminary recovery information from Canada geese banded in their respective states. R. P. Morgan, Chesapeake Biological Laboratory, analyzed goose blood serum. R. T. Sterling, Ducks Unlimited (Canada), kindly provided information about the molt migration of Canada geese. K. K. Falke, University of Idaho Computer Services, wrote most of the computer programs used in this investigation.

This study was possible only because so many people banded geese over the years throughout the West. G. H. Jensen, retired FWS, deserves recognition for being a pioneer goose bander in Alberta, Idaho, Montana, Utah, and Wyoming. Also, we express our appreciation to the banders who graciously gave us permission to use their data (see Krohn 1977: Appendix B).

Editorial comments were provided by University of Idaho Wildlife faculty members E. D. Ables, C. R. Hatch, and M. G. Hornocker, and by the cooperators listed in the first paragraph above. D. R. Anderson, Utah Cooperative Wildlife Research Unit, reviewed the manuscript and contributed numerous valuable suggestions for improvement.

References

Alberta Fish and Wildlife Division. 1975. Goose management in Alberta. Alberta Recreation Parks Wildlife, Wildl. Manage. Ser. 2. 19 pp.

Anderson, D. R. 1975. Population ecology of the mallard: V. Temporal and geographic estimates of survival, recovery, and harvest rates. U.S. Fish Wildl. Serv., Resour. Publ. 125. 110 pp.

Anderson, D. R., and K. P. Burnham. 1976. Population ecology of the mallard: VI. The effect of exploitation on survival. U.S. Fish Wildl. Serv., Resour. Publ. 128. 66 pp.

Anderson, W. 1965. Waterfowl production in the vicinity of gull colonies. Calif. Fish Game 51(1):5-15.

Appel, R. R. 1969. Measure the influence of artificial nesting platforms and tubs on Canada goose nesting activity and success. Job Completion Rep. W-71-R-5, Wyoming Game and Fish Commission, Cheyenne, 59 pp.

Arneson, P. D. 1970. Evaluation of molting areas of Great Basin Canada geese. M.S. Thesis. Utah State University, Logan. 71 pp.

Atwater, M. G. 1959. A study of renesting in Canada geese in Montana. J. Wildl. Manage. 23(1):91-97.

Ballou, R. M. 1955. Nesting distribution, and mortality studies of Canada geese. Job Completion Rep. W-50-R-5, Wyoming Game and Fish Commission, Cheyenne. 78 pp.

Ballou, R. M. 1957. A brief review of Wyoming's goose restoration program. Proc. Annu. Conf. West. Assoc. State Game Fish Comm. 37:251-255.

Barraclough, M. E. 1954. Biology of Canada geese (*Branta canadensis moffitti*) in the Flathead Valley of Montana. M.S. Thesis. Montana State University, Missoula. 91 pp.

Bedwell, S. F. 1973. Fort Rock Basin—Prehistory and environment. University of Oregon Books, Eugene. 189 pp.

Bellrose, F. C. 1976. Ducks, geese, and swans of North America. Stackpole Books, Harrisburg, Penn. 543 pp.

Boeker, H. M. 1953. Waterfowl production in the Yampa River Valley, Colorado. M.S. Thesis. Colorado State University, Fort Collins. 117 pp.

Brakhage, G. K. 1965. Biology and behavior of tub-nesting Canada geese. J. Wildl. Manage. 29(4):751-771.

Brooks, R. H. 1956. Appendix III: Faunal remains. Pages 106-112 *in* R. F. Heizer and A. D. Kroeger. The archaeology of Humboldt Cave, Churchill County, Nevada. Univ. Calif. Publ. Am. Archit. Ethnol. 47(1).

Brownie, C., D. R. Anderson, K. P. Burnham, and D. S. Robson. 1978. Statistical inference from band recovery data: A handbook. U.S. Fish Wildl. Serv., Resour. Publ. 131. 212 pp.

Burroughs, R. D. 1961. The natural history of the Lewis and Clark expedition. Michigan State University Press, East Lansing. 340 pp.

Carney, S. M., M. F. Sorensen, and E. M. Martin. 1975. Distribution in States and counties of waterfowl species harvested during 1961-70 hunting seasons. U.S. Fish Wildl. Serv., Spec. Sci. Rep.—Wildl. 187. 132 pp.

Caughley, G., R. Sinclair, and D. Scott-Kemmis. 1976. Experiments in aerial survey. J. Wildl. Manage. 40(2):290-300.

Chapman, J. A., C. J. Henny, and H. M. Wight. 1969. The status, population dynamics, and harvest of the dusky Canada goose. Wildl. Monogr. 18. 48 pp.

Childress, D. A. 1971. Canada goose production and water level relationships on the Madison River, Montana. M.S. Thesis. Montana State University, Bozeman. 35 pp.

Childress, D. A., and R. Eng. 1979. Dust abatement project with wildlife enhancement on Canyon Ferry Reservoir,

Montana. Pages 282-288 *in* Journal Series 965, Montana Agricultural Experiment Station, Bozeman.
Chupp, N. R., and P. D. Dalke. 1964. Waterfowl mortality in the Coeur d'Alene River Valley, Idaho. J. Wildl. Manage. 28(4):692-702.
Collias, N.E., and L. R. Jahn. 1959. Social behavior and breeding success in Canada geese (*Branta canadensis*) confined under semi-natural conditions. Auk 76 (4):478-509.
Craighead, F. C., Jr., and J. J. Craighead. 1949. nesting Canada geese on the Upper Snake River. J. Wildl. Manage. 13(1):51-64.
Craighead, J. J., and D. S. Stockstad. 1956. Measuring hunting pressure on Canada geese in the Flathead Valley. Trans. N. Am. Wildl. Conf. 21:210-238.
Craighead, J. J. and D. S. Stockstad. 1961. Evaluating the use of aerial nesting platforms by Canada geese. J. Wildl. Manage. 25(4):363-372.
Craighead, J. J., and D. S. Stockstad. 1964. Breeding age of Canada geese. J. Wildl. Manage. 28(1):57-64.
Culbertson, J. L., L. L. Cadwell, and I. O. Buss. 1971. Nesting and movements of Canada geese on the Snake River in Washington. Condor 73(2):230-236.
Dey, N. H. 1964. Canada goose production and population stability, Ogden Bay Waterfowl Area, Utah. M.S. Thesis. Utah State University, Logan. 38 pp.
Dimmick, R. W. 1968. Canada geese of Jackson Hole: Their ecology and management. Wyo. Game Fish Comm., Bull. 11. 86 pp.
Dow, J. S. 1943. A study of nesting Canada geese in Honey Lake Valley, California. Calif. Fish Game 29(1):3-18.
Ewaschuk, E., and D. A. Boag. 1972. Factors affecting hatching success of densely nesting Canada geese. J. Wildl. Manage. 36(4):1097-1106.
Flath, D. L. 1970. Reproductive success of Canada geese in the Bitterroot Valley, Montana. M.S. Thesis. Univ. of Montana, Missoula. 61 pp.
Fleming, W. B. 1959. Migratory waterfowl in Arizona. Ariz. Game Fish Dep., Wildl. Bull. 5. 74 pp.
Geis, M. B. 1956. Productivity of Canada geese in the Flathead Valley, Montana. J. Wildl. Manage. 20(4):409-419.
Gibson, L. W., and I. O. Buss. 1972. Reactions of Canada geese to reservoir impoundment on the Snake River in Washington. Northwest Sci. 46(4):301-318.
Gore, J. F. 1973. Forcing Canada geese into elevated nesting structures. Proc. Southeast. Assoc. Game Fish Comm. 27:324-328.
Greenwood, R. J., and W. C. Bair. 1974. Ice on waterfowl markers. Wildl. Soc. Bull. 2(3):130-134.
Grieb, J. R. 1968. Canada goose populations of the Central Flyway—their status and future. Pages 31-41 *in* R. L. Hine and C. Schoenfeld, eds. Canada goose management: Current continental problems and programs. Dembar Education Research Service, Madison, Wis. 195 pp.
Grieb, J. R. 1970. The Shortgrass Prairie Canada goose population. Wildl. Monogr. 22. 49 pp.
Grieb, J. R., M. G. Sheldon, and D. J. Neff. 1961. The nesting Canada geese of Moffat County, Colorado. Proc. Annu. Conf. West. Assoc. State Game Fish Comm. 41:136-146.
Haines, A. L., editor. 1955. Osborne Russell's journal of a trapper. University of Nebraska Press, Lincoln. 191 pp.
Hansen, H. A. 1968. Pacific Flyway Canada goose management—Federal and State cooperation. Pages 43-49 *in* R. L. Hine and C. Schoenfeld, eds. Canada goose management: Current continental problems and programs. Dembar Education Research Service, Madison, Wis. 195 pp.
Hansen, H. A., and W. H. Oliver. 1951. The status of resident Canada geese in south-central Washington, spring, 1950. Murrelet 32(1):2-7.
Hanson, H. C. 1965. The giant Canada goose. Southern Illinois University Press, Carbondale. 226 pp.
Hanson, W. C., and L. L. Eberhardt. 1971. A Columbia River Canada goose population, 1950-1970. Wildl. Monogr. 28. 61 pp.
Henny, C. J., and K. P. Burnham. 1976. A reward band study of mallards to estimate band reporting rates. J. Wildl. Manage. 40(1):1-14.
Hildebrand, B. W. 1979. Habitat requirements of molting Canada geese at Lima Reservoir, Montana. M.S. Thesis. Montana State University, Bozeman. 79 pp.
Hinz, T. C. 1974. Seasonal activity numbers, and distribution of Canada geese (*Branta canadensis*) in the lower Yellowstone Valley, Montana. M.S. Thesis. Montana State University, Bozeman. 88 pp.
Hook, D. L. 1973. Production and habitat use by Canada geese at Freezout Lake, Montana. M.S. Thesis. Montana State University, Bozeman. 53 pp.
Jarvis, R. L., and S. W. Harris. 1967. Canada goose nest success and habitat use at Malheur Refuge. Murrelet 48(2):46-51.
Kossack, C. W. 1950. Breeding habits of Canada geese under refuge conditions. Am. Midl. Nat. 43(3):627-649.
Krohn, W. B. 1977. The Rocky Mountain population of the western Canada goose: Its distribution, habitats, and management. Ph.D. Thesis. University of Idaho, Moscow. 300 pp.
Krohn, W. B., and E. G. Bizeau. 1979. Molt migration of the Rocky Mountain population of the Western Canada Goose. Pages 130-140 *in* R. L. Jarvis and J. C. Bartonek, eds. Management and biology of Pacific Flyway geese. Oregon State University Book Stores, Inc., Corvallis. 346 pp.
Kuyt, E. 1966. Further observations on large Canada geese molting on the Thelon River, Northwest Territories. Can. Field-Nat. 80(2):63-69.
Lack, D. 1967. The significance of clutch-size in waterfowl. Wildfowl 18:125-128.
Lack, D. 1968. Ecological adaptations for breeding in birds. Methuen and Co., Ltd., London. 409 pp.
Loud, L. L., and M. R. Harrington. 1929. Lovelock Cave. Univ. Calif. Publ. Am. Archit. Ethnol. 25:1-183.
MacInnes, C. D. 1966. Population behavior of eastern arctic Canada geese. J. Wildl. Manage. 30(3):536-553.
MacInnes, C. D., R. A. Davis, R. N. Jones, B. C. Lieff, and A. J. Pakulak. 1974. Reproductive efficiency of McConnell River small Canada geese. J. Wildl. Manage. 38(4):686-707.
MacInnes, C. D., and R. K. Misra. 1972. Predation on Canada goose nests at McConnell River, Northwest Territories. J. Wildl. Manage. 36(2):414-422.
Martin, F. W. 1964. Behavior and survival of Canada geese in Utah. Utah Dep. Fish Game, Inf. Bull. 64-67. 89 pp.
Martinson, R. K., and J. A. McCann. 1966. Proportion of recovered goose and brant bands that are reported. J. Wildl. Manage. 30(4):856-858.
McCarthy, J. J. 1973. Response of nesting Canada geese (*Branta canadensis*) to islands in stockdams in northcentral Montana. M.S. Thesis. Montana State University, Bozeman. 36 pp.
Meinzer, O. E. 1922. Map of the Pleistocene lakes of the Basin-and-Range Province and its significance. Bull. Geol. Soc. Am. 33:541-552.
Merrill, L. B., and E. G. Bizeau. 1972. Canada goose production as related to stream flow on the South Fork of the Snake River in Idaho: A preliminary study. Idaho Cooperative Wildlife Research Unit, University of Idaho, Moscow. 39 pp.
Miller, A. H., and J. F. Ashley. 1934. Goose footprints on a Pliocene mud-flat. Condor 36(4):178-179.

Miller, A. W., and B. D. Collins. 1953. A nesting study of Canada geese on Tule Lake and lower Klamath National Wildlife Refuges, Siskiyou County, California. Calif. Fish Game 39(3):385-396.

Milne, H. 1965. Seasonal movements and distribution of eiders in northeast Scotland. Bird Study 12(3):170-180.

Morgan, R. P., II, S. T. Sulkin, and C. J. Henny. 1977. Serum proteins and Canada goose (*Branta canadensis*) subspecies. Condor 79(2):275-278.

Munro, D. A. 1960. Factors affecting reproduction of the Canada goose (*Branta canadensis*). Proc. Int. Ornithol. Congr. 12:542-556.

Nagel, J. E., and G. F. Wrakestraw. 1968. The impact of season limits on Great Basin goose harvest. Pages 117-121 *in* R. L. Hine and C. Schoenfeld, eds. Canada goose management: Current continental problems and programs. Dembar Education Research Serv., Madison, Wis. 195 pp.

Naylor, A. E. 1953. Production of the Canada goose on Honey Lake Refuge, Lassen County, California. Calif. Fish Game 39(1):83-94.

Naylor, A. E., and E. G. Hunt. 1954. A nesting study and population survey of Canada geese on the Susan River, Lassen County, California. Calif. Fish Game 40(1):5-16.

Nelson, H. K. 1962. Recent approaches to Canada goose management. U.S. Fish Wildl. Serv., Spec. Sci. Rep.—Wildl. 66. 25 pp.

Nieman, D. J., and H. J. Dirschl. 1973. Waterfowl populations on the Peace-Athabasca Delta, 1969 and 1970. Can. Wildl. Serv., Occas. Pap. 17. 26 pp.

Ohmart, R. D., W. O. Deason, and S. J. Freeland. 1975. Dynamics of marshland formation and succession along the lower Colorado River and their importance and management problems as related to wildlife in the arid Southwest. N. Am. Wildl. Nat. Resour. Conf. 40:240-252.

Owen, M. 1973. The management of grassland areas of wintering geese. Wildfowl 24:123-130.

Owen, M. 1975. Cutting and fertilizing grassland for winter goose management. J. Wildl. Manage. 39(1):163-167.

Palmer, R. S., editor. 1976. Handbook of North American Birds. Vol. 2. Yale University Press, New Haven, Conn. 521 pp.

Patterson, R. L., and R. M. Ballou. 1953. The status of the Canada goose in Wyoming. Wyo. Wildl. 17(8):4-14, 36.

Rand McNally and Company. 1975. Commercial atlas and marketing guide. Rand McNally & Company, San Francisco, California. 669 pp.

Raveling, D. G. 1969. Roost sites and flight patterns of Canada geese in winter. J. Wildl. Manage. 33(2):319-330.

Raveling, D. G. 1976*a*. Status of giant Canada geese in southeast Manitoba. J. Wildl. Manage. 40(2):214-226.

Raveling, D. G. 1976*b*. Migration reversal: A regular phenomenon of Canada geese. Science 193(4248):153-154.

Raveling, D. G. 1978. Dynamics of distribution of Canada geese in winter. N. Am. Wildl. Nat. Resour. Conf. 43:206-225.

Reeves, H. M. 1954. Muskrat and waterfowl production and harvest on Dingle Swamp, Bear Lake County, Idaho. M.S. Thesis. Utah State University, Logan. 183 pp.

Rienecker, W. C. 1971. Canada goose nest platforms. Calif. Fish Game 57(2):113-123.

Rienecker, W. C., and W. Anderson. 1960. A waterfowl nesting study on Tule Lake and Lower Klamath National Wildlife refuges, 1957. Calif. Fish Game 46(4):481-506.

Rutherford, W. H., editor. 1965. Description of Canada goose populations common to the Central Flyway. Central Flyway Waterfowl Council Technical Committee. 20 pp.

Saake, N. 1975. Native marshes to man-made desert. Ducks Unlimited 39(2):28-30, 38.

Salomonsen, F. 1968. The molt migration. Wildfowl 19:5-24.

Salter, R. L. 1956. Canada goose nesting studies in Idaho. Proc. Annu. Conf. West. Assoc. State Game Fish Comm. 36:191-194.

Saul, D. 1970. Influence of artificial nesting platforms on Canada geese. Job Completion Rep. W-71-R-6, Wyoming Game and Fish Commission, Cheyenne. 21 pp.

Schroeder, L. D., S. M. Carney, and E. M. Martin. 1974. Distribution of duck stamp sales within States during fiscal years 1962-71. U.S. Fish Wildl. Serv., Spec. Sci. Rep.—Wildl. 180. 46 pp.

Steel, P. E., P. D. Dalke, and E. G. Bizeau. 1957. Canada goose production at Gray's Lake, Idaho, 1949-1951. J. Wildl. Manage. 21(1):38-41.

Sterling, T., and A. Dzubin. 1967. Canada goose molt migrations to the Northwest Territories. Trans. N. Am. Wildl. Conf. 32:355-373.

Surrendi, D. C. 1970. The mortality, behavior, and homing of transplanted juvenile Canada geese. J. Wildl. Manage. 34(4):719-733.

Swarth, H. S. 1913. A study of a collection of geese of the *Branta canadensis* group from the San Joaquin Valley, California. Univ. Calif. Publ. Zool. 12(1):1-24.

Szymczak, M. R. 1975. Canada goose restoration along the foothills of Colorado. Colo. Wildl. Div., Tech. Rep. 31. 64 pp.

Tautin, J. 1976. Population dynamics and harvest of Canada geese in Utah. M.S. Thesis. Utah State University, Logan. 100 pp.

Tautin, J., and J. B. Low. 1975. Harvest trends of Canada geese in Utah. N. Am. Wildl. Nat. Resour. Conf. 40:334-343.

Tester, J. R. 1953. Waterfowl production in Brown's Park, Colorado. M.S. Thesis. Colorado State University, Fort Collins. 98 pp.

Vermeer, K. 1970. A study of Canada geese, *Branta canadensis*, nesting on islands in southeastern Alberta. Can. J. Zool. 48(2):235-240.

Williams, C. S. 1967. Honker: A discussion of the habits and needs of the largest of our Canada geese. D. Van Nostrand Co., Inc., Princeton, N.J. 179 pp.

Williams, C. S., and W. H. Marshall. 1937. Goose nesting studies on Bear River Migratory Waterfowl Refuge. J. Wildl. Manage. 1(3-4):77-86.

Williams, C. S., and W. H. Marshall. 1938. Survival of Canada goose goslings, Bear River Refuge, Utah, 1937. J. Wildl. Manage. 2(1):17-19.

Yocom, C. F. 1952. Techniques used to increase nesting of Canada geese. J. Wildl. Manage. 16(4):425-428.

Yocom, C. F. 1962. History of the Great Basin Canada goose in the Pacific Northwest and adjacent areas. Murrelet 43(1):1-9.

Yocom, C. F., C. L. Buechele, and S. W. Harris. 1956. Great Basin Canada geese nesting population at the former Lake Lenore National Wildlife Refuge, Washington. Murrelet 37(2):14-17.

APPENDIX A

Definitions of the Reference Areas Used in this Report

The following reference areas, except Southern Alberta, were defined by counties. The coordinates in parentheses can be used when computer tabulations require approximate definitions of regions by latitudes and longitudes. Southern Alberta was delimited according to seven points.

Southern Alberta. This region was outlined as follows (N. lat., W. long.): 52°00′, 112°30′; 51°00′, 112°00′; 50°30′, 111°30′; 50°00′, 111°30′; 49°00′, 111°00′; 49°00′, 114°00′; and 52°00′, 114°00′ (roughly Alberta S. of 52° lat., W. of 111° long.)

Central Montana. Beaverhead, Broadwater, Cascade, Chouteau, Deer Lodge, Gallatin, Glacier, Golden Valley, Jefferson, Judith Basin, Lewis and Clark, Liberty, Madison, Meagher, Park, Pondera, Silver Bow, Sweet Grass, Teton, Toole, Wheatland (Montana W. of 110° long., E. of 113° long.).

Southeastern Idaho. Bannock, Bear Lake, Bingham, Blaine, Bonneville, Butte, Camas, Caribou, Cassia, Clark, Custer, Franklin, Fremont, Jefferson, Jerome, Lemhi, Lincoln, Madison, Minidoka, Oneida, Power, Teton (Idaho S. of 45° lat., E. of 115° long.).

Western Wyoming. Lincoln, Sublette, Sweetwater, Teton, Uinta, Yellowstone National Park (Wyoming W. of 109° long.).

Central Wyoming. Big Horn, Carbon, Fremont, Hot Springs, Park, Washakie (Wyoming E. of 109° long., W. of 106° long.).

Northwestern Colorado. Delta, Garfield, Mesa, Moffat, Montrose, Rio Blanco, Routt (Colorado N. of 38° lat., W. of 107° long.).

Northern Utah. Box Elder, Cache, Daggett, Davis, Duchesne, Morgan, Rich, Salt Lake, Summit, Tooele, Uintah, Utah, Wasatch, Weber (Utah N. of 40° lat.).

Southern Utah. Beaver, Carbon, Emery, Garfield, Grand, Iron, Juab, Kane, Millard, Piute, San Juan, Sanpete, Sevier, Washington, Wayne (Utah S. of 40° lat.).

Northeastern Nevada. Elko, Eureka, Lander, White Pine (Nevada N. of 38° lat., E. of 117° long.).

Northwestern Nevada. Churchill, Douglas, Humboldt, Lyon, Mineral, Ormsby, Pershing, Storey, Washoe (Nevada N. of 38° lat., W. of 117° long.).

Southern Nevada. Clark, Esmeralda, Lincoln, Nye (Nevada S. of 38° lat.).

Central California. Alameda, Alpine, Amador, Calaveras, Contra Costa, El Dorado, Fresno, Inyo, Kern, Kings, Madera, Mariposa, Merced, Mono, Monterey, Sacramento, San Francisco, San Benito, San Joaquin, San Luis Obispo, San Mateo, Santa Barbara, Santa Clara, Sante Cruz, Stanislaus, Tulare, Tuolumne, Ventura (California S. of 39° lat., N. of 35° lat.).

Southern California. Imperial, Los Angeles, Orange, Riverside, San Bernadino, San Diego (California S. of 35° lat.).

Western Arizona. Mohave, Yuma (Arizona W. of 113° long.).

Eastern Arizona. Apache, Cochise, Coconino, Gila, Graham, Greenlee, Maricopa, Navajo, Pima, Pinal, Santa Cruz, Yavapai (Arizona E. of 113° long.).

APPENDIX B

Geographic Distributions of Band Recoveries by Reference Areas and Banding Types

The distributions, by degree blocks of latitude and longitude, of recoveries from Canada geese banded in the Intermountain Region are shown in Figs. B-1 through B-33. Three types of banding information are presented in these figures: (1) summer bandings of goslings and adults captured on nesting areas, (2) summer bandings of concentrations of adults and subadults caught on molting areas, and (3) fall-winter-spring bandings of geese of all ages captured on migration and wintering areas. Maps are arranged by reference areas in the sequence listed in Fig. 1 of text according to banding types (1) through (3).

Recoveries used in the following figures were limited to banded normal-wild geese that were reported shot. Usually, direct recoveries (HSS-1) were separated from indirect recoveries (HSS-2 through HSS-N). In areas where both type 1 and 2 bandings occurred in the same years, all adults were considered as molters (i.e., type 2 bandings) and the goslings (generally very few) were excluded. Band recoveries used in these figures were those that were in the computer files of the U.S. Fish and Wildlife Service as of August 1974 (i.e., recovered and reported through the 1973-74 hunting season).

The degree blocks in which the geese were banded are shaded in all figures. Only band recoveries from sites contributing 10 or more recoveries per map were plotted. All unaged geese (i.e., FWS Bird Banding Laboratory age code 00) banded on molting areas were plotted on the following maps. However, these unaged birds were excluded in computer tabulations and thus the number of recoveries on the maps and in some tables do not correspond.

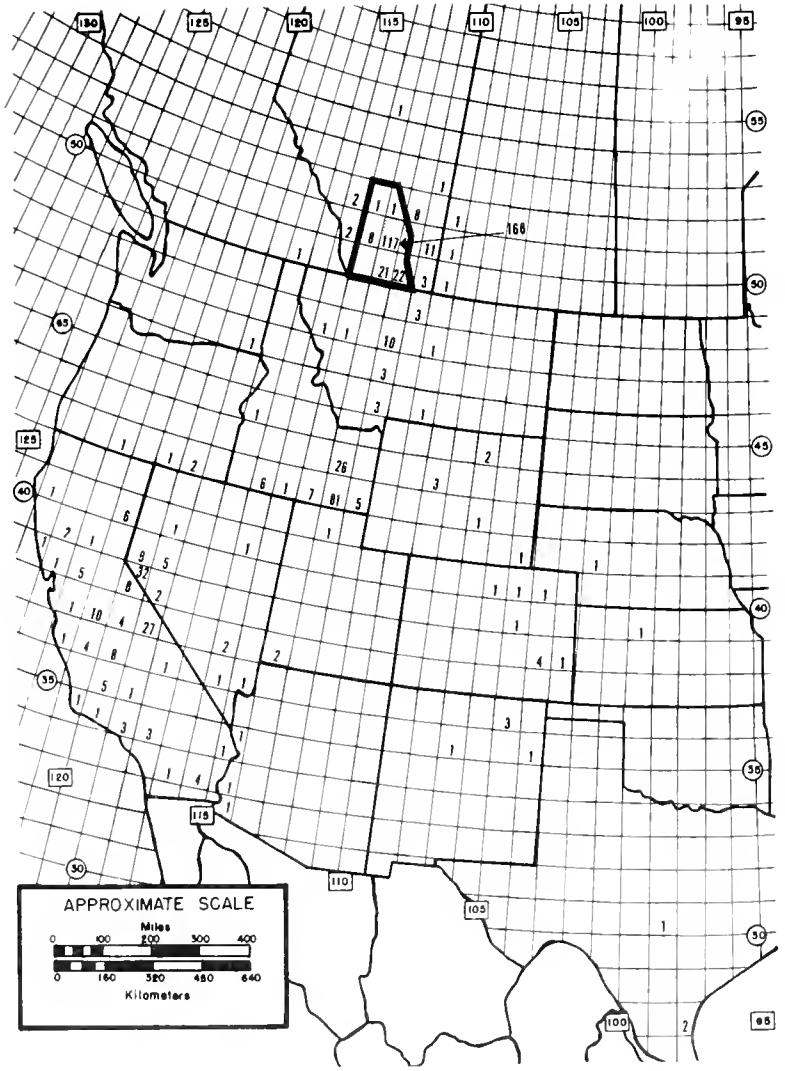


Fig. B-1. Geographic distribution of 712 direct recoveries from Canada geese banded preseason as goslings or adults on breeding areas in Southern Alberta, 1947-73.

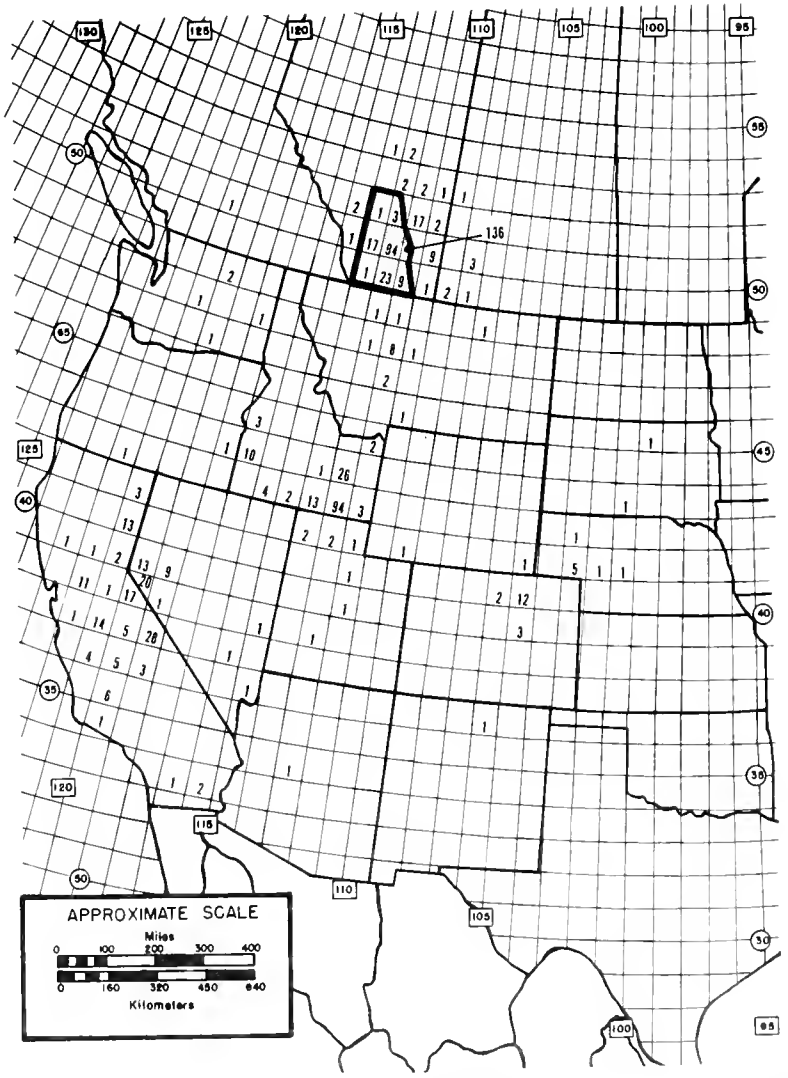


Fig. B-2. Geographic distribution of 717 indirect recoveries from Canada geese banded preseason as goslings or adults on breeding areas in Southern Alberta, 1947-73.

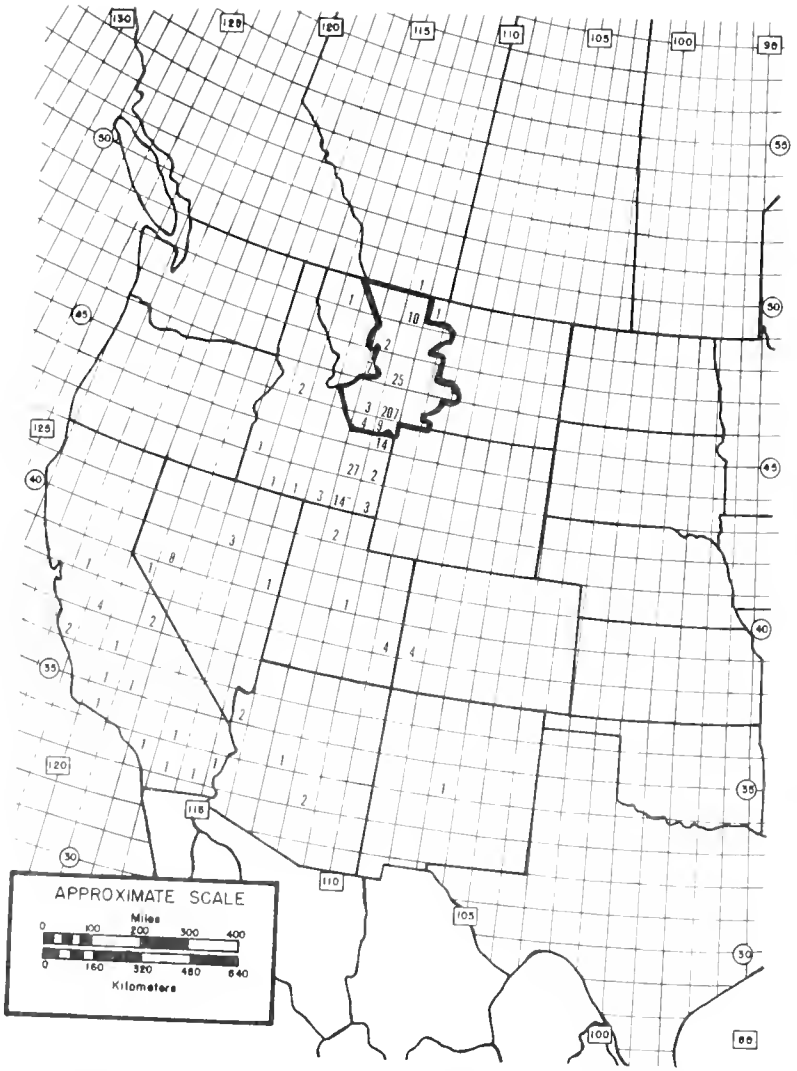


Fig. B-3. Geographic distribution of 519 direct recoveries from Canada geese banded preseason as goslings or adults on breeding areas in Central Montana, 1946-73.

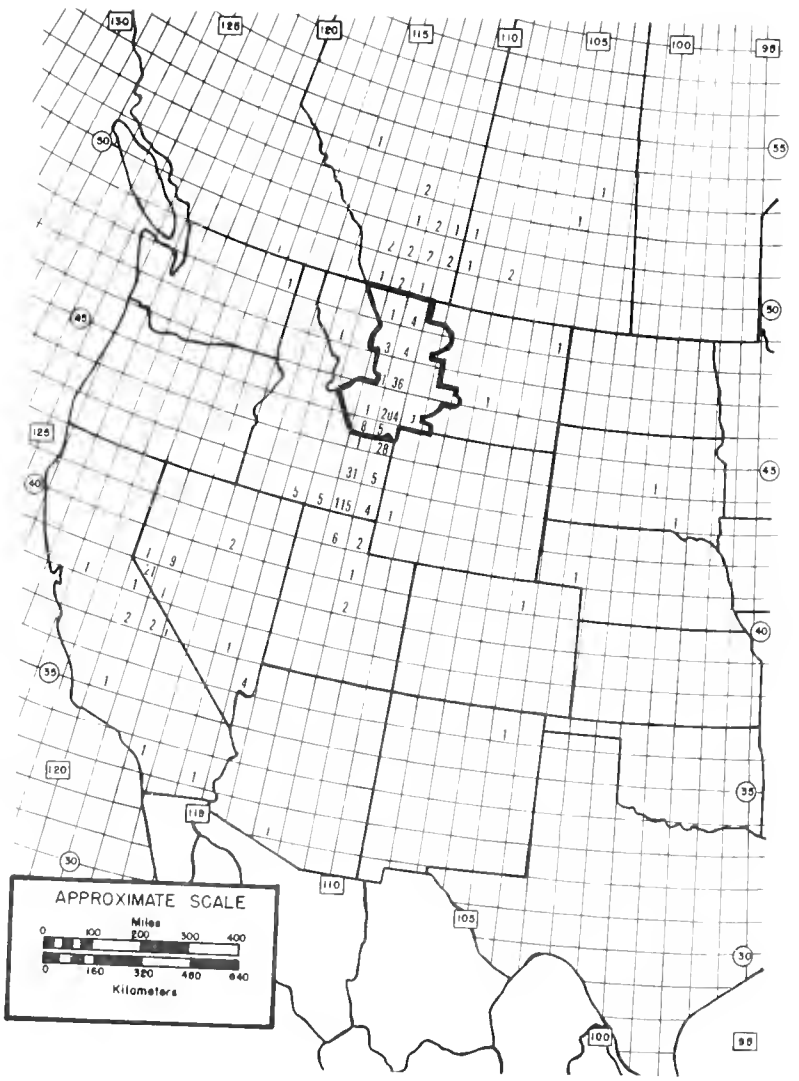


Fig. B-4. Geographic distribution of 560 indirect recoveries from Canada geese banded preseason as goslings or adults on breeding areas in Central Montana, 1946-73.

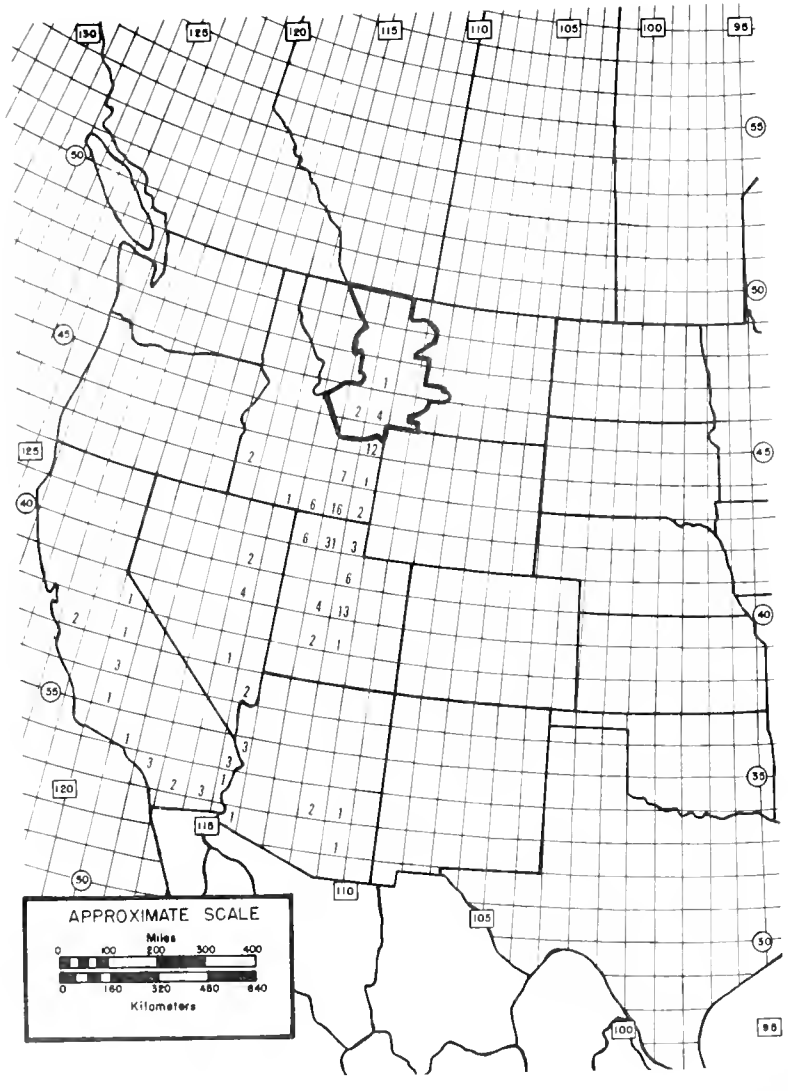


Fig. B-5. Geographic distribution of 158 direct recoveries from Canada geese banded preseason as adults on molting areas in Central Montana (Lima Reservoir), 1961-62.

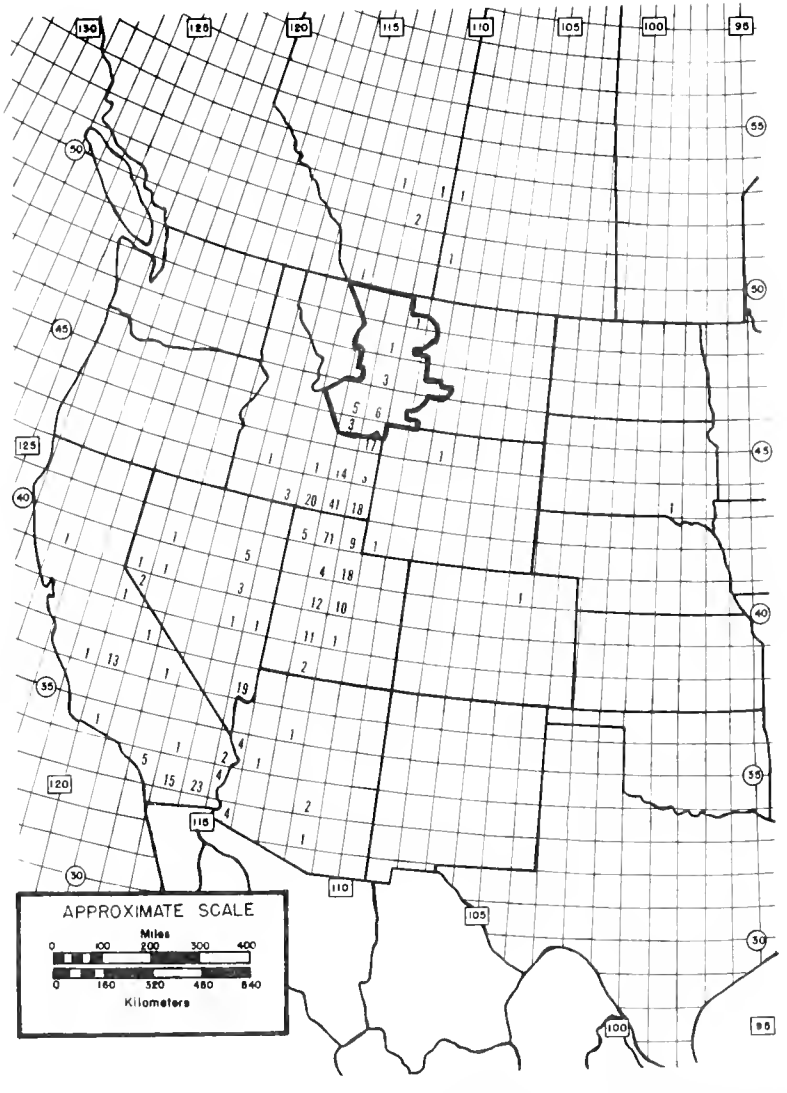


Fig. B-6. Geographic distribution of 407 indirect recoveries from Canada geese banded preseason as adults on molting areas in Central Montana (Lima Reservoir), 1961-62.

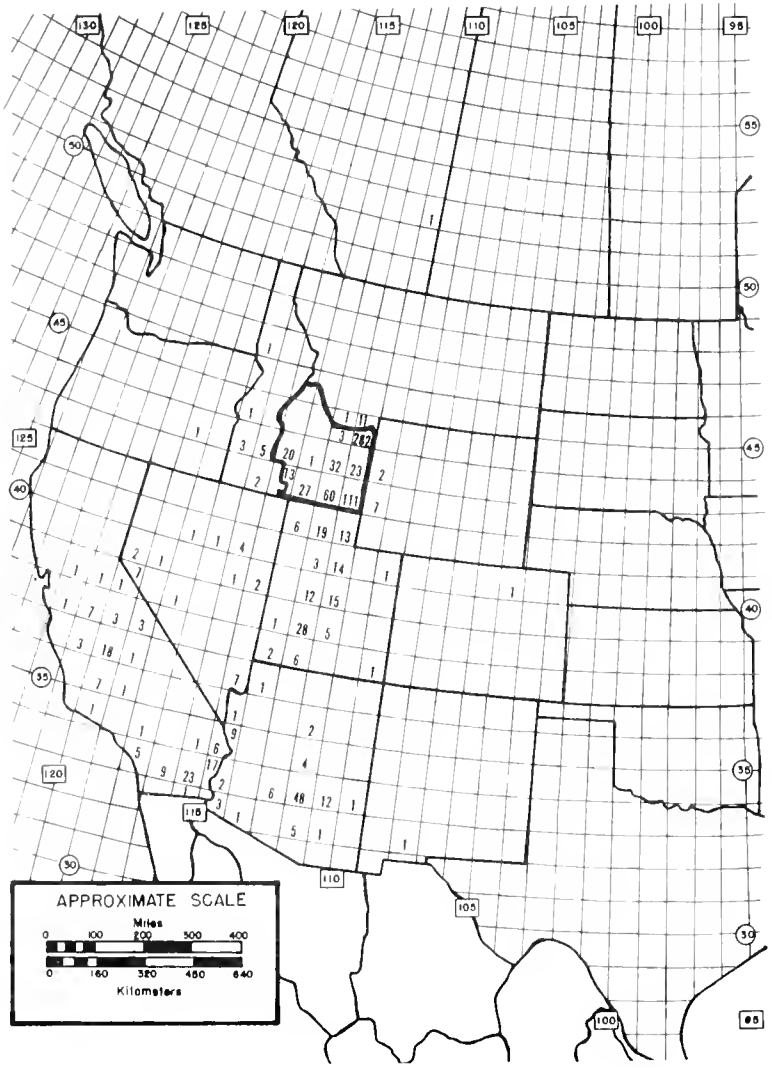


Fig. B-7. Geographic distribution of 969 direct recoveries from Canada geese banded preseason as goslings or adults on breeding areas in Southeastern Idaho, 1947-73.

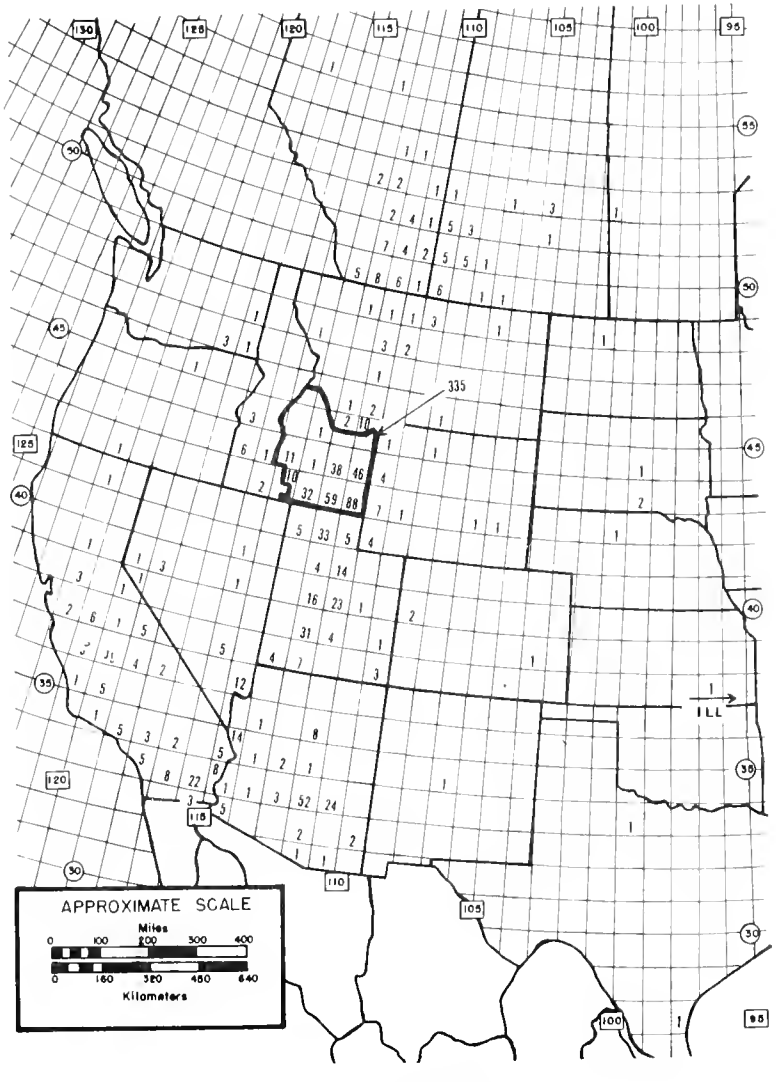


Fig. B-8. Geographic distribution of 1,196 indirect recoveries from Canada geese banded preseason as goslings or adults on breeding areas in Southeastern Idaho, 1947-73.

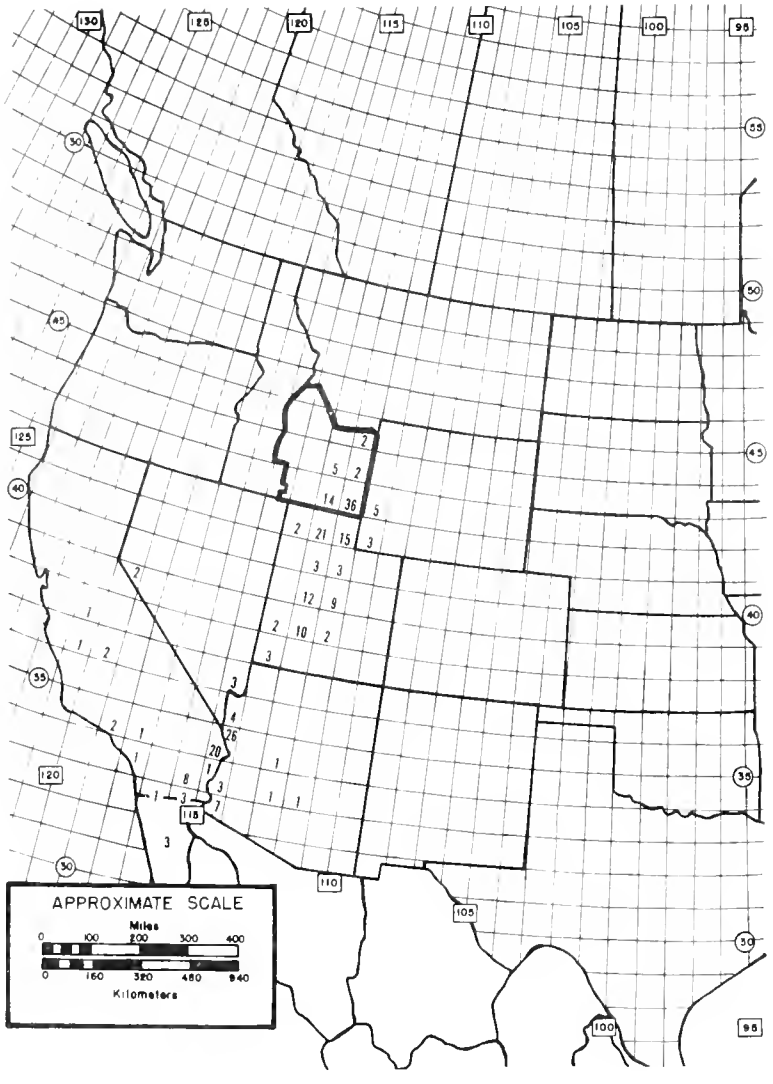


Fig. B-9. Geographic distribution of 241 direct recoveries from Canada geese banded preseason as adults on molting areas in Southeastern Idaho, 1946-66.

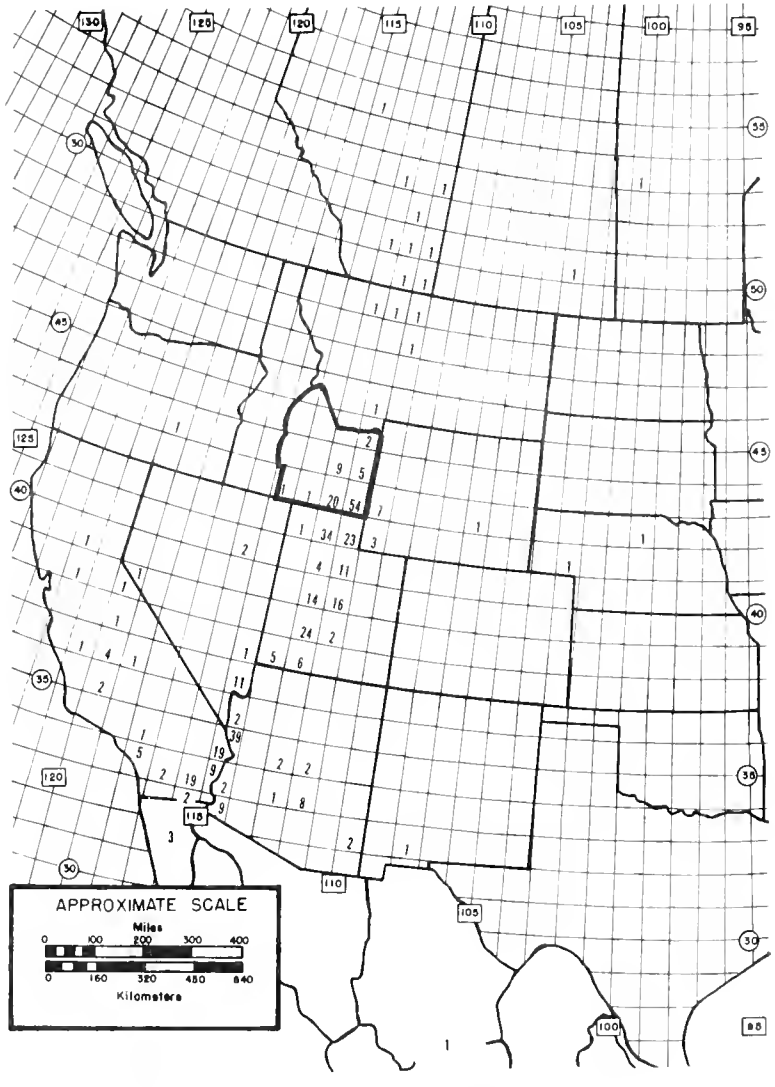


Fig. B-10. Geographic distribution of 418 indirect recoveries from Canada geese banded preseason as adults on molting areas in Southeastern Idaho, 1946-66.

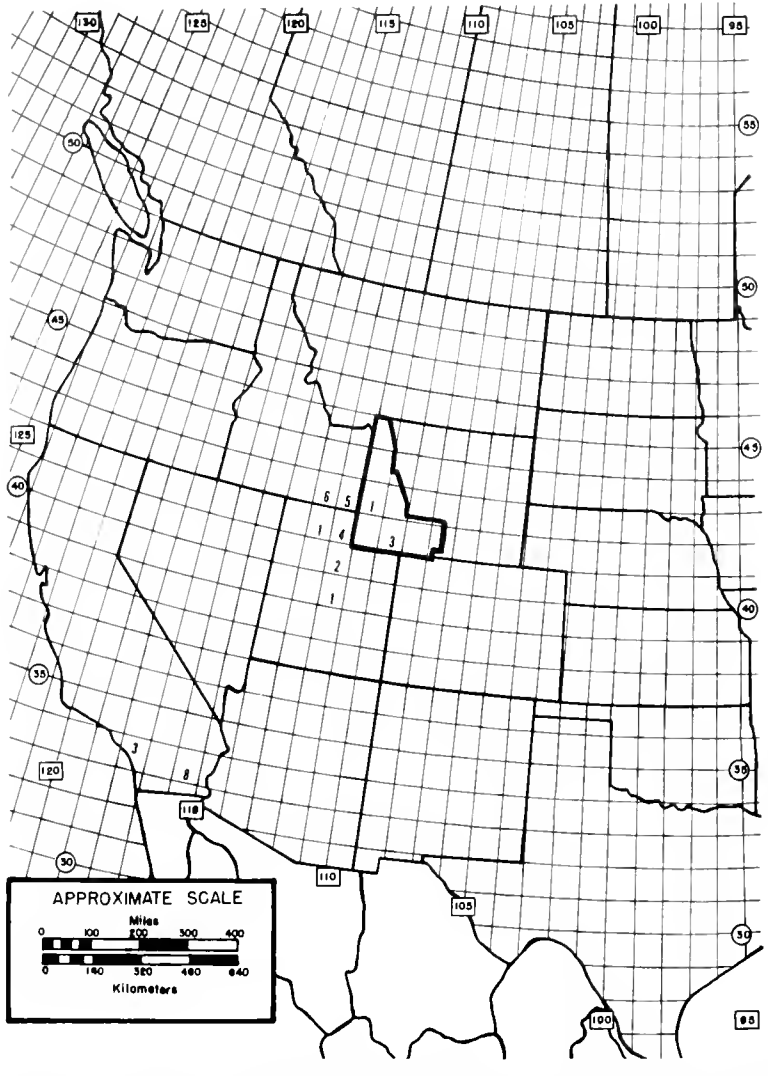


Fig. B-11. Geographic distribution of 34 direct recoveries from Canada geese banded preseason as goslings or adults on breeding areas in Western Wyoming, 1958-69.

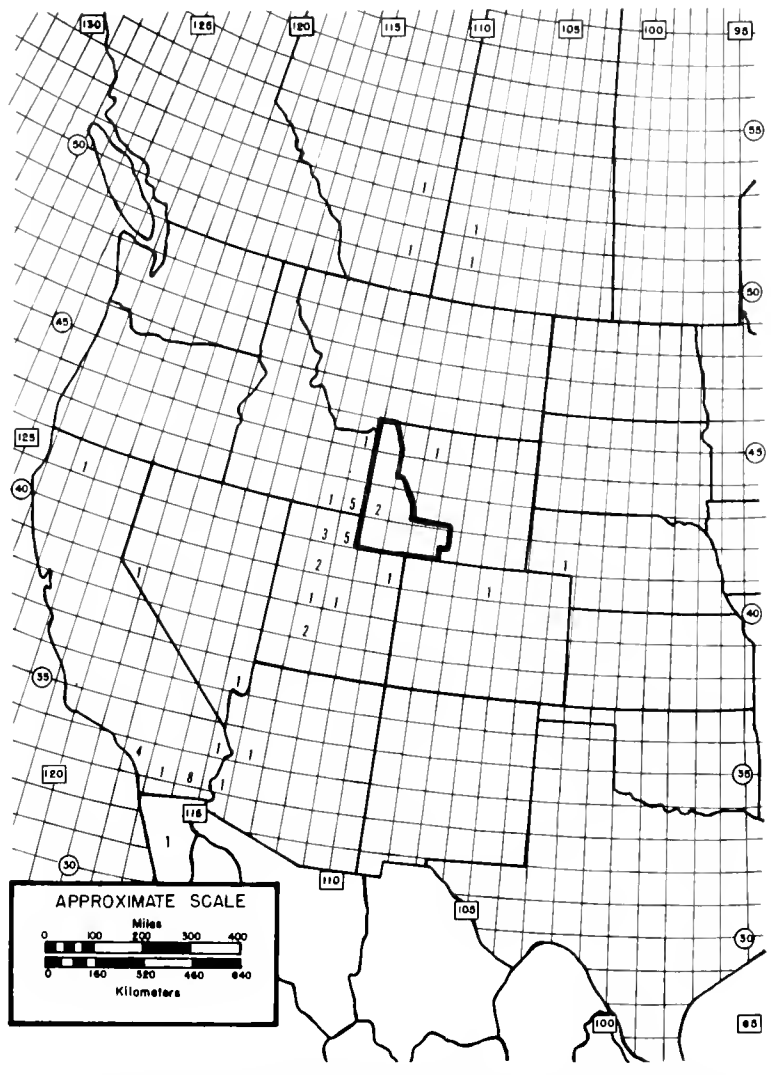


Fig. B-12. Geographic distribution of 51 indirect recoveries from Canada geese banded preseason as goslings or adults on breeding areas in Western Wyoming, 1958-69.

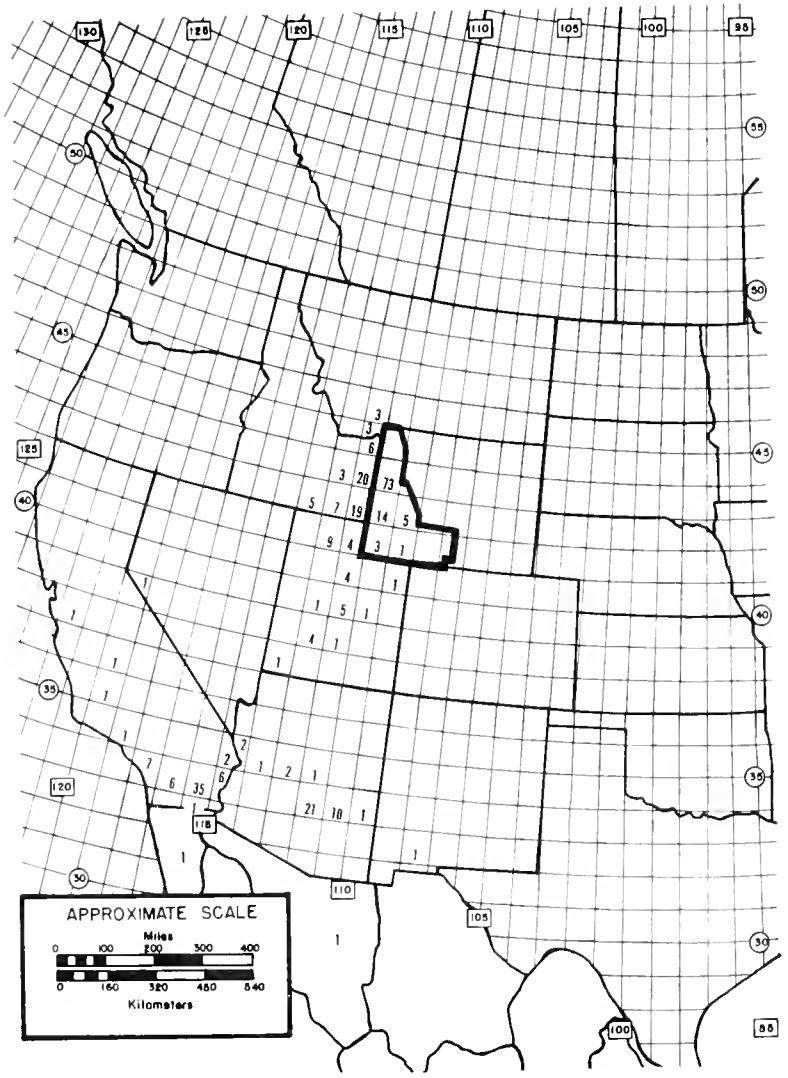


Fig. B-13. Geographic distribution of 296 direct recoveries from Canada geese banded preseason as adults on molting areas in Western Wyoming (Turbid Lake), 1956-72.

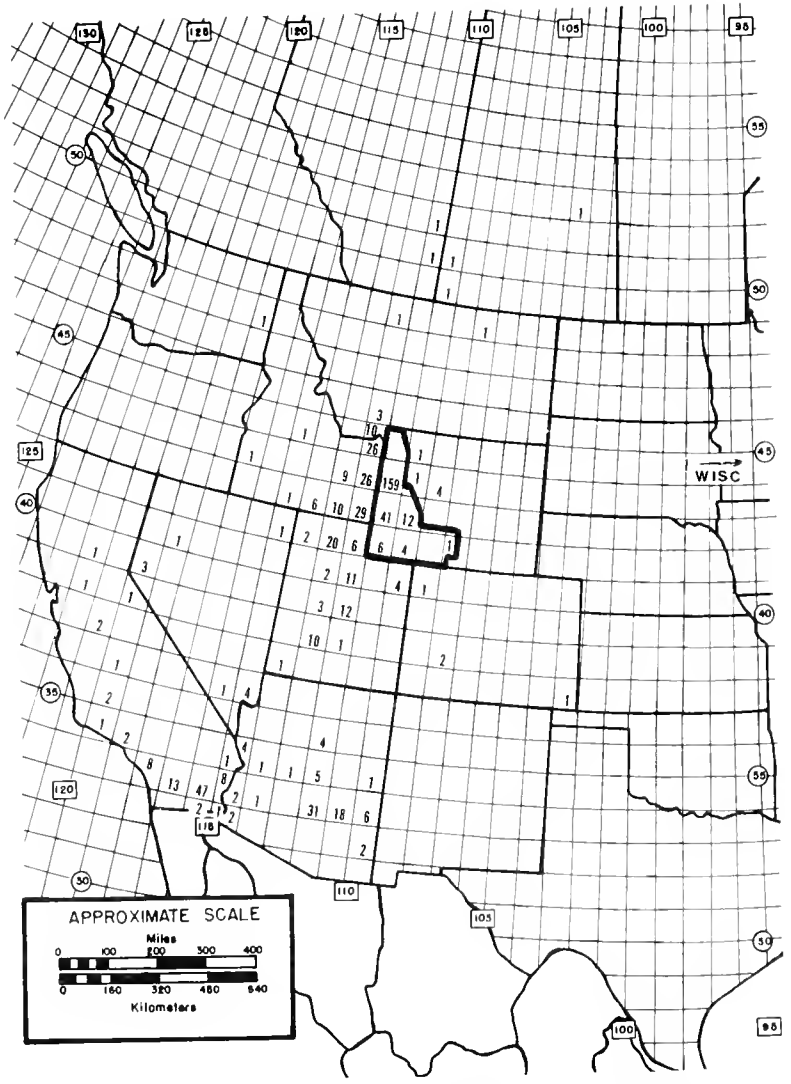


Fig. B-14. Geographic distribution of 615 indirect recoveries from Canada geese banded preseason as adults on molting areas in Western Wyoming (Turbid Lake), 1956-72.

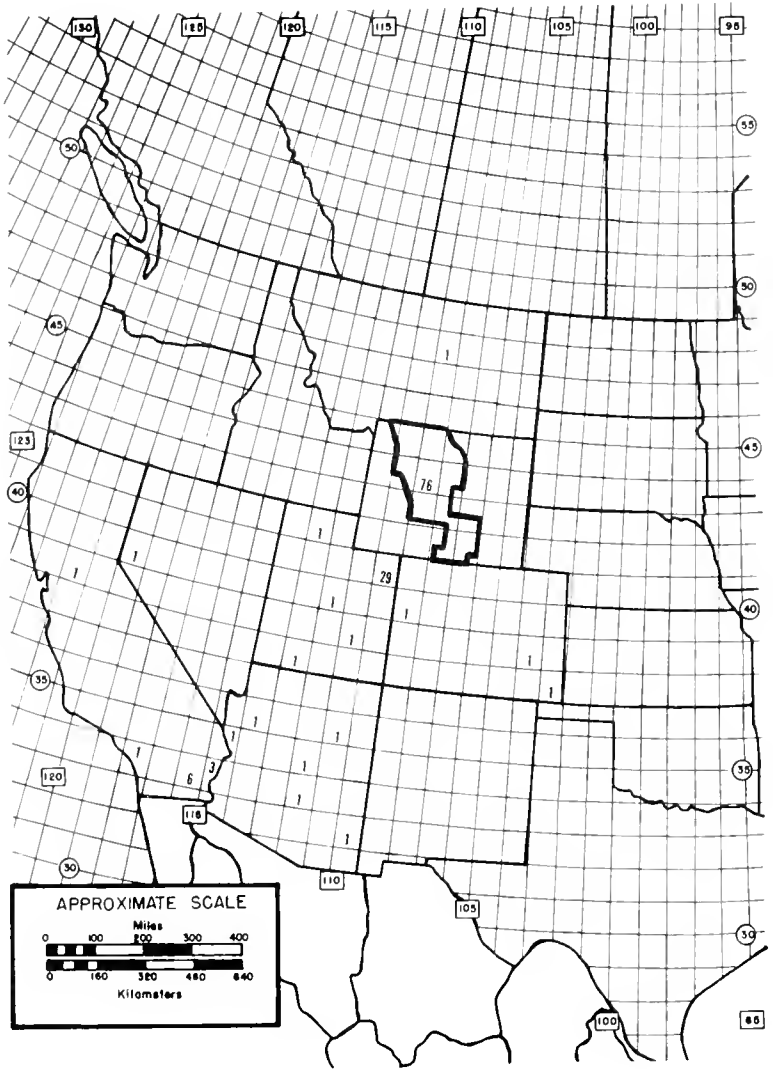


Fig. B-15. Geographic distribution of 131 direct recoveries from Canada geese banded preseason as goslings or adults on breeding areas in Central Wyoming (Ocean Lake WMA), 1955-73.

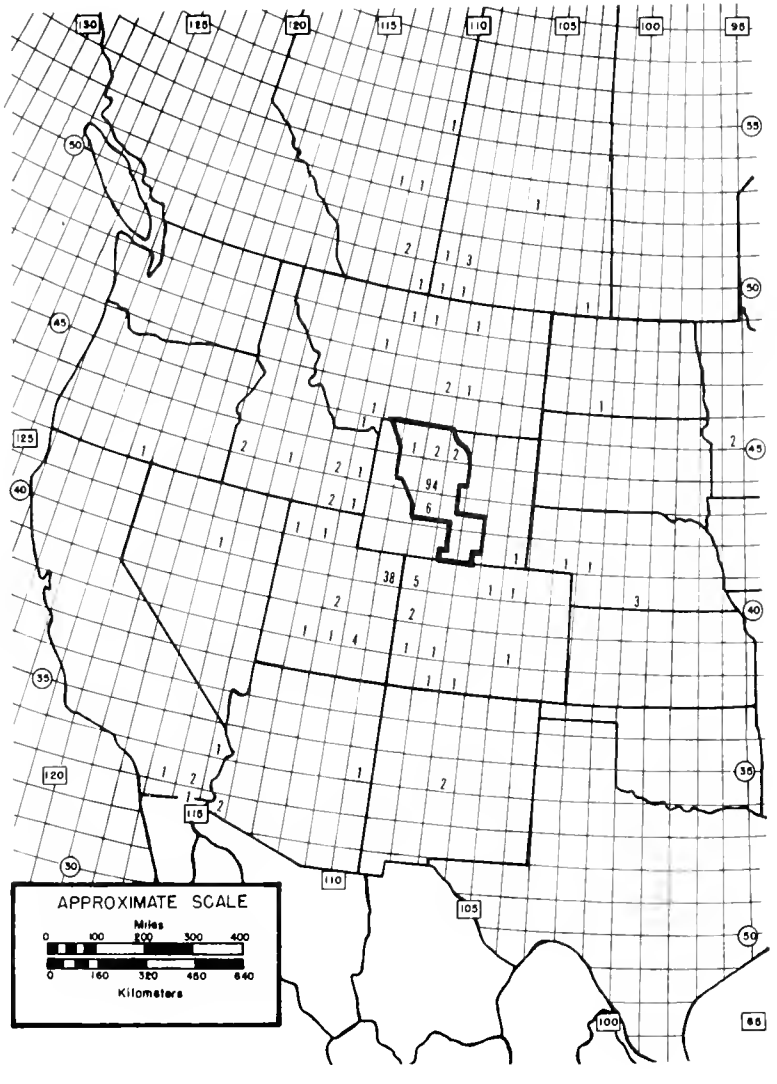


Fig. B-16. Geographic distribution of 220 indirect recoveries from Canada geese banded preseason as goslings or adults on breeding areas in Central Wyoming (Ocean Lake WMA), 1955-73.

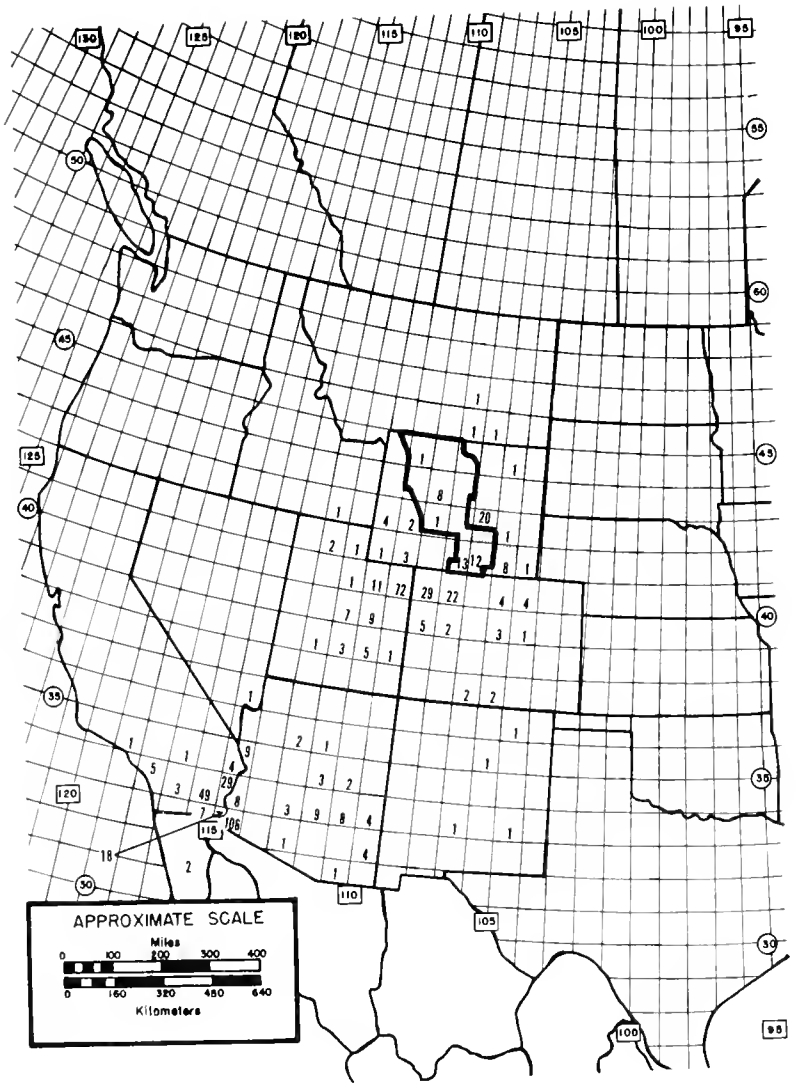


Fig. B-17. Geographic distribution of 552 direct recoveries from Canada geese banded preseason as adults on molting areas in Central Wyoming (Pathfinder and Wheatland reservoirs), 1952-73.

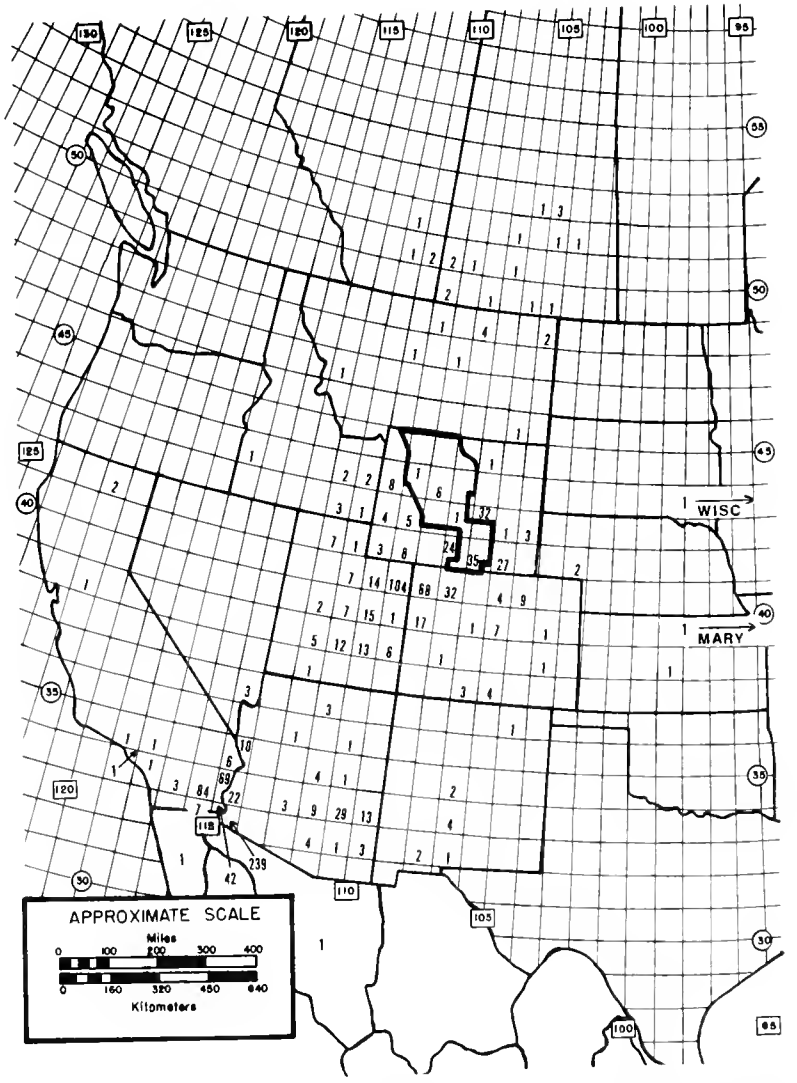


Fig. B-18. Geographic distribution of 1,123 indirect recoveries from Canada geese banded preseason as adults on molting areas in Central Wyoming (Pathfinder and Wheatland reservoirs), 1952-73.

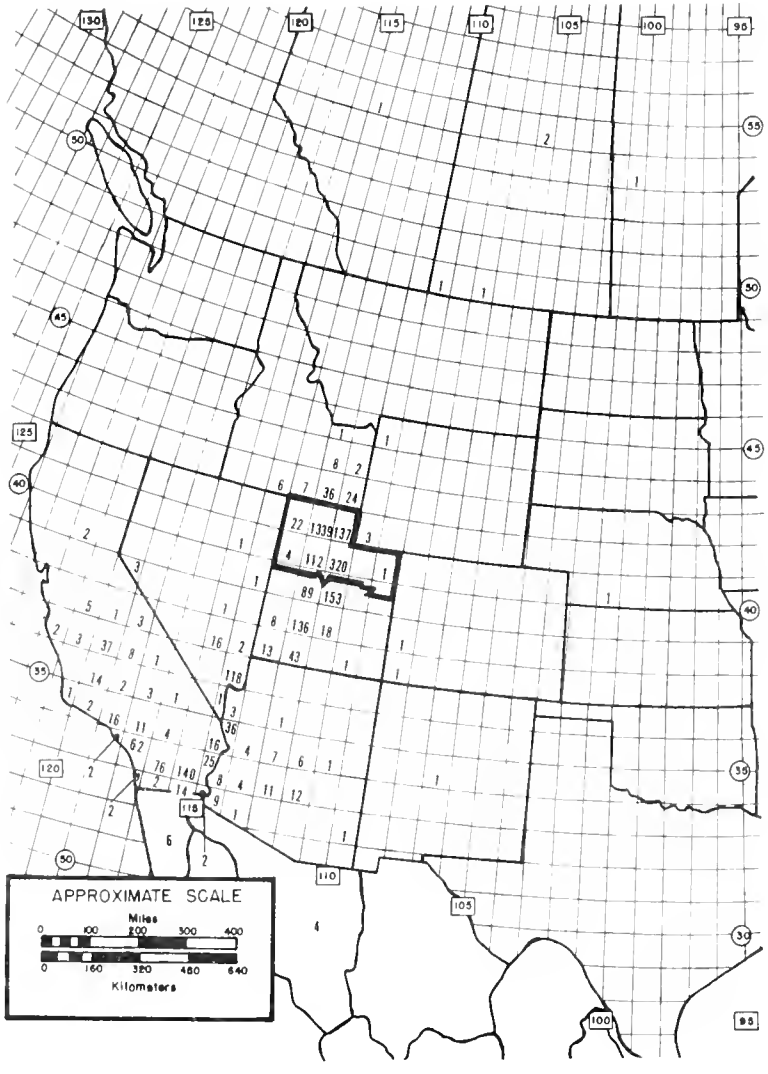


Fig. B-19. Geographic distribution of 3,208 direct recoveries from Canada geese banded preseason as goslings or adults on breeding areas in Northern Utah, 1938-73.

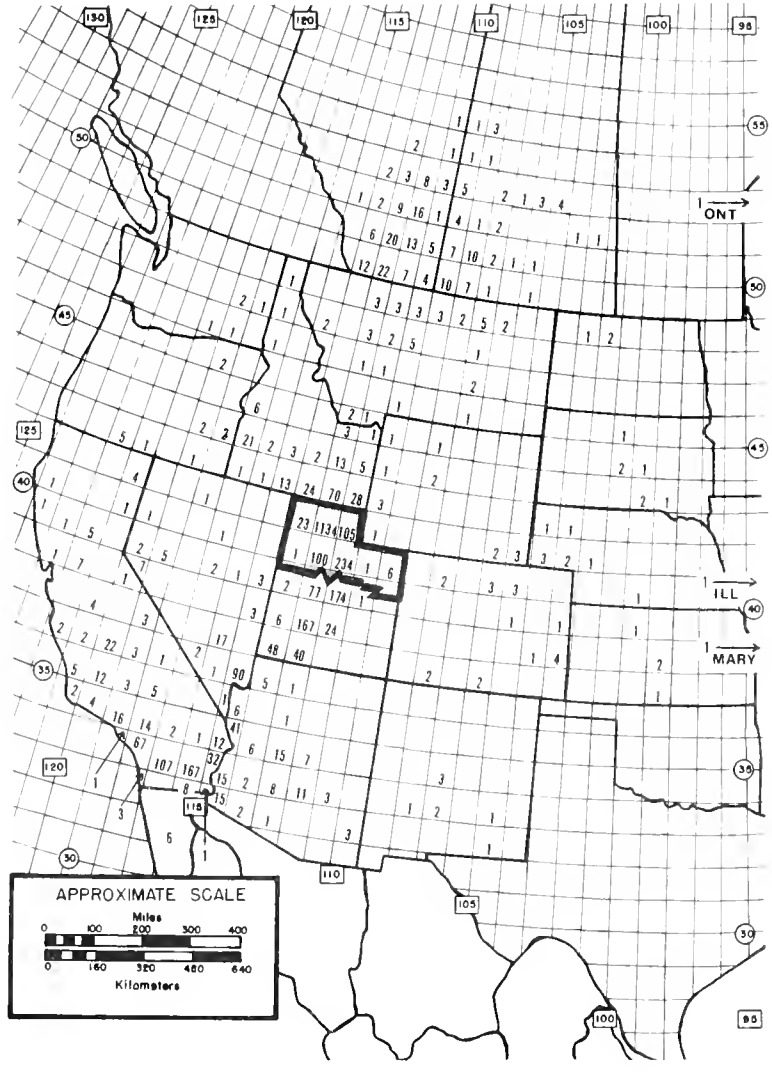


Fig. B-20. Geographic distribution of 3,481 indirect recoveries from Canada geese banded preseason as goslings or adults on breeding areas in Northern Utah, 1938-73.

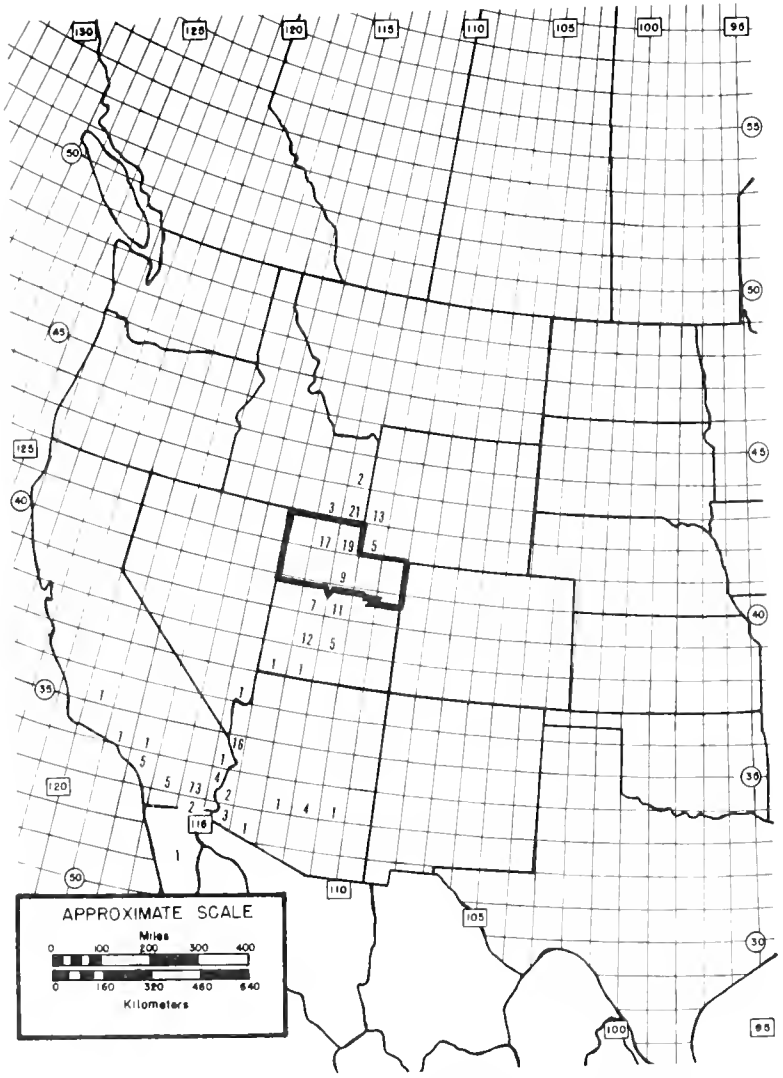


Fig. B-21. Geographic distribution of 249 direct recoveries from Canada geese banded preseason as adults on molting areas in Northern Utah (Neponset Reservoir), 1953-73.

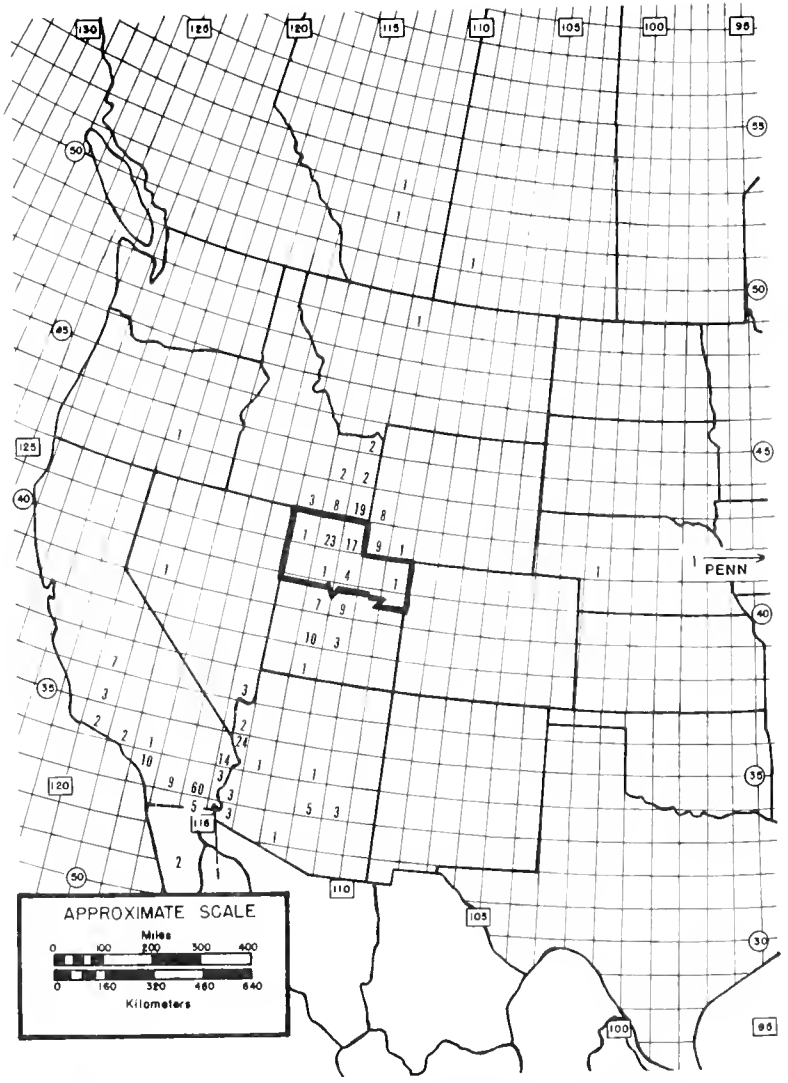


Fig. B-22. Geographic distribution of 304 indirect recoveries from Canada geese banded preseason as adults on molting areas in Northern Utah (Neponset Reservoir), 1953-73.

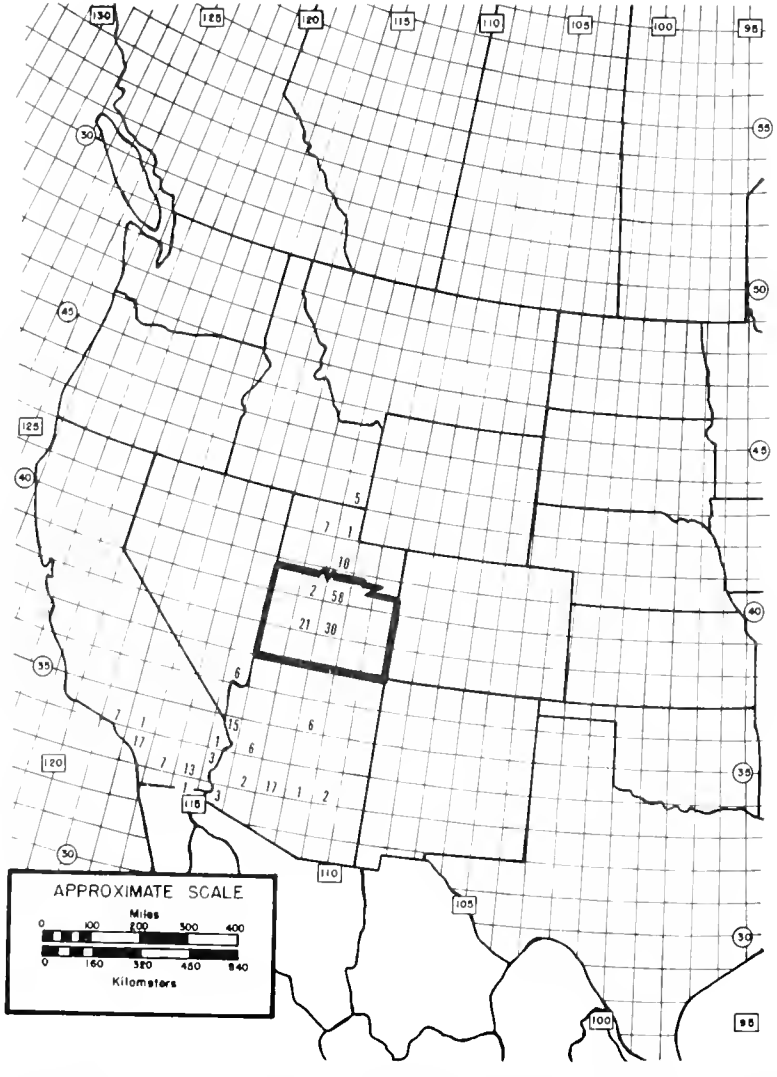


Fig. B-23. Geographic distribution of 242 direct recoveries from Canada geese banded preseason as goslings or adults on breeding areas in Southern Utah, 1955-73.

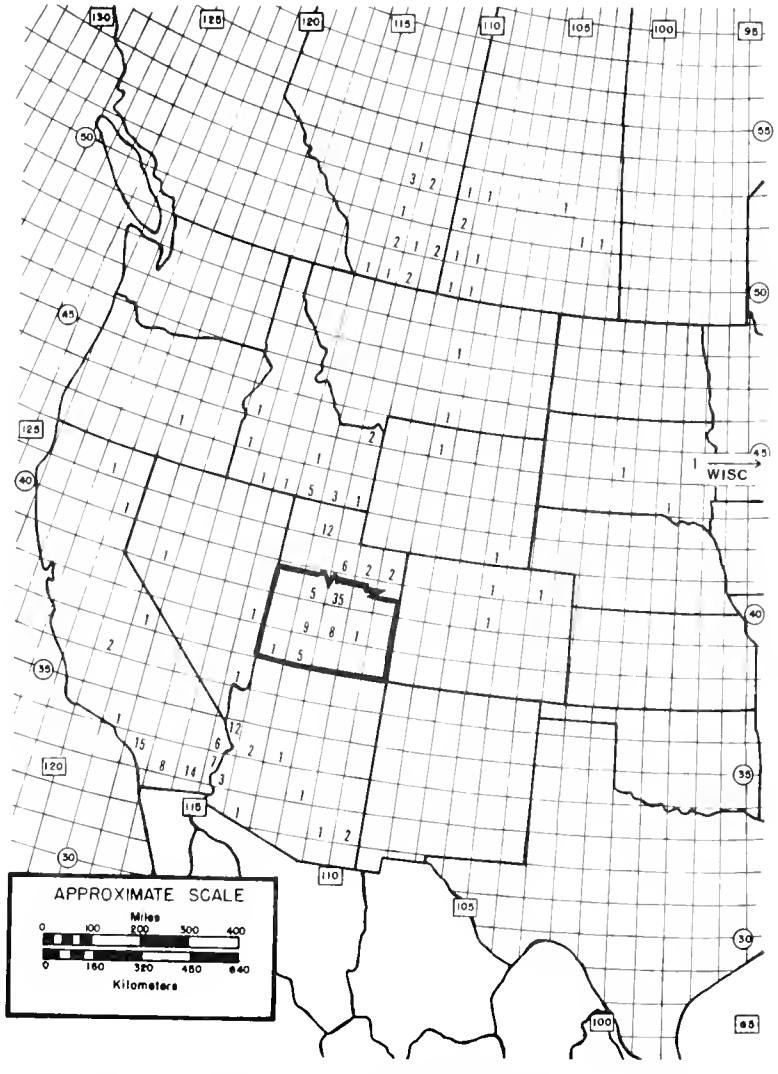


Fig. B-24. Geographic distribution of 222 indirect recoveries from Canada geese banded preseason as goslings or adults on breeding areas in Southern Utah, 1955-73.

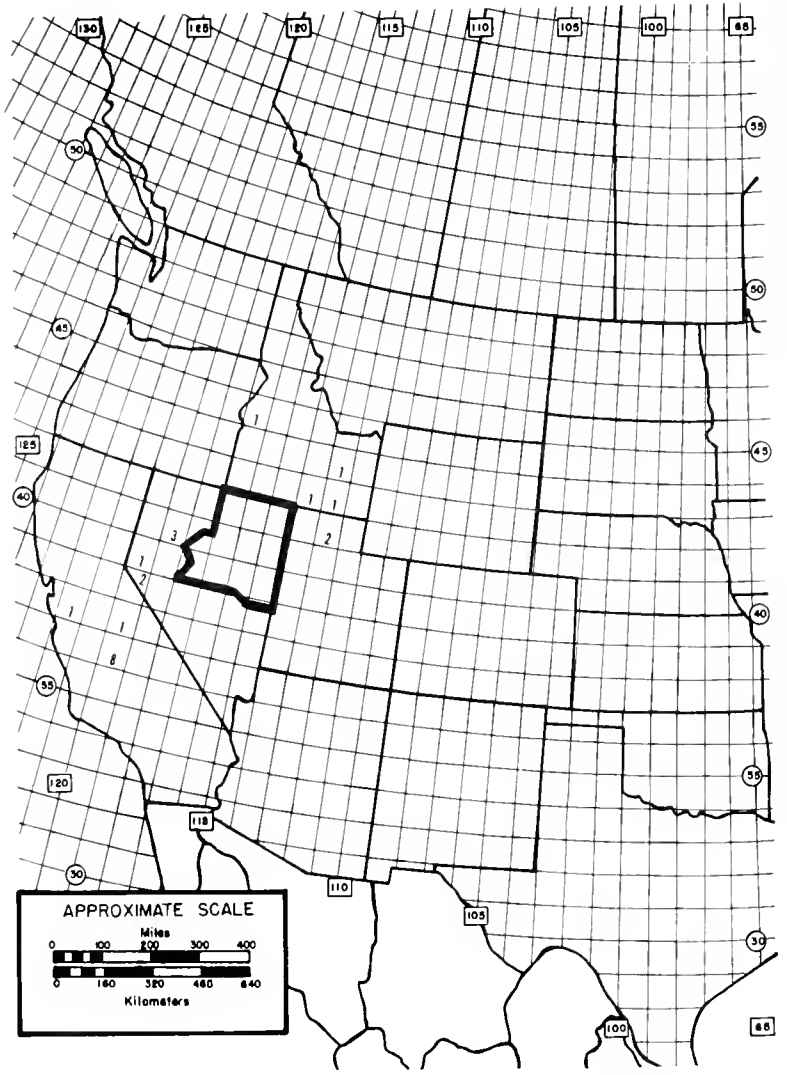


Fig. B-25. Geographic distribution of 22 direct recoveries from Canada geese banded preseason as goslings or adults on breeding areas in Northeastern Nevada (Ruby Lake NWR), 1959-68.

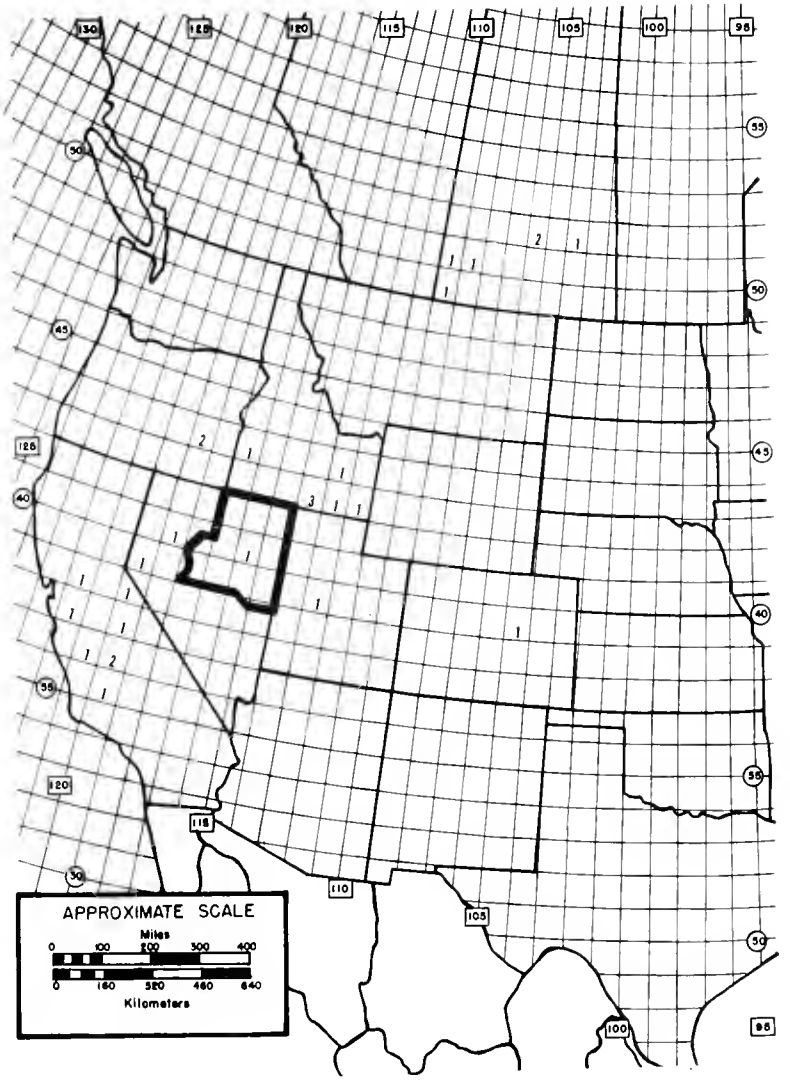


Fig. B-26. Geographic distribution of 28 indirect recoveries from Canada geese banded preseason as goslings or adults on breeding areas in Northeastern Nevada (Ruby Lake NWR), 1959-68.

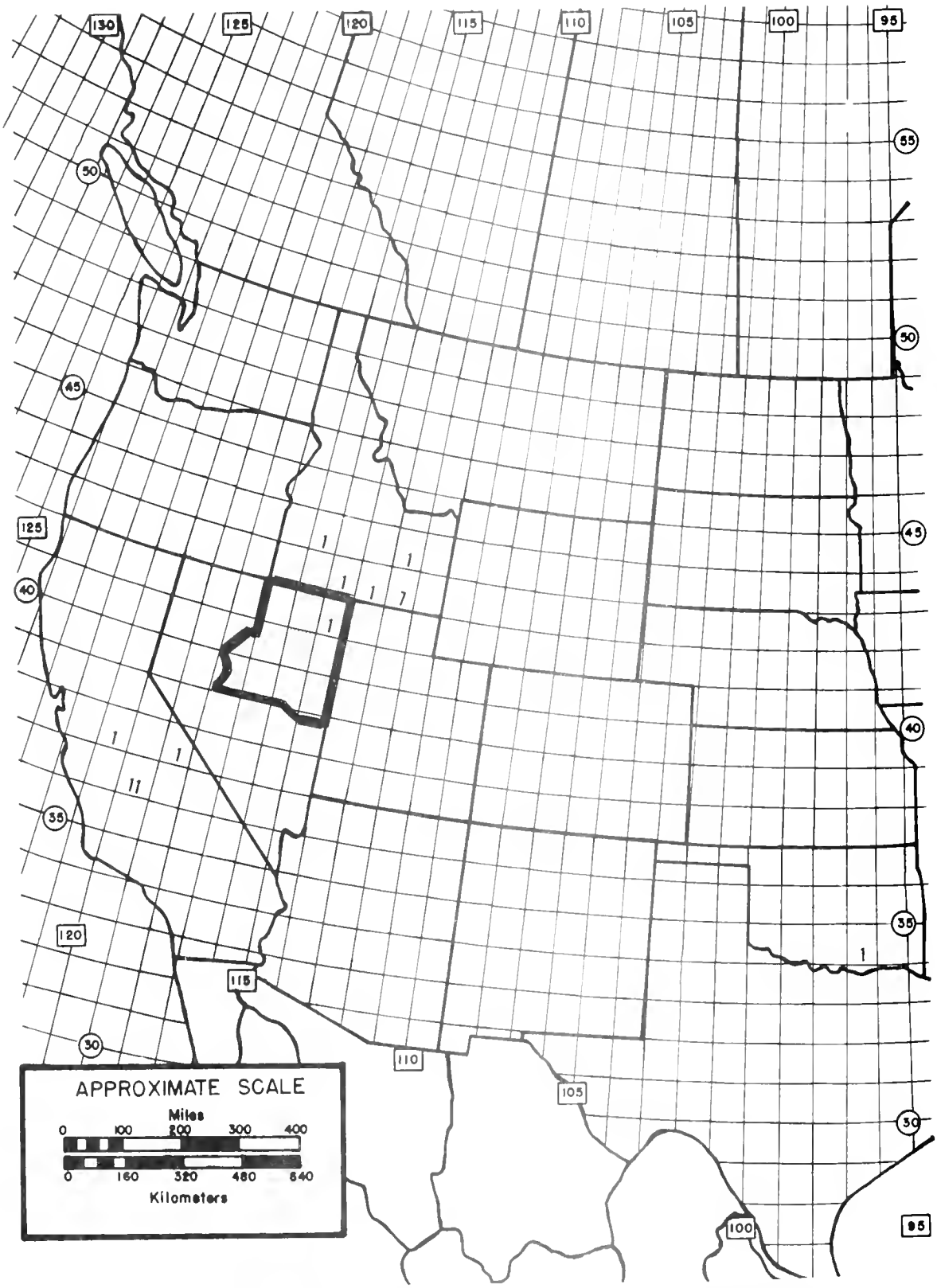


Fig. B-27. Geographic distribution of 26 indirect recoveries from migrating and wintering Canada geese banded in- and post-season in Northeastern Nevada (Ruby Lake NWR), 1959-60.

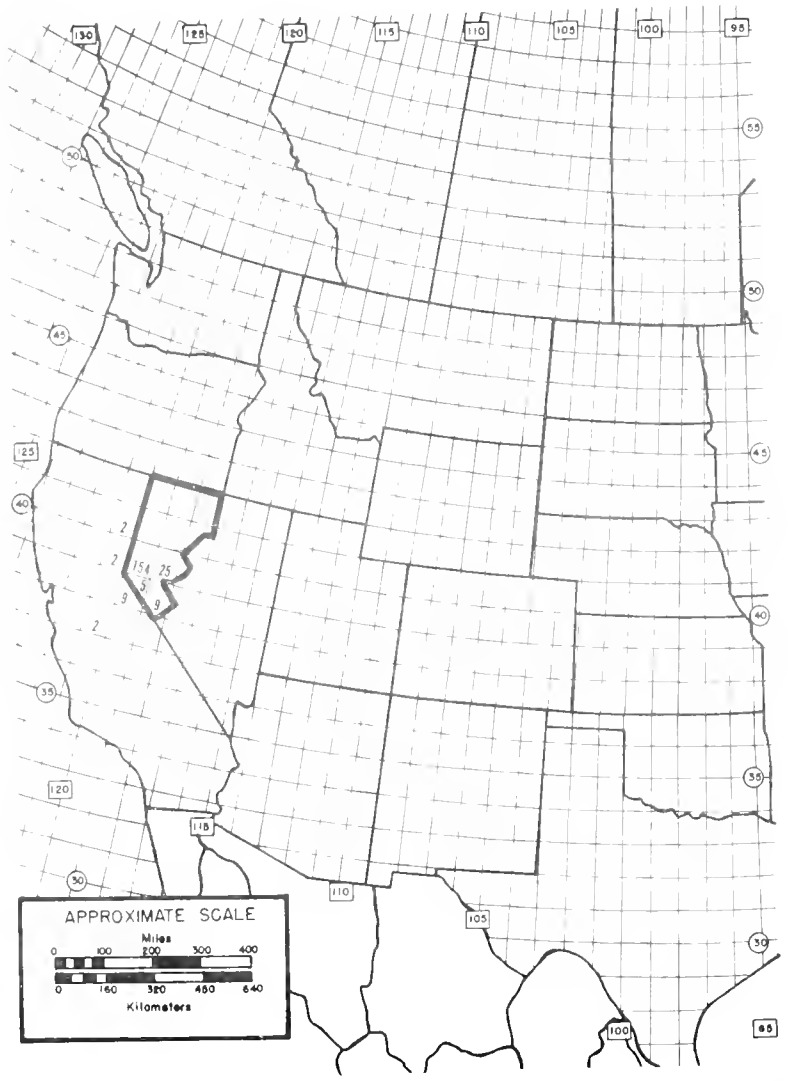


Fig. B-28. Geographic distribution of 208 direct recoveries from Canada geese banded preseason as goslings or adults on breeding areas in Northwestern Nevada, 1954-69.

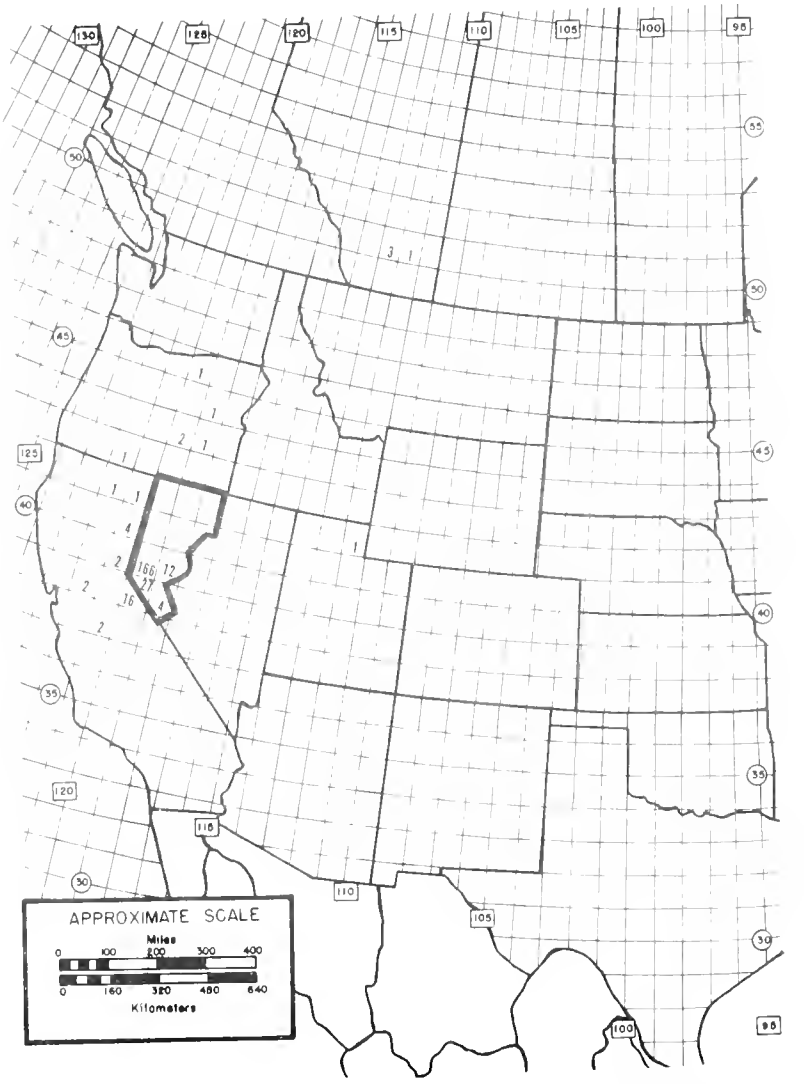


Fig. B-29. Geographic distribution of 248 indirect recoveries from Canada geese banded preseason as goslings or adults on breeding areas in Northwestern Nevada, 1954-69.

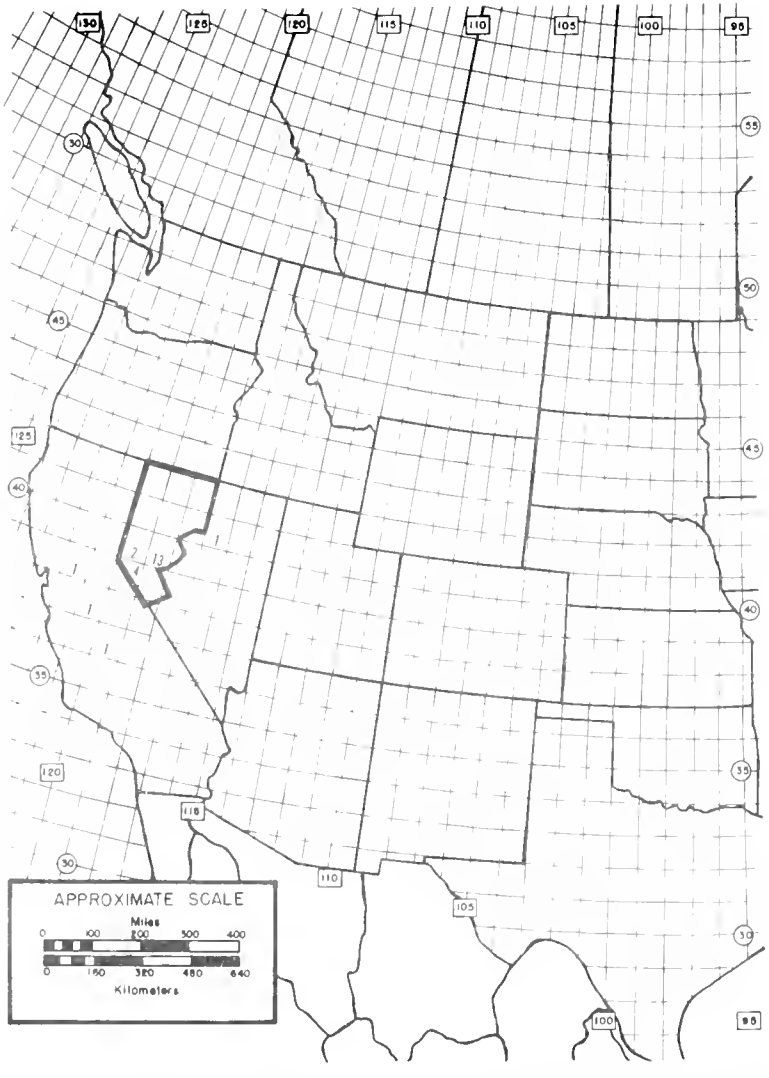


Fig. B-30. Geographic distribution of 23 direct recoveries from Canada geese banded preseason as adults on molting areas in Northwestern Nevada, 1955 and 1972.

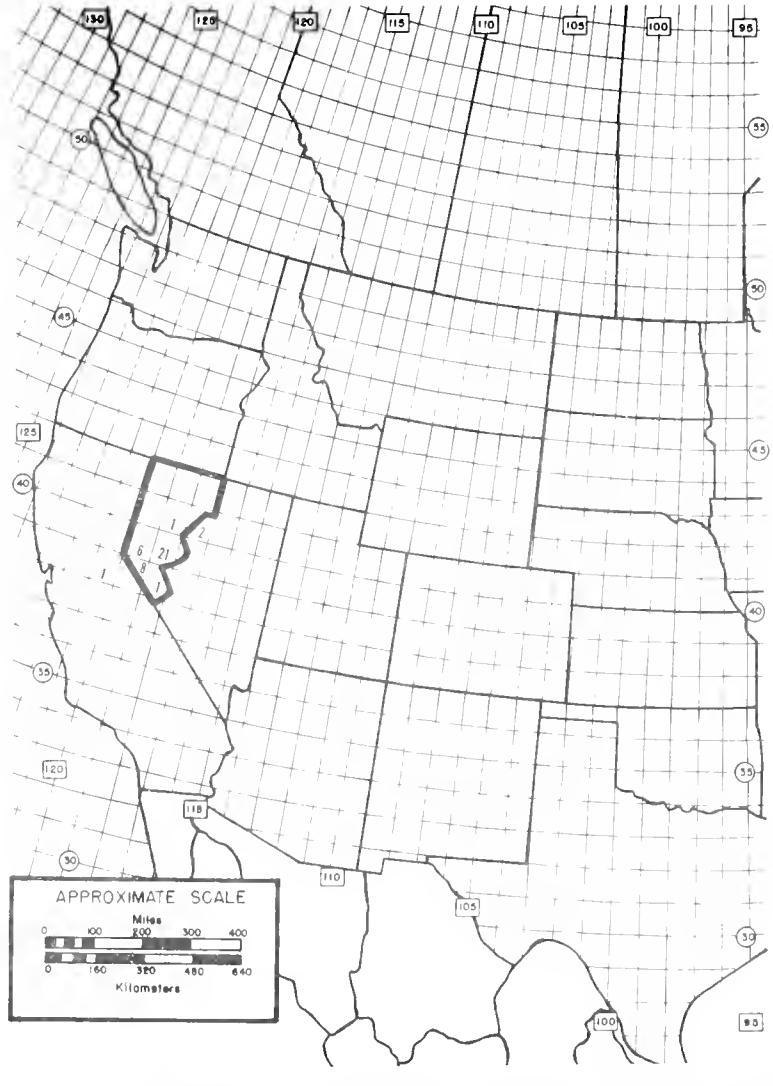


Fig. B-31. Geographic distribution of 40 indirect recoveries from Canada geese banded preseason as adults on molting areas in Northwestern Nevada, 1955 and 1972.

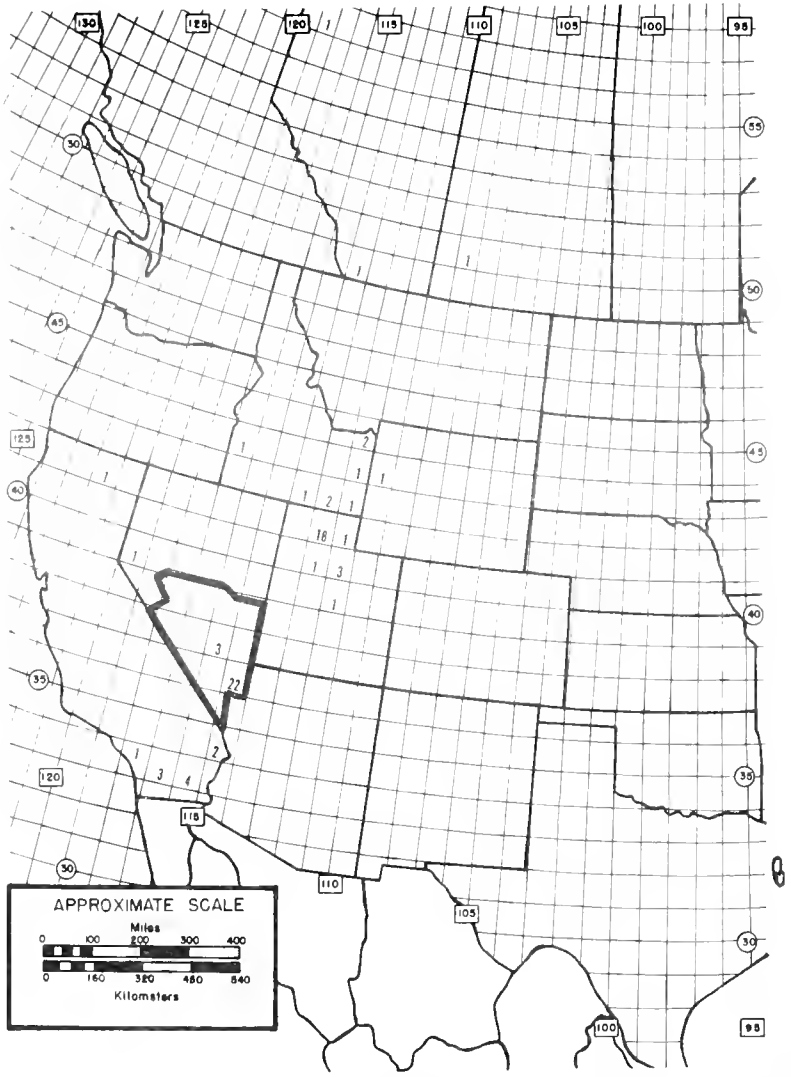


Fig. B-32. Geographic distribution of 72 indirect recoveries from Canada geese handed postseason on wintering areas in Southern Nevada (Overton WMA), 1956-67.

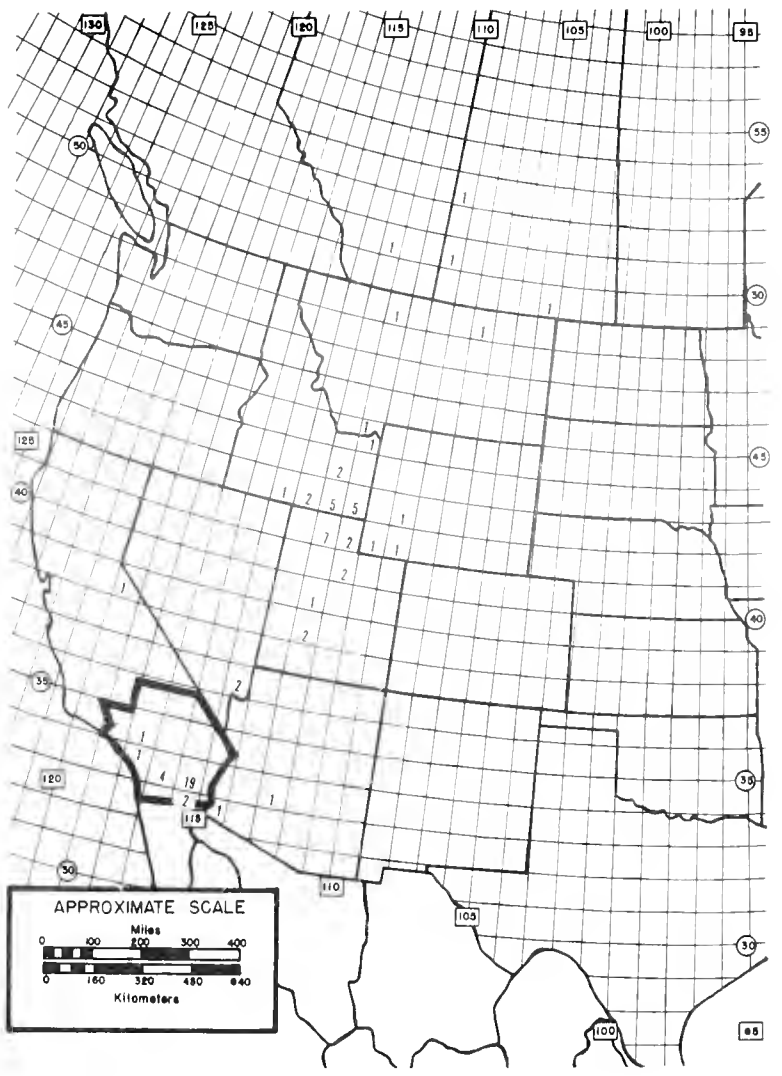


Fig. B-33. Geographic distribution of 72 indirect recoveries from Canada geese banded postseason on wintering areas in Southern California (Salton Sea NWR), 1967-69.

APPENDIX C

Chronologic-Geographic Distributions of Band Recoveries by Reference Areas and Banding Types

Tables C-1 through C-18 present the distributions of recoveries for the three banding types and reference areas according to twice-monthly periods when recovered and State or Province where recovered. The recoveries used in these tables were limited to the normal-wild bandings that were reported shot on a given day or week. Band recoveries used in the tables of this appendix were those in the computer files of the U.S. Fish and Wildlife Service as of August 1974 (i.e., recovered and reported through the 1973-74 hunting season).

Table C-1. *Chronologic-geographic distribution of 602 direct and 577 indirect band recoveries from Canada geese banded preseason on breeding areas in Southern Alberta, 1947-73. Percentage of shot recoveries from normal-wild geese; ages and sexes combined.*

	September		October		November		December		January	
Recovered in:	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-31
					Direct Recoveries					
Alberta	100.0	100.0	96.9	97.0	75.5	13.0	2.1	1.2	--	--
British Columbia	--	--	--	--	--	--	--	--	1.8	--
Saskatchewan	--	--	2.1	--	2.0	--	--	--	--	--
Oregon	--	--	--	1.5	--	--	--	--	1.8	--
Washington	--	--	--	--	--	--	--	--	1.8	--
Montana	--	--	--	--	6.1	7.4	11.6	2.4	--	--
Idaho	--	--	1.0	1.5	16.3	48.1	50.5	30.6	8.8	--
Wyoming	--	--	--	--	--	7.4	3.2	--	--	--
Colorado	--	--	--	--	--	1.9	4.2	1.2	1.8	--
Utah	--	--	--	--	--	1.9	--	2.4	--	--
Nevada	--	--	--	--	--	11.1	13.7	21.2	17.5	--
California	--	--	--	--	--	5.6	13.7	36.5	63.2	100.0
Arizona	--	--	--	--	--	--	--	3.5	--	--
Others	--	--	--	--	--	3.7	1.1	1.2	3.5	--
Total recoveries	20	76	96	66	49	54	95	85	57	4
					Indirect Recoveries					
Alberta	100.0	97.3	90.5	83.8	58.5	17.5	1.3	--	1.8	--
Saskatchewan	--	2.7	2.7	2.5	--	--	--	--	--	--
Oregon	--	--	--	--	--	1.8	--	--	1.8	--
Washington	--	--	--	--	1.9	1.8	--	--	--	--
Montana	--	--	2.7	--	1.9	7.0	3.9	2.1	--	--
Idaho	--	--	2.7	8.8	18.9	38.6	47.4	44.8	17.9	20.0
Wyoming	--	--	--	--	--	--	1.3	--	--	--
Colorado	--	--	--	--	--	--	5.3	5.2	5.4	--
Utah	--	--	--	1.3	--	3.5	1.3	1.0	1.8	--
Nevada	--	--	--	1.3	3.8	12.3	10.5	10.4	21.4	--
California	--	--	1.4	2.5	13.2	14.0	27.6	35.4	50.0	80.0
Arizona	--	--	--	--	--	--	--	1.0	--	--
Others	--	--	--	--	1.9	3.6	1.3	--	--	--
Total recoveries	7	73	74	80	53	57	76	96	56	5

Table C-2. *Chronologic-geographic distribution of 413 direct and 424 indirect band recoveries from Canada geese banded preseason on breeding areas in Central Montana, 1946-73. Percentage of shot recoveries from normal-wild geese; ages and sexes combined.*

	September		October		November		December		January	
Recovered in:	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-31
					Direct Recoveries					
Alberta	--	--	--	--	1.7	--	--	--	--	--
Montana	--	--	86.9	63.0	51.7	65.3	34.4	7.1	6.5	--
Idaho	--	--	13.1	37.0	46.6	33.3	50.8	73.2	41.9	--
Colorado	--	--	--	--	--	--	--	1.8	--	--
Utah	--	--	--	--	--	--	1.6	--	--	--
Nevada	--	--	--	--	--	--	1.6	5.4	25.8	50.0
California	--	--	--	--	--	1.3	6.6	8.9	25.8	50.0
Arizona	--	--	--	--	--	--	4.9	3.6	--	--
Total recoveries	0	0	84	46	58	75	61	56	31	2
					Indirect Recoveries					
Alberta	40.0	62.5	4.3	2.6	--	1.1	--	--	--	--
Saskatchewan	20.0	37.5	2.2	--	--	--	--	--	--	--
Washington	--	--	--	--	--	--	1.9	--	--	--
Montana	40.0	--	80.6	65.8	58.3	60.0	37.0	14.9	--	--
Idaho	--	--	10.8	26.3	29.2	33.3	46.3	62.7	55.0	--
Wyoming	--	--	--	2.6	--	1.1	--	--	--	--
Colorado	--	--	--	--	--	--	--	1.5	--	100.0
Utah	--	--	1.1	2.6	2.1	3.3	1.9	--	--	--
Nevada	--	--	--	--	6.3	1.1	5.6	9.0	30.0	--
California	--	--	--	--	--	--	5.6	10.4	15.0	--
Arizona	--	--	--	--	--	--	1.9	--	--	--
Others	--	--	1.1	--	4.2	--	--	1.5	--	--
Total recoveries	5	8	93	38	48	90	54	67	20	1

Table C-3. *Chronologic-geographic distribution of 118 direct and 348 indirect band recoveries from Canada geese banded preseason on molting areas in Central Montana (Lima Reservoir), 1961-62. Percentage of shot recoveries from normal-wild geese; sexes combined.*

	September		October		November		December		January	
Recovered in:	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-31
				Direct Recoveries						
Montana	--	--	10.0	--	11.1	--	--	--	--	--
Idaho	--	--	10.0	40.0	33.3	33.3	26.3	17.1	--	--
Utah	100.0	--	80.0	60.0	33.3	55.6	47.4	45.7	--	--
Nevada	--	--	--	--	22.2	11.1	--	11.4	20.0	--
California	--	--	--	--	--	--	21.1	20.0	60.0	--
Arizona	--	--	--	--	--	--	5.3	5.7	20.0	--
Total recoveries	1	0	20	15	9	9	19	35	10	0
				Indirect Recoveries						
Alberta	--	75.0	--	2.8	--	--	--	--	--	--
Saskatchewan	--	25.0	1.6	--	--	--	--	--	--	--
Montana	--	--	6.3	5.6	6.3	22.2	2.1	1.1	--	--
Idaho	--	--	30.2	69.4	40.6	8.3	23.4	12.4	17.9	--
Wyoming	--	--	--	--	--	2.8	2.1	--	--	--
Colorado	--	--	--	--	--	2.8	--	--	--	--
Utah	100.0	--	57.1	19.4	40.6	50.0	40.4	32.6	2.6	100.0
Nevada	--	--	3.2	--	12.5	2.8	4.3	11.2	23.1	--
California	--	--	--	2.8	--	5.6	25.5	36.0	43.6	--
Arizona	--	--	1.6	--	--	2.8	2.1	6.7	7.7	--
Others	--	--	--	--	--	2.8	--	--	5.2	--
Total recoveries	1	4	63	36	32	36	47	89	39	1

Table C-4. *Chronologic-geographic distribution of 835 direct and 920 indirect band recoveries from Canada geese banded preseason on breeding areas in Southeastern Idaho, 1947-73. Percentage of shot recoveries from normal-wild geese; ages and sexes combined.*

	September		October		November		December		January	
Recovered in:	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-31
					Direct Recoveries					
Alberta	--	--	--	0.9	--	--	--	--	--	--
Montana	--	--	4.7	3.6	1.7	--	--	--	--	--
Idaho	--	--	90.6	78.2	71.7	55.9	44.9	35.4	20.8	--
Wyoming	--	--	0.8	1.8	4.2	0.8	0.7	--	--	--
Colorado	--	--	--	--	--	--	--	0.6	--	--
Utah	--	--	3.9	13.6	14.2	27.1	14.5	14.0	--	--
Nevada	--	--	--	--	1.7	5.1	2.9	4.3	3.8	--
California	--	--	--	--	5.8	2.5	20.3	23.2	41.5	75.0
Arizona	--	--	--	1.8	0.8	8.5	15.9	22.6	32.1	--
Others	--	--	--	--	--	--	0.7	--	1.9	25.0
Total recoveries	0	0	128	110	120	118	138	164	53	4
					Indirect Recoveries					
Alberta	50.0	66.7	8.6	6.5	3.8	--	--	--	--	--
Saskatchewan	25.0	33.3	8.6	5.6	1.3	--	--	--	--	--
Oregon	--	--	--	--	--	0.7	--	--	--	--
Washington	--	--	0.7	--	1.3	0.7	--	--	--	--
Montana	--	--	12.1	4.6	3.8	0.7	0.7	--	--	--
Idaho	25.0	--	60.0	66.7	64.1	67.1	42.1	31.5	18.8	20.0
Wyoming	--	--	2.9	2.8	3.8	2.9	2.0	--	--	--
Colorado	--	--	--	0.9	--	1.4	0.7	--	--	20.0
Utah	--	--	5.7	10.2	15.4	15.0	17.8	15.5	7.9	--
Nevada	--	--	--	--	--	2.1	5.3	3.6	3.0	20.0
California	--	--	--	0.9	1.3	3.6	18.4	27.4	30.7	40.0
Arizona	--	--	--	1.9	2.6	3.6	12.5	20.2	38.6	--
Others	--	--	1.4	--	2.6	2.1	0.7	1.8	1.0	--
Total recoveries	4	24	140	108	78	140	152	168	101	5

Table C-5. *Chronologic-geographic distribution of 198 direct and 339 indirect band recoveries from Canada geese banded preseason on molting areas in Southeastern Idaho, 1946-66. Percentage of shot recoveries from normal-wild gesse; sexes combined.*

	September		October		November		December		January	
Recovered in:	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-31
					Direct Recoveries					
Idaho	--	--	45.0	57.7	40.0	10.0	4.9	3.6	--	--
Wyoming	--	--	25.0	--	8.6	3.3	--	--	--	--
Utah	--	--	30.0	38.5	28.6	56.7	48.8	14.3	--	--
Nevada	--	--	--	--	5.7	--	--	--	16.7	--
California	--	--	--	3.8	2.9	10.0	26.8	39.3	44.4	--
Arizona	--	--	--	--	8.6	20.0	19.5	42.9	33.3	--
Others	--	--	--	--	5.7	--	--	--	5.6	--
Total recoveries	0	0	20	26	35	30	41	28	18	0
					Indirect Recoveries					
Alberta	100.0	66.7	7.3	--	--	--	--	--	--	--
Saskatchewan	--	33.3	--	--	--	--	--	--	--	--
Montana	--	--	4.9	1.7	--	--	--	--	--	--
Idaho	--	--	56.1	44.1	18.9	8.9	10.7	7.3	6.7	--
Wyoming	--	--	14.6	6.8	--	1.8	1.8	--	--	--
Utah	--	--	14.6	39.0	51.4	53.6	39.3	23.6	--	--
Nevada	--	--	2.4	5.1	2.7	3.6	7.1	3.6	3.3	--
California	--	--	--	--	8.1	16.1	21.4	23.6	66.7	100.0
Arizona	--	--	--	3.4	18.9	16.1	19.6	38.2	23.3	--
Others	--	--	--	--	--	--	--	3.6	--	--
Total recoveries	1	3	41	59	37	56	56	55	30	1

Table C-6. *Chronologic-geographic distribution of 28 direct and 41 indirect band recoveries from Canada geese banded prescason on breeding areas in Western Wyoming, 1958-69. Percentage of shot recoveries from normal-wild geese; ages and sexes combined.*

	September		October		November		December		January	
Recovered in:	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-31
				Direct Recoveries						
Idaho	--	--	85.7	66.7	--	25.0	--	--	--	--
Wyoming	--	--	14.3	--	100.0	25.0	--	--	--	--
Utah	--	--	--	33.3	--	50.0	33.3	14.3	--	--
California	--	--	--	--	--	--	66.7	85.7	100.0	--
Total recoveries	0	0	7	3	1	4	3	7	3	0
				Indirect Recoveries						
Alberta	--	66.7	--	--	--	--	--	--	--	--
Saskatchewan	--	33.3	25.0	--	--	--	--	--	--	--
Idaho	--	--	25.0	40.0	25.0	14.3	--	--	--	--
Wyoming	--	--	--	40.0	--	--	--	--	--	--
Utah	--	--	50.0	20.0	25.0	57.1	14.3	25.0	--	--
Nevada	--	--	--	--	--	--	14.3	12.5	--	--
California	--	--	--	--	50.0	14.3	57.1	50.0	66.7	--
Arizona	--	--	--	--	--	--	--	12.5	33.3	--
Others	--	--	--	--	--	14.3	14.3	--	--	--
Total recoveries	0	3	4	5	4	7	7	8	3	0

Table C-7. *Chronologic-geographic distribution of 256 direct and 451 indirect band recoveries from Canada geese banded preseason on molting areas in Western Wyoming (Turbid Lake), 1956-72. Percentage of shot recoveries from normal-wild geese; sexes combined.*

	September		October		November		December		January	
Recovered in:	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-31
				Direct Recoveries						
Montana	--	--	3.1	4.5	10.0	--	1.9	1.4	--	--
Idaho	--	--	56.3	31.8	30.0	25.9	3.7	5.6	--	--
Wyoming	--	--	40.6	40.9	40.0	59.3	38.9	31.0	3.3	--
Utah	--	--	--	22.7	15.0	7.4	11.1	7.0	--	--
Nevada	--	--	--	--	--	--	--	1.4	20.0	--
California	--	--	--	--	--	3.7	31.5	32.4	46.7	--
Arizona	--	--	--	--	5.0	3.7	13.0	19.7	26.7	--
Others	--	--	--	--	--	--	--	1.4	3.3	--
Total recoveries	0	0	32	22	20	27	54	71	30	0
				Indirect Recoveries						
Alberta	--	--	4.4	--	--	--	--	--	--	--
Saskatchewan	--	100.0	--	--	--	--	--	--	--	--
Washington	--	--	2.2	--	--	--	--	--	--	--
Montana	--	--	11.1	20.0	3.0	--	--	--	--	--
Idaho	100.0	--	37.8	16.7	21.2	24.0	9.0	7.5	5.2	--
Wyoming	--	--	40.0	40.0	42.4	54.0	37.0	43.6	8.6	--
Colorado	--	--	--	--	--	4.0	2.0	--	--	--
Utah	--	--	4.4	20.0	21.2	8.0	15.0	9.0	1.7	--
Nevada	--	--	--	--	--	--	2.0	1.5	5.2	--
California	--	--	--	--	12.1	4.0	24.0	21.8	32.8	--
Arizona	--	--	--	--	--	6.0	11.1	16.5	46.6	--
Others	--	--	--	3.3	--	--	--	--	--	--
Total recoveries	1	1	45	30	33	50	100	133	58	0

Table C-8. *Chronologic-geographic distribution of 134 direct and 189 indirect band recoveries from Canada geese banded preseason on breeding areas in Central Wyoming (Ocean Lake WMA), 1955-73. Percentage of shot recoveries from normal-wild geese; ages and sexes combined.*

	September		October		November		December		January	
Recovered in:	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-31
					Direct Recoveries					
Montana	--	--	--	6.3	--	--	--	--	--	--
Wyoming	--	--	100.0	93.8	94.1	76.2	38.5	24.0	--	--
Colorado	--	--	--	--	--	9.5	--	4.0	9.1	--
Utah	--	--	--	--	5.9	9.5	30.8	48.0	72.7	77.8
Nevada	--	--	--	--	--	--	3.8	--	--	--
California	--	--	--	--	--	--	19.2	16.0	--	--
Arizona	--	--	--	--	--	4.8	7.7	8.0	9.1	--
Others	--	--	--	--	--	--	--	--	9.1	22.2
Total recoveries	0	0	9	16	17	21	26	25	11	9
					Indirect Recoveries					
Alberta	100.0	33.3	5.9	6.3	--	--	--	--	--	--
Saskatchewan	--	50.0	8.8	6.3	--	--	--	--	--	--
Oregon	--	--	--	--	--	2.4	--	--	--	--
Montana	--	16.7	20.6	--	--	2.4	3.4	--	--	--
Idaho	--	--	5.9	6.3	10.0	2.4	3.4	2.6	--	--
Wyoming	--	--	52.9	81.3	40.0	58.5	24.1	33.3	27.3	--
Colorado	--	--	--	--	20.0	7.3	13.8	10.3	18.2	--
Utah	--	--	2.9	--	10.0	19.5	44.8	43.6	27.3	100.0
Nevada	--	--	--	--	--	--	3.4	--	--	--
California	--	--	--	--	--	--	6.9	5.1	18.2	--
Arizona	--	--	--	--	--	--	--	2.6	9.1	--
Others	--	--	2.9	--	20.0	7.3	--	2.6	--	--
Total recoveries	1	6	34	16	10	41	29	39	11	2

Table C-9. *Chronologic-geographic distribution of 434 direct and 836 indirect band recoveries from geese banded preseason on molting areas in Central Wyoming (Pathfinder and Wheatland Reservoirs), 1952-73. Percentage of shot recoveries from normal-wild geese; sexes combined.*

	September		October		November		December		January	
Recovered in:	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-31
				Direct Recoveries						
Montana	--	--	--	--	4.1	--	--	--	--	--
Idaho	--	--	--	--	2.0	--	--	--	--	--
Wyoming	--	--	50.0	29.4	38.8	17.1	4.4	2.6	2.6	--
Colorado	--	--	15.0	38.2	28.6	17.1	14.7	3.5	5.3	66.7
Utah	--	--	30.0	32.4	22.4	30.0	19.1	16.7	2.6	33.3
Nevada	--	--	--	--	--	--	--	--	1.3	--
California	--	--	--	--	4.1	10.0	26.5	41.2	39.5	--
Arizona	--	--	5.0	--	--	25.7	35.3	35.1	43.4	--
Others	--	--	--	--	--	--	--	0.9	5.2	--
Total recoveries	0	0	20	34	49	70	68	114	76	3
				Indirect Recoveries						
Alberta	50.0	42.9	--	1.3	--	--	--	--	--	--
Saskatchewan	50.0	57.1	11.5	1.3	--	--	--	--	--	--
Montana	--	--	13.5	1.3	1.1	0.8	--	--	--	--
Idaho	--	--	1.9	--	2.2	1.6	0.6	1.0	--	--
Wyoming	--	--	38.5	49.3	20.2	16.0	6.7	4.4	1.9	--
Colorado	--	--	11.5	20.0	30.3	20.0	12.1	9.2	7.4	28.6
Utah	--	--	21.2	25.3	38.2	20.8	14.5	11.2	3.7	--
Nevada	--	--	--	--	--	--	--	1.0	0.9	14.3
California	--	--	--	--	3.4	11.2	33.9	35.4	29.6	28.6
Arizona	--	--	--	--	3.4	28.8	31.5	36.9	51.9	28.6
Others	--	--	1.9	1.3	1.1	0.8	0.6	1.0	4.6	--
Total recoveries	2	7	52	75	89	125	165	206	108	7

Table C-10. *Chronologic-geographic distribution of 3,065 direct and 3,036 indirect band recoveries from Canada geese banded preseason on breeding areas in Northern Utah, 1938-73. Percentage of shot recoveries from normal-wild geese; ages and sexes combined.*

	September		October		November		December		January	
Recovered in:	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-31
					Direct Recoveries					
Idaho	--	--	6.5	2.5	2.5	2.1	2.1	1.6	0.4	--
Wyoming	--	--	1.4	0.2	0.3	0.8	--	--	--	--
Colorado	--	--	--	--	--	--	--	0.2	0.4	--
Utah	100.0	100.0	91.9	96.6	94.6	89 8	65.9	42.2	18.6	25.0
Nevada	--	--	--	0.4	0.6	1.0	5.9	10.1	17.1	25.0
California	--	--	--	0.2	1.9	4.4	20.0	36.6	54.3	25.0
Arizona	--	--	0.2	--	--	1.8	5.9	8.9	8.2	--
Others	--	--	--	0.2	--	--	0.2	0.4	1.1	25.0
Total recoveries	7	5	556	526	316	387	475	516	269	8
					Indirect Recoveries					
Alberta	38.1	64.5	9.9	2.0	1.7	1.0	--	0.2	--	--
British Columbia	--	--	0.2	--	--	--	--	--	--	--
Saskatchewan	19.0	24.7	5.7	3.1	0.3	--	--	0.2	--	--
Oregon	--	--	0.2	0.5	0.3	0.7	0.2	0.5	0.3	--
Washington	--	--	--	0.5	0.3	--	0.2	--	--	--
Montana	4.8	3.2	4.7	2.8	2.1	1.2	0.2	--	--	--
Idaho	--	1.1	9.2	10.9	7.6	6.7	4.0	3.8	1.9	--
Wyoming	--	--	2.0	0.3	--	0.2	0.2	0.4	--	--
Colorado	--	--	--	0.3	1.0	0.7	0.7	0.5	0.3	--
Utah	38.1	5.4	66.6	76.6	83.2	76.5	61.8	40.1	20.3	7.1
Nevada	--	--	0.2	1.3	0.7	1.7	6.4	7.1	14.6	21.4
California	--	1.1	0.5	0.8	1.7	5.7	20.7	36.3	47.0	64.3
Arizona	--	--	--	0.3	0.7	4.0	4.9	10.1	13.0	7.1
Others	--	--	0.6	0.8	0.3	1.4	1.0	0.8	2.6	--
Total recoveries	21	93	404	393	291	405	547	553	315	14

Table C-11. *Chronologic-geographic distribution of 202 direct and 245 indirect band recoveries from Canada geese banded preseason on molting areas in Northern Utah (Neponset Reservoir), 1953-73. Percentage of shot recoveries from normal-wild geese; sexes combined.*

	September		October		November		December		January	
Recovered in:	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-31
				Direct Recoveries						
Idaho	--	--	43.2	18.8	11.1	8.0	2.8	--	--	--
Wyoming	--	--	24.3	6.3	11.1	28.0	--	--	--	--
Utah	--	--	32.4	68.8	55.6	40.0	36.1	2.4	5.3	--
Nevada	--	--	--	--	--	--	--	2.4	--	--
California	--	--	--	--	22.2	20.0	38.9	65.9	81.6	--
Arizona	--	--	--	6.3	--	4.0	19.4	29.3	13.2	--
Others	--	--	--	--	--	--	2.8	--	--	--
Total recoveries	0	0	37	16	9	25	36	41	38	0
				Indirect Recoveries						
Alberta	--	100.0	--	--	--	--	--	--	--	--
Saskatchewan	--	--	4.5	--	--	--	--	--	--	--
Oregon	--	--	--	2.6	--	--	--	--	--	--
Montana	--	--	--	--	4.8	--	--	--	--	--
Idaho	--	--	36.4	28.9	19.0	14.3	3.6	1.9	--	--
Wyoming	--	--	18.2	7.9	19.0	3.6	1.8	1.9	--	--
Utah	--	--	36.4	55.3	33.3	32.1	18.2	7.7	--	--
Nevada	--	--	--	--	--	--	--	5.8	3.6	--
California	--	--	4.5	2.6	14.3	28.6	60.0	69.2	53.6	--
Arizona	--	--	--	2.6	9.5	17.9	14.5	13.5	39.3	--
Others	--	--	--	--	--	3.6	1.8	--	3.6	--
Total recoveries	0	1	22	38	31	28	55	52	28	0

Table C-12. *Chronologic-geographic distribution of 221 direct and 193 indirect band recoveries from Canada geese banded preseason on breeding areas in Southern Utah, 1955-73. Percentage of shot recoveries from normal-wild geese; ages and sexes combined.*

	September		October		November		December		January	
Recovered in:	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-31
				Direct Recoveries						
Idaho	--	--	6.9	6.7	--	--	--	--	--	--
Utah	--	--	93.1	93.3	82.4	66.7	40.7	12.5	--	--
Nevada	--	--	--	--	--	--	3.4	7.5	--	--
California	--	--	--	--	17.6	3.7	20.3	45.0	61.1	100.0
Arizona	--	--	--	--	--	29.6	35.6	35.0	38.9	--
Total recoveries	0	0	29	30	17	27	59	40	18	1
				Indirect Recoveries						
Alberta	--	57.1	12.5	--	--	--	--	--	--	--
Saskatchewan	100.0	35.7	8.3	11.1	--	--	--	--	--	--
Oregon	--	--	--	--	--	--	3.0	--	4.2	--
Montana	--	--	--	--	--	4.8	--	--	--	--
Idaho	--	--	8.3	22.2	5.9	9.5	12.1	5.0	--	--
Wyoming	--	--	--	--	--	--	--	2.5	--	--
Colorado	--	--	--	--	--	--	--	2.5	8.3	--
Utah	--	7.1	70.8	50.0	76.5	61.9	30.3	17.5	8.3	--
Nevada	--	--	--	5.6	--	--	--	--	4.2	--
California	--	--	--	5.6	5.9	14.3	27.3	47.5	58.3	--
Arizona	--	--	--	5.6	--	4.8	24.2	25.0	12.5	--
Others	--	--	--	--	11.8	4.8	3.0	--	4.2	100.0
Total recoveries	1	14	24	18	17	21	33	40	24	1

Table C-13. *Chronologic-geographic distribution of 18 direct and 24 indirect band recoveries from Canada geese banded preseason on breeding areas in Northeastern Nevada (Ruby Lake NWR), 1959-68. Percentage of shot recoveries from normal-wild geese; ages and sexes combined.*

	September		October		November		December		January	
Recovered in:	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-31
					Direct Recoveries					
Oregon	--	--	--	--	--	50.0	--	--	--	--
Idaho	--	--	--	100.0	100.0	--	--	--	--	--
Utah	--	--	--	--	--	50.0	--	--	--	--
Nevada	--	--	--	--	--	--	16.7	--	100.0	--
California	--	--	--	--	--	--	83.3	100.0	--	--
Total recoveries	0	0	0	1	1	2	6	6	2	0
					Indirect Recoveries					
Saskatchewan	--	100.0	66.7	--	50.0	--	--	--	--	--
Oregon	--	--	--	33.3	--	--	--	--	--	--
Idaho	--	--	33.3	33.3	--	75.0	40.0	--	--	--
Colorado	--	--	--	--	--	--	20.0	--	--	--
Utah	--	--	--	33.3	--	--	--	--	--	--
California	--	--	--	--	50.0	25.0	40.0	100.0	--	--
Total recoveries	0	2	3	3	2	4	5	5	0	0

Table C-14. *Chronologic-geographic distribution of 24 indirect band recoveries from migrating and wintering Canada geese banded in- and postseason in Northeastern Nevada (Ruby Lake NWR), 1959-60. Percentage of shot recoveries from normal-wild geese; ages undetermined.*

	September		October		November		December		January	
Recovered in:	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-31
					Recoveries					
Montana	--	--	--	--	--	--	14.3	--	--	--
Idaho	--	--	100.0	--	100.0	60.0	28.6	--	--	--
Nevada	--	--	--	--	--	20.0	--	66.7	--	--
California	--	--	--	--	--	20.0	57.1	33.3	100.0	--
Total recoveries	0	0	3	0	2	5	7	3	4	0

Table C-15. *Chronologic-geographic distribution of 201 and 195 indirect band recoveries from Canada geese banded preseason on breeding areas in Northwestern Nevada, 1954-69. Percentage of shot recoveries from normal-wild geese; ages and sexes combined.*

	September		October		November		December		January	
Recovered in:	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-31
					Direct Recoveries					
Nevada	--	--	100.0	100.0	93.8	92.9	92.3	95.2	73.9	100.0
California	--	--	--	--	6.3	7.1	7.7	4.8	26.1	--
Total recoveries	0	0	22	17	16	28	52	42	23	1
					Indirect Recoveries					
Alberta	--	100.0	6.7	--	--	--	--	--	--	--
Oregon	--	--	13.3	7.7	--	--	3.4	2.0	--	--
Nevada	--	--	80.0	92.3	90.9	95.2	89.7	90.2	81.4	--
California	--	--	--	--	9.1	4.8	6.9	7.8	18.6	--
Total recoveries	0	1	15	13	22	21	29	51	43	0

Table C-16. *Chronologic-geographic distribution of 22 direct and 36 indirect band recoveries from Canada geese banded preseason on molting areas in Northwestern Nevada, 1955 and 1972. Percentage of shot recoveries from normal-wild geese; sexes combined.*

	September		October		November		December		January	
Recovered in:	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-31
					Direct Recoveries					
Nevada	--	--	--	100.0	--	100.0	100.0	71.4	--	--
California	--	--	--	--	--	--	--	28.6	100.0	--
Total recoveries	0	0	0	4	0	7	3	7	1	0
					Indirect Recoveries					
Nevada	--	--	50.0	--	100.0	100.0	100.0	100.0	100.0	--
California	--	--	50.0	--	--	--	--	--	--	--
Total recoveries	0	0	2	0	5	8	6	9	6	0

Table C-17. *Chronologic-geographic distribution of 61 indirect band recoveries from Canada geese banded postseason on wintering areas in Southern Nevada (Overton WMA), 1956-67. Percentage of shot recoveries from normal-wild geese; ages and sexes combined.*

	September		October		November		December		January	
Recovered in:	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-31
					Recoveries					
Saskatchewan	--	--	25.0	--	--	--	--	--	--	--
Idaho	--	--	25.0	--	14.3	50.0	--	--	--	--
Wyoming	--	--	--	--	--	--	10.0	--	--	--
Utah	--	--	50.0	100.0	71.4	25.0	30.0	7.7	6.3	--
Nevada	--	--	--	--	14.3	25.0	30.0	61.5	81.3	100.0
California	--	--	--	--	--	--	30.0	30.8	12.5	--
Total recoveries	0	0	4	6	7	4	10	13	16	1

Table C-18. *Chronologic-geographic distribution of 66 indirect band recoveries from Canada geese banded postseason on wintering areas in Southern California (Salton Sea NWR), 1967-69. Percentage of shot recoveries from normal-wild geese; ages and sexes combined.*

	September		October		November		December		January	
Recovered in:	1-15	16-30	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-31
					Recoveries					
Alberta	--	100.0	--	--	--	--	--	--	--	--
Saskatchewan	--	--	27.3	--	--	--	--	--	--	--
Montana	--	--	9.1	20.0	--	20.0	--	--	--	--
Idaho	--	--	54.5	40.0	28.6	20.0	--	12.5	--	--
Wyoming	--	--	--	--	28.6	--	--	--	--	--
Utah	--	--	9.1	40.0	42.9	20.0	33.3	12.5	--	--
Nevada	--	--	--	--	--	20.0	8.3	--	--	--
California	--	--	--	--	--	20.0	50.0	68.8	100.0	--
Arizona	--	--	--	--	--	--	8.3	6.3	--	--
Total recoveries	0	1	11	5	7	5	12	16	9	0

* U. S. GOVERNMENT PRINTING OFFICE 1980 - 679-699/32 Reg. 8

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.

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
EDITORIAL OFFICE
AYLESWORTH HALL CSU
FORT COLLINS COLORADO 80523

THIRD-CLASS MAIL

POSTAGE AND FEES PAID
U S DEPARTMENT OF THE INTERIOR

PERMIT No. G-77

NOTE: Mailing lists are computerized. Please return address label with change of address.