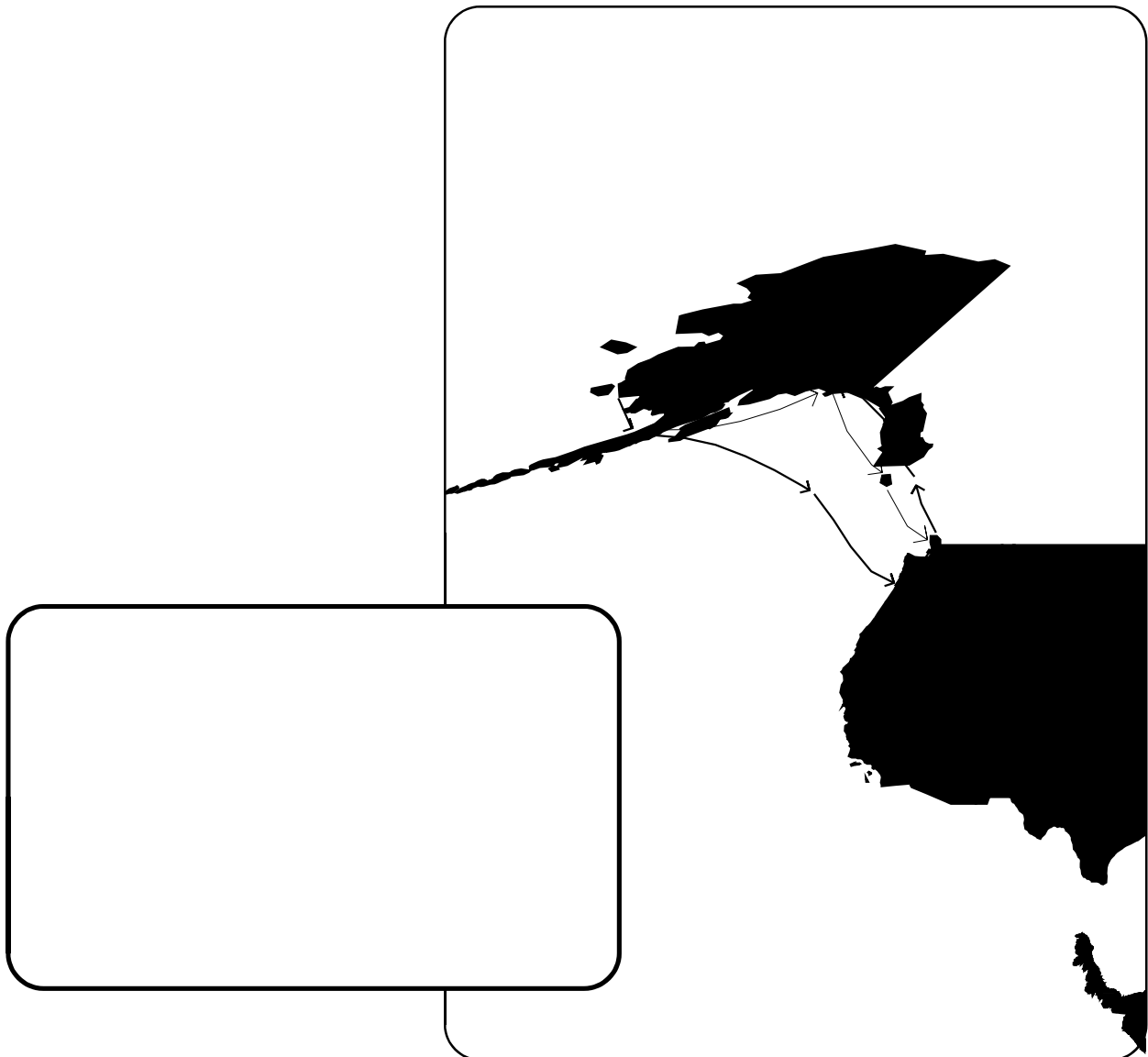


Cackling Canada Geese



PACIFIC FLYWAY MANAGEMENT PLAN
FOR THE
CACKLING CANADA GOOSE

Prepared for the
Pacific Flyway Council
U.S. Fish and Wildlife Service

by the
Subcommittee on the Cackling Canada Goose
Pacific Flyway Study Committee

Approved by: _____
Chair, Pacific Flyway Council

Date

July 1986
Revised July 1999

Suggested Citation: Pacific Flyway Council. 1999. Pacific Flyway management plan for the cackling Canada goose. Cackling Canada Goose Subcomm., Pacific Flyway Study Comm. [c/o USFWS], Portland, OR. Unpubl. Rept. 36 pp.+ appendices.

This management plan is one of a series of cooperatively developed plans for managing populations of migratory game birds of the Pacific Flyway. Inquiries about this plan may be directed to member states of the Pacific Flyway Council or to the Pacific Flyway Representative, U.S. Fish and Wildlife Service, 911 NE 11th Avenue, Portland, OR 97232.

PREFACE

The first Pacific Flyway management plan for the cackling Canada goose was adopted in July 1986. This document is the first revision of that plan. It was developed by the Pacific Flyway Study Committee, Cackling Canada Goose Subcommittee. Members include representatives from California Department of Fish and Game, Oregon Department of Fish and Wildlife, Washington Department of Fish and Wildlife, Alaska Department of Fish and Game, U.S. Fish and Wildlife Service Regions 1 and 7, and participating cooperators. The plan is not intended as a comprehensive compendium of scientific information on the cackling goose. It includes summaries of historical data and information from recent surveys and research, relevant to guiding management actions over the next five years.

Tom Rothe, Alaska Department of Fish and Game
Subcommittee Chair

TABLE OF CONTENTS

TABLE OF CONTENTS.....	i
LIST OF FIGURES.....	iii
LIST OF APPENDICES	iv
I. INTRODUCTION.....	1
II. GOAL AND OBJECTIVES	4
III. STATUS AND DISTRIBUTION	5
A. Status, Trends, and Management Indices.....	5
B. Breeding Grounds	7
C. Autumn Migration	8
D. Winter.....	9
Change in Winter Distribution.....	9
Washington and Oregon.....	11
California.....	11
E. Spring Migration	12
IV. HABITAT USE AND MANAGEMENT.....	13
A. Alaska.....	13
B. Washington and Oregon	13
C. California.....	17
V. HARVEST.....	17
A. Harvest Guidelines.....	17
B. Estimation of Harvests and Survival Rates.	18
C. Alaska	19
D. California.....	19
E. Washington and Oregon	20
VI. NON-CONSUMPTIVE USE.....	21
VII. CURRENT MANAGEMENT PROCEDURES.....	21
A. Production Assessments	21
B. Population Size and Distribution	22
C. Mortality Estimates and Regulations.....	22
D. Habitat Management.....	22
VIII. PROBLEMS	23
IX. RECOMMENDED MANAGEMENT PROCEDURES	24
A. Habitat.....	24
B. Population Inventory and Management.....	25
C. Harvest Management.....	26

D. Crop Depredation Control	27
E. Research and Education	27
F. Plan Implementation and Review	28
X. ACKNOWLEDGEMENTS.....	30
XI. LITERATURE CITED.....	31

LIST OF FIGURES

- Figure 1. Cackling Canada goose range maps.
- Figure 2. Peak fall counts of cackling Canada geese in the Klamath Basin, 1965-1983.
- Figure 3. Peak fall counts of cackling Canada geese, Pacific Flyway coordinated survey, 1979-1998.
- Figure 4. Indicated breeding pair indices of cackling Canada geese from Y-K Delta aerial surveys, 1985-1999.
- Figure 5. Relationship between indices of cackling geese from the fall and breeding ground surveys.
- Figure 6. Distribution by week and year of first observations of neck banded cackling Canada geese in California and Washington-Oregon, 1988-1997.

LIST OF APPENDICES

- Appendix A. Important use areas for cackling Canada geese throughout their range.
- Appendix B. Peak fall counts of cackling Canada geese in the Klamath Basin (1965-90) and from coordinated flywaywide surveys (1979-98).
- Appendix C. Population indices of cackling Canada geese on the Yukon-Kuskokwim Delta from early June aerial surveys, 1985-1999.
- Appendix D. Estimates of density and number of cackling Canada goose nests on the Y-K Delta, Alaska, 1986-1999.
- Appendix E. Derivation of the annual population index from the relationship between previous fall surveys and indicated breeding pair index.
- Appendix F. Indirect estimates of population size of cackling Canada geese in the Pacific Flyway from mark-recapture data 1989-90 through 1998-99.
- Appendix G. Proportion of nests remaining active, mean clutch size, and estimated hatching dates of cackling geese from random plot surveys on the Y-K Delta, 1986-1999.
- Appendix H. Cackling Canada Goose Harvest Strategy, March 1999 – March 2001.
- Appendix I. Estimated harvest of cackling Canada geese from measurements of tail retrices in the Parts Collection Survey applied to total Canada goose harvest.
- Appendix J. Seasonal and annual subsistence harvest of cackling Canada geese on the Y-K Delta, Alaska from village household surveys 1985-1997.
- Appendix K. Harvest of cackling Canada geese on state and federal public hunting areas in California, 1962-1983.
- Appendix L. Composition of Canada goose harvest in southwest Washington from hunter check station records, 1984-1998.
- Appendix M. Composition of Canada goose harvest in northwest Oregon from hunter check station records, 1984-1998.

PACIFIC FLYWAY MANAGEMENT PLAN FOR THE CACKLING CANADA GOOSE

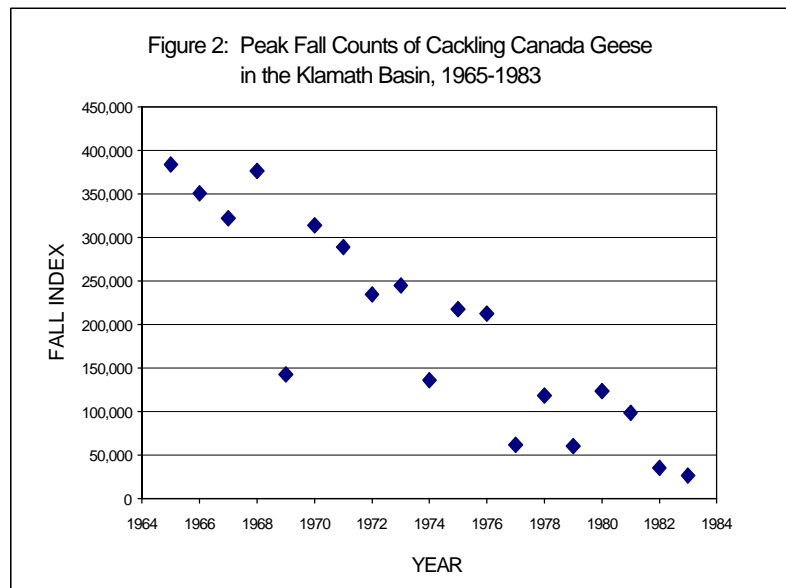
I. INTRODUCTION

The purpose of this plan is to establish guidelines for cooperative management of cackling Canada geese (*Branta canadensis minima*) during the planning period 1999-2004.

The cackling goose is the smallest subspecies of Canada goose (Palmer 1976). Johnson et al. (1979) demonstrated that cackling geese can be classified accurately among Pacific Flyway geese from morphological measurements. Early attempts to genetically distinguish Canada goose subspecies indicated that cackling Canada geese were different from others (Morgan et al. 1977; Van Wagner and Baker 1986). Mitochondrial DNA studies have shown that cackling geese are associated with a group of small-bodied forms of Canada geese that developed west and north of the Alaska Range (Shields and Wilson 1987). Further work by Shields (1994) demonstrated a clear distinction between cackling geese and the adjacent Aleutian Canada goose (*B.c. leucopareia*). Taxonomic relations of cackling and other Canada geese is reviewed by Pierson et al. (in prep.) in light of recent genetic analyses.

Currently, the entire population of cackling geese nests on the Yukon-Kuskokwim Delta (Y-K Delta) of Alaska. Historically, nearly all cacklers staged in the Klamath Basin during spring and fall, and wintered in the Central Valley of California. Since the early 1990s, the majority of cacklers have wintered in western Oregon and southwestern Washington (Trost and Harb 1995; Figure 1). Appendix A describes key use areas for cacklers throughout their range.

The population status of the cackling goose has been of concern to wildlife managers in the Pacific Flyway for many years. Peak counts of cackling geese from fall aerial surveys of the Klamath Basin documented a decline from over 400,000 birds in the late 1960s to less than 50,000 by the late 1970s (O'Neill 1979; Raveling 1984; Figure 2). Coordinated fall surveys in California and Oregon indicated a record low count of less than 26,000 cacklers in 1984.



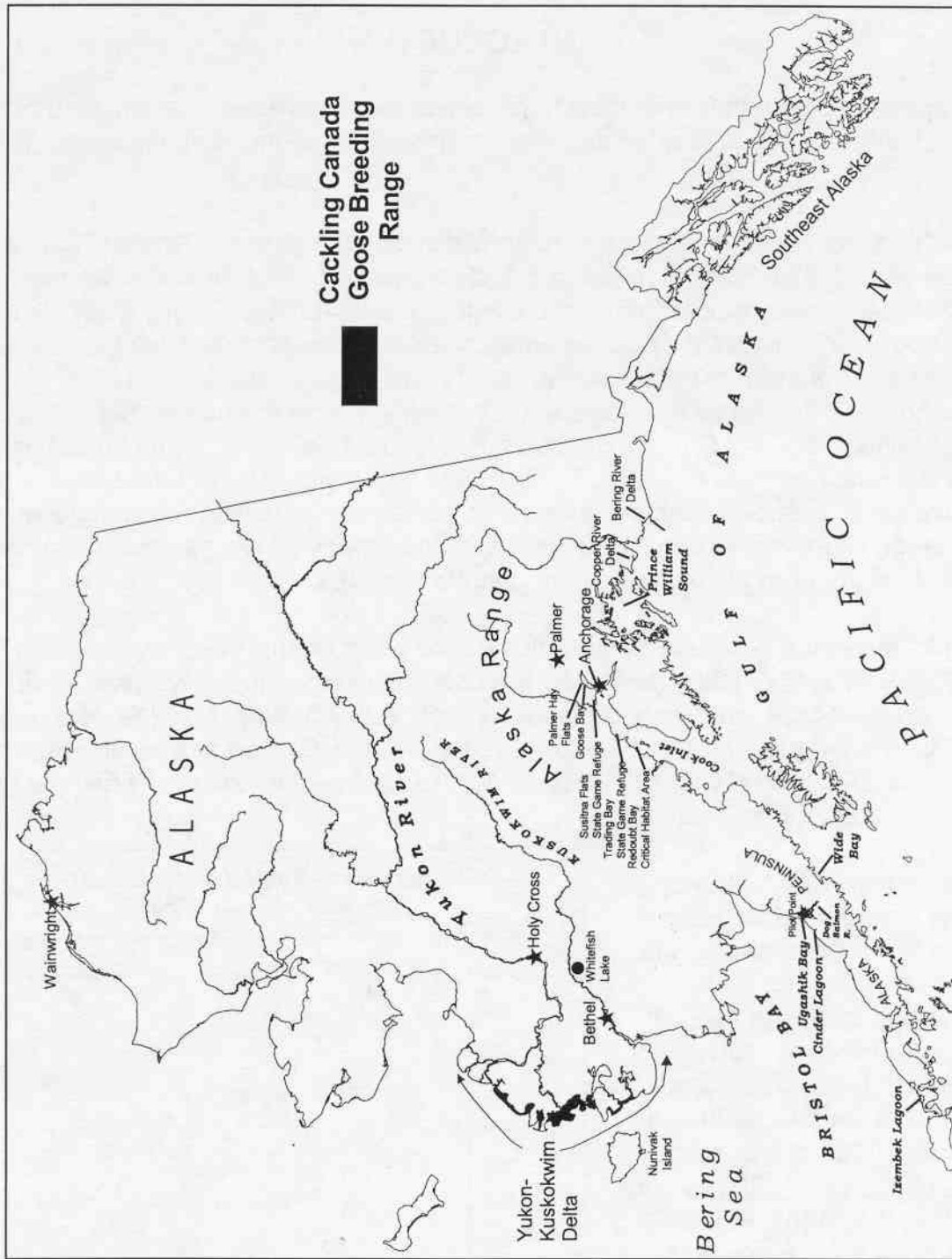


Figure 1a. Range and use areas of cackling Canada geese: Alaska breeding and migration.

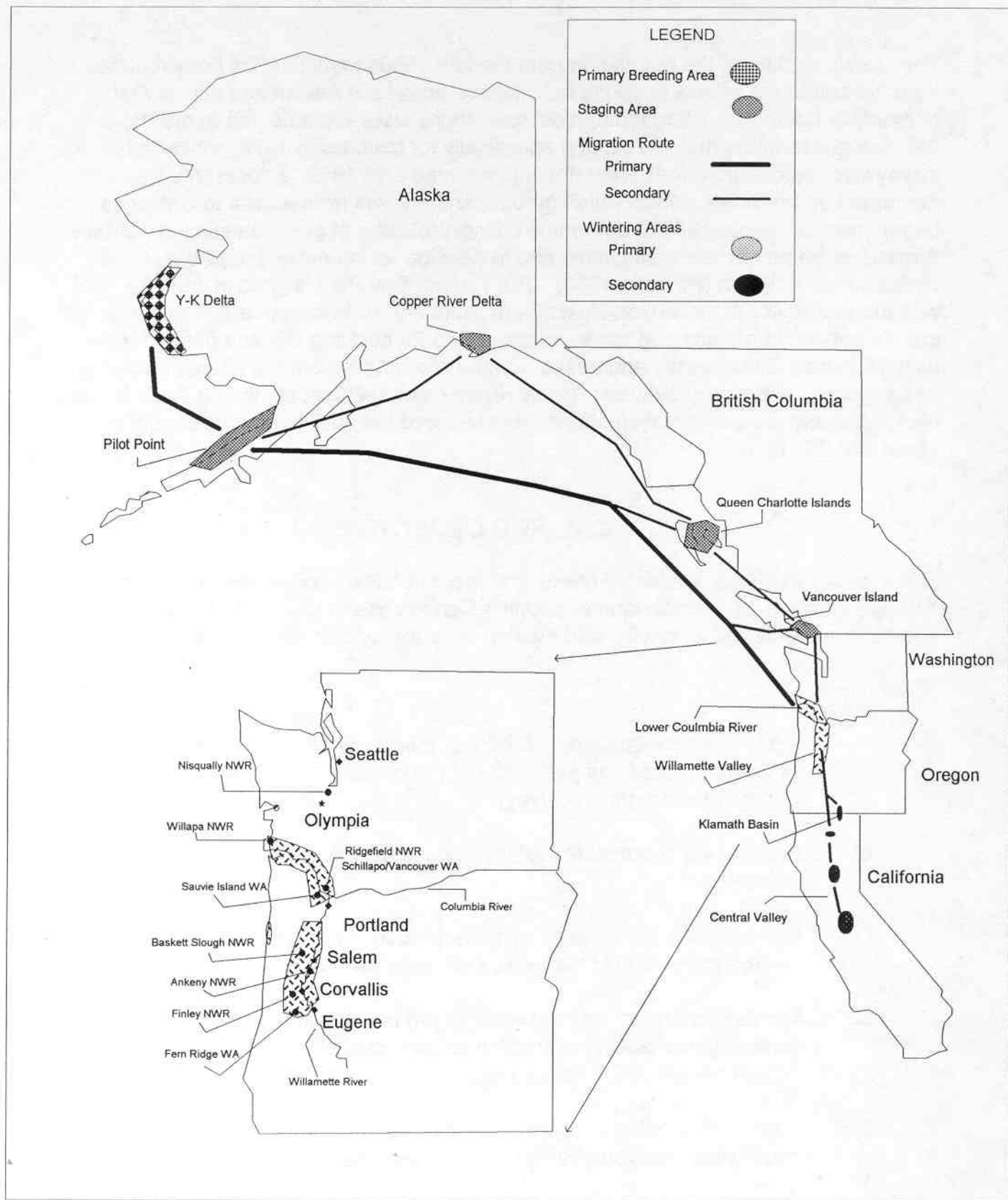


Figure 1b. Range and use areas of cackling Canada geese: fall and winter.

The steady decline of the population from the late 1960s to mid-1980s likely resulted from the combined effects of spring subsistence hunting in Alaska and fall harvest, primarily in California. Although harvest restrictions were implemented to protect Aleutian geese in the mid-1970s, and specifically for cacklers in 1979, concerted flywaywide restoration efforts were not implemented until 1983. Representatives of management agencies, conservation groups, and hunters from Alaska to California began meeting in late 1983 to determine critical problems of geese nesting in western Alaska, agree on harvest restrictions, and to develop an intensive, broad-based conservation program (Pamplin 1986). The Hooper Bay Plan, signed in January 1984, was the progenitor of the Yukon-Kuskokwim Delta Goose Management Plan which has guided harvest strategies and conservation efforts for cackling Canada geese for the past 15 years. By necessity and desire, annual coordination among interested parties has ensured consistency between Pacific Flyway management plans and the Y-K Delta plan. Cooperative conservation efforts have restored the cackling goose population to about 200,000 birds.

II. GOAL AND OBJECTIVES

The goal of this plan is to identify needs and responsibilities necessary to cooperatively manage numbers and distribution of cackling Canada geese to provide for optimal aesthetic, educational, scientific, and hunting uses throughout their range.

Objectives are:

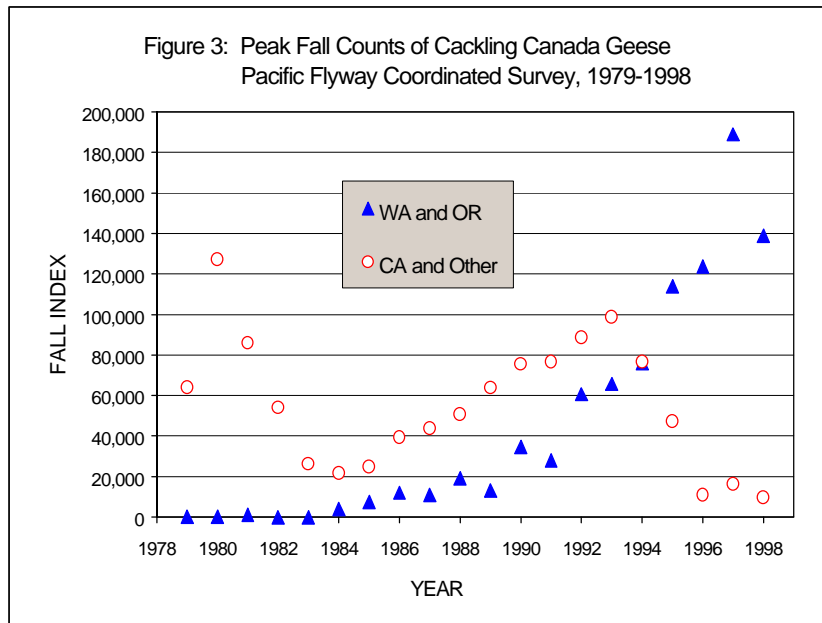
- A. Achieve a population of 250,000 as measured by a 3-year average index of indicated breeding pairs (27,660) from the Yukon-Kuskokwim Delta aerial breeding goose survey.
- B. Promote an average annual increase of 5-10% toward the population objective.
- C. Manage for a winter distribution that includes no more than 20% of the current population in the lower Columbia River and Willamette Valley.
- D. Maintain, manage, and enhance where feasible, nesting, migration and wintering habitats in sufficient quantity and quality to meet population objectives and public use goals.
- E. Manage habitats and harvest to minimize agricultural depredation complaints, consistent with Pacific Flyway plans and policies.

III. STATUS AND DISTRIBUTION

A. Status, Trends, and Management Indices

During the period 1965-1978, the cackling goose population was estimated from peak fall counts of small Canada geese (Taverner's and cacklers) in the Klamath Basin (O'Neill 1979, Hainline pers. comm.). These counts were then partitioned to subspecies based on ground observations. Peak numbers of cackling Canada geese in the basin declined from about 400,000 in the late 1960's to less than 20,000 in 1984 and 1985 (Figure 2, Appendix B).

Inventory procedures were changed in 1979 to improve the survey procedures and investigate concerns that the rapid decline in the annual index may have been worsened by distributional shifts out of the traditional fall survey area, rather than a steep decline in the population. Beginning in 1979, coordinated fall surveys included the Sacramento Valley, and in 1984, the Willamette Valley-Lower Columbia River region of Washington and Oregon



was added. The expanded survey coverage improved estimates of the population as it began to increase. Since 1986, the fall index of cackling geese increased at a relatively steady rate until 1993 and reached 205,000 in 1997 (Figure 3, Appendix B).

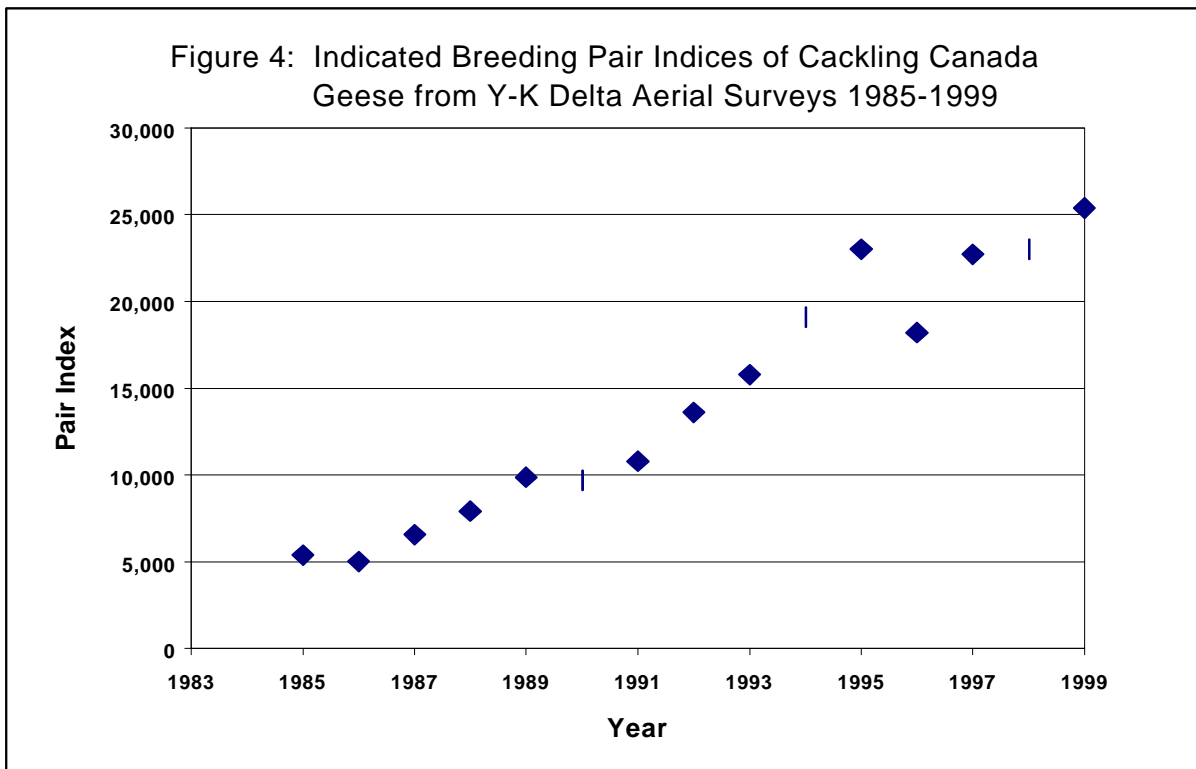
The number of cackling Canada geese tallied in different regions for the November survey illustrated a dramatic shift in their fall and winter distribution, particularly after 1993 (see below). Presently, almost all cackling Canada geese migrate to and winter in the Willamette Valley-Lower Columbia River region of Washington and Oregon (Figure 3). This region also winters significant numbers of six other subspecies of Canada geese. Mixing of cacklers with other Canada geese, coupled with operational problems (e.g. extended periods of inclement weather) have confounded the ability to obtain reliable counts of cacklers from this region in recent years.

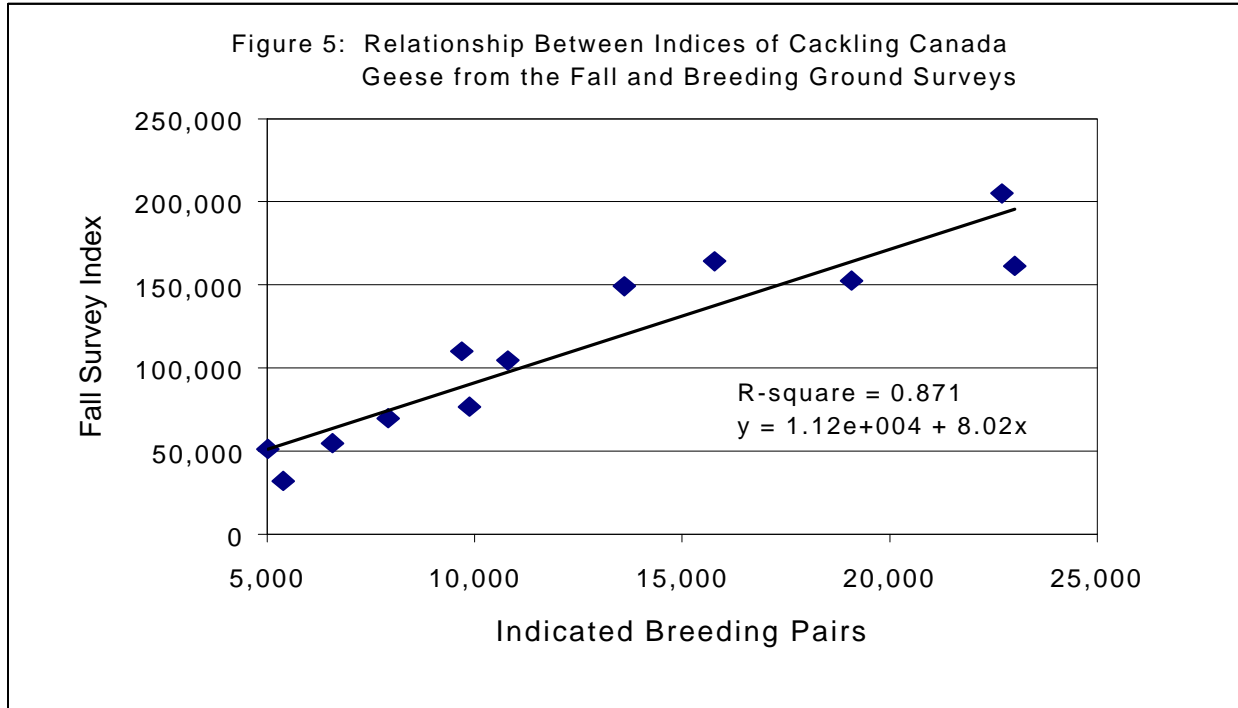
In 1985, a special aerial transect survey was initiated to quantify the number and distribution of breeding geese in the coastal region of the Y-K Delta (Butler et al. 1995b). This survey covers nearly all of the cackling goose nesting range and has documented the steady increase in breeding birds since 1986 (Stehn 1998; Figure 4,

Appendix C). Survey methods have been continually refined. A random plot ground survey of the same region, instituted in 1986, provides numbers of nests and other information (Bowman et al. 1999; Appendix D) for development of air:ground comparisons of goose observations. By integrating results of the aerial and ground surveys, a highly reliable breeding population estimate can be developed from the number of indicated pairs and a nest-per-observation ratio (Stehn 1998).

Due to difficulties encountered with the fall inventory, the Pacific Flyway Council adopted the Y-K Delta breeding ground surveys as the official annual assessment of population status, beginning in 1998. These surveys now guide management actions directed at cackling Canada geese throughout the Pacific Flyway, and produce benchmarks for the success of this plan and the Y-K Delta Goose Management Plan.

To estimate the total population size, the number of indicated breeding pairs on Y-K Delta aerial surveys is expanded by a constant factor, derived from the average relationship between breeding and fall surveys for the period 1985-97 (Figure 5, Appendix E). The expansion factor was calculated excluding data from 1996 and 1998 due to incomplete fall survey coverage. The relationship between the number of indicated breeding pairs and the total fall population is a matter that will be further explored during the period of this plan.





A cooperative study of the number and distribution of cacklers during winter based on observation of neck-banded birds was initiated during winter 1982 (Raveling and Zezulak 1988, Raveling et al. 1992). This program became an operational effort under the direction of the Pacific Flyway Council and the U. S. Fish and Wildlife Service in 1988 and is continuing. Indirect population estimates, derived from mark-recapture data from collars (Raveling and Zezulak 1988, Drut and Trost 1999), have mirrored population changes indicated by breeding ground and fall surveys (Appendix F).

B. Breeding Grounds

Distribution. Historically, the breeding range of cackling geese may have included the Bering Sea coast from Wainwright to the Alaska Peninsula (Nelson 1887; Gabrielson and Lincoln 1959), but the former range can not be reliably determined (Palmer 1976; Bellrose 1980). Cackling geese now nest only within the coastal fringe of the Y-K Delta (King and Lensink 1971; Figure 1a). This region was described by Spencer et al. (1951) as “America’s greatest goose-brant nesting area”. Aerial surveys flown for breeding geese since 1985 (Butler et al. 1988) have indicated that nearly all cacklers nest within 30 km of the coast, but their density and distribution have changed between 1985 and the early 1990s, concurrent with the population increase (Butler et al. 1995a).

Cacklers are observed near the mouth of the Kuskokwim River downstream from Bethel as early as April 25 (R. King pers comm.). Cacklers often stay in the Kuskokwim area until early May, when snowmelt opens tundra habitats along the Yukon Delta. Peak arrival on nesting grounds usually occurs by the second week of May (Raveling 1978;

Dau and Mickelson 1979; Ely et al. 1996). In fall, cacklers stage on Nunivak Island from early September until their departure from the delta in mid-October.

The breeding range of Taverner's Canada geese (*B.c. taverneri*) slightly overlaps cackler nesting, with scattered nests within 30 km of the coast; Taverner's are predominant on inland portions of the Delta (King and Lensink 1971) and Nunivak Island, and throughout much of western Alaska. Habitat preferences of the two subspecies differ, but specific isolating mechanisms are unknown.

Status and Productivity. A substantial decline in cackling Canada geese became evident on the breeding grounds by the early 1970s from the Alaska-Yukon Waterfowl Breeding Population Survey and continued into the 1980s (King and Conant 1983; Conant and Hodges 1986; King and Derksen 1986). The coastal aerial transect survey has shown increases in indicated breeding pairs and total birds for cackling geese since 1986 (Eldridge and Butler 1996). During 1985-97, aerial indices of cacklers exhibited average annual growth rates of 14% for indicated breeding birds and 16.8% for total geese (Stehn 1998; Figure 4, Appendix C).

Random plot ground surveys on the Y-K Delta began in 1986 to gather information on nest densities, distribution and success for geese and other waterbirds (Stehn 1986). Data and trends from ground plot surveys are summarized by Bowman et al. (1999). Since 1986, cackler nest density on plots has increased 4-fold and estimates of total nests have increased 3-fold (Appendix D). Clutch size has varied little around the average of 4.62 eggs (Appendix G).

From the early to mid-1980s, the arctic fox (*Alopex lagopus*) population reached a cyclic high and nest predation was significant on the diminished cacklers. Low densities of cackling geese and greatly reduced numbers of other geese as buffer prey made nests more vulnerable. Nest success ranged from 25-64% during 1981-1985 (Stehn 1986). Since 1987, the proportion of nests still active at mid- to late incubation has been relatively high, although these data do not reflect ultimate nest success to hatching. From 1985 to 1998, the percent of nests active in late incubation averaged 83% (Appendix G). Slight decreases in productivity in 1996-97 are probably insignificant (flooding reduced productivity in 1997). In recent years, nest losses to predators have been low, but may be significant in local areas of the Y-K Delta. There is little information on gosling survival between hatch and fledging. However, a 1994 study produced a minimum estimate of 34,000 cackler goslings taken by glaucous gulls (Bowman et al. 1997).

C. Autumn Migration

Nelson and Hansen (1959) noted the importance of the Alaska Peninsula to staging cacklers from September through departures in late October. During the mid-1980's, nearly the entire cackler population used the Alaska Peninsula as a fall migration staging area (Bollinger and Sedinger 1985). Ugashik Bay near Pilot Point and Cinder

Lagoon are the primary feeding and roosting areas (Sedinger and Bollinger 1987; Gill et al. 1997)(Figure 1a). Peak numbers of cacklers occur around October 10, with about 70% of the birds using Cinder River (Gill et al. 1986). Fidelity of geese to these areas is high (Gill et al. 1997). Concurrent with the population increase of the 1990s, cacklers have become more prevalent near Izembek Lagoon at the end of the Alaska Peninsula (R. King, C. Dau, pers. comm.).

The majority of birds leave the area in mid-October, via a route up the Dog Salmon River to Wide Bay on the Pacific side of the Alaska Peninsula. Their departure usually coincides with the passage of major weather systems through the area and associated strong northwest winds (Gill et al. 1997). However, in some years (e.g. 1987), large portions of the population may bypass these staging areas completely and fly directly to wintering grounds (Gill et al. 1997). Based on departure and arrival dates, cacklers probably fly nonstop from the Alaska Peninsula to the Lower Columbia River region, with some going to the Klamath Basin in Oregon and California. Gill et al. (1997) documented 11 marked birds that departed the Alaska Peninsula and arrived at the Klamath Basin within 48-72 hours. Occasionally cackling Canada geese are sighted in northern Puget Sound (Skagit Flats), the northern Olympic Peninsula, and eastern Washington during fall migration.

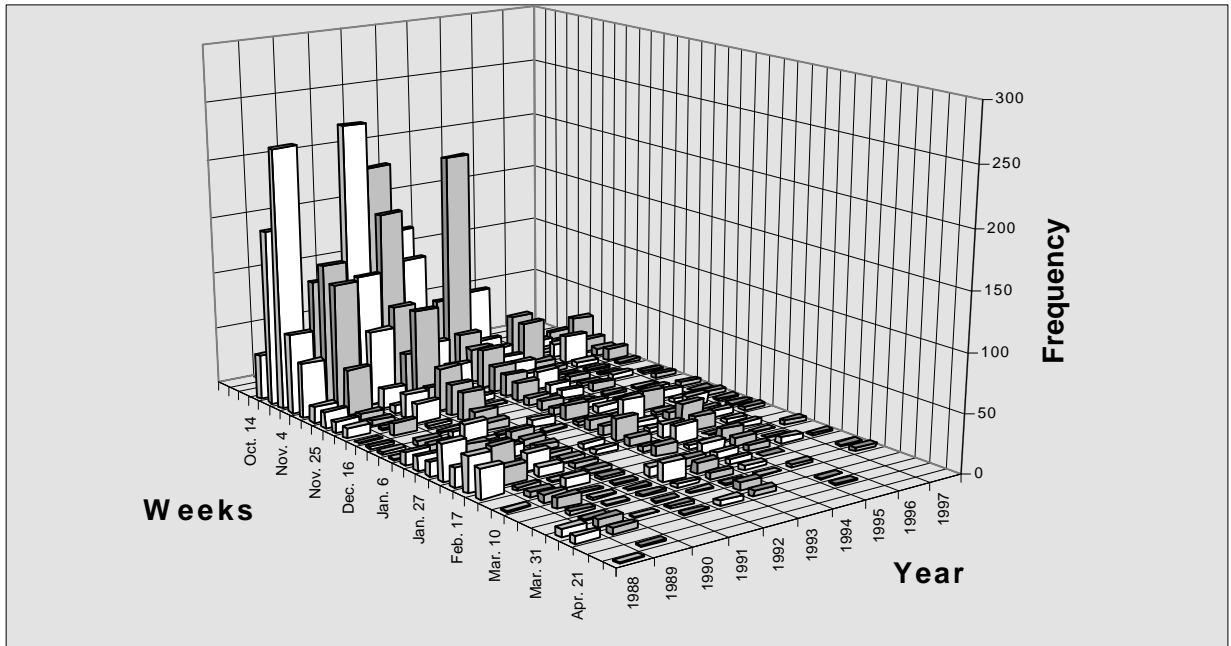
Cackling Canada geese appear to reach the lower 48 States from Alaska at about the same time as they always have. The first major arrivals in southwest Washington and northwest Oregon occur in mid- to late-October, with peak populations occurring between 25 October-7 November. The fall distribution of cacklers and the timing of their movements can be studied by examining the dates and numbers of first encounters of marked individuals in both California and the Willamette Valley-Lower Columbia River region of Washington and Oregon (Figure 6). These observations illustrate the relative constancy of the timing of arrivals and departures, but show a marked shift in the autumn distribution of cacklers to Oregon and Washington (see below). The percentage of cacklers seen in Oregon and Washington during the fall dark goose survey has risen from <1% in 1979-83 to 70% in 1995 (Trost 1997).

D. Winter

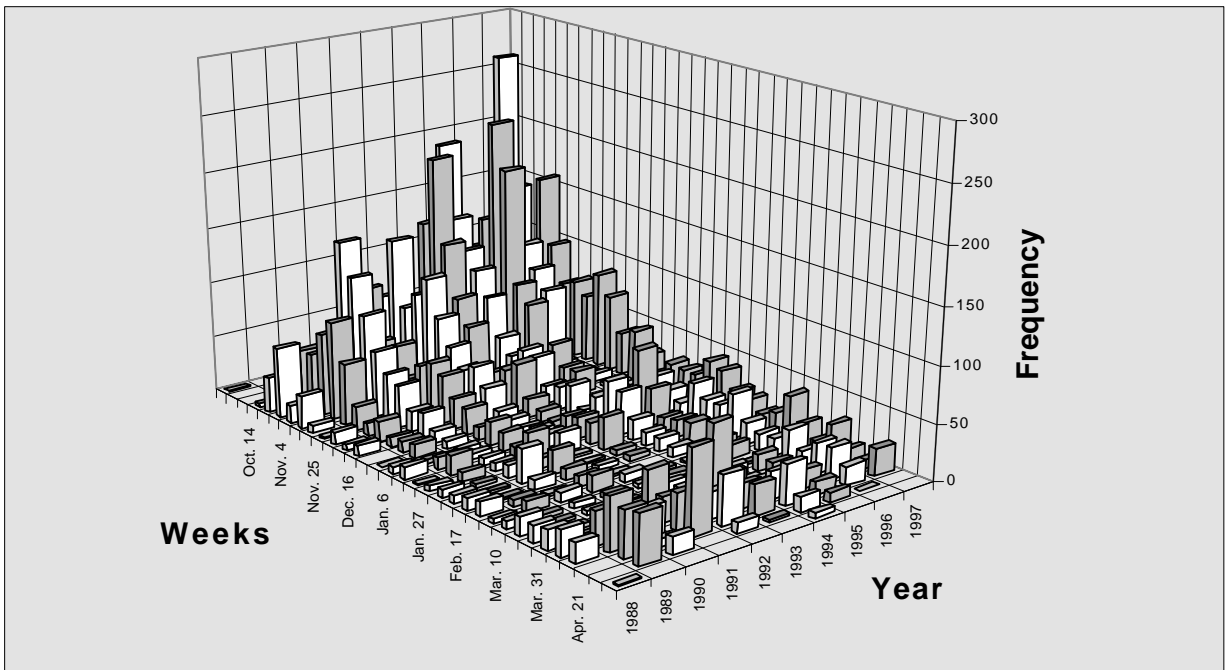
Change in Winter Distribution

Historically, most cackling Canada geese wintered in central California (Nelson and Hansen 1959, King and Lensink 1971, Raveling 1984). Intensive banding and marking of cackling geese was conducted during the period 1982-84 on the Y-K Delta in Alaska and in northern California. Subsequent observations of these geese in 1984-85 illustrate the historic winter distribution prevalent prior to the population increase and shift of the 1990s. Sixty-eight percent were seen in the Klamath Basin between mid-October to mid-February, 62% in the Sacramento Valley from late October to mid-

Figure 6. Distribution by week and year of first observations of neck banded cackling Canada geese in California and Washington - Oregon, 1988-1997.



CALIFORNIA



WASHINGTON-OREGON

February, 5% in the Sacramento-San Joaquin River Delta from early February to mid-March, and 26% in the San Joaquin Valley from early February to late February. Migrations to northeastern California and Oregon (37%) occurred in late February with dispersal northward through April, and major departures occurred 27 April-2 May (Raveling et al. 1985).

The winter distribution of cackling Canada geese has shifted markedly northward in recent years. Since 1985, all banding and marking has occurred on the Y-K Delta. Collar observation data illustrate the dramatic change in winter distribution in the 1990s (Figure 6). During the 10-year period 1988-97, observations of marked cackling Canada geese observed in either southern Oregon or California have dropped to very low levels. Concurrently, the number observed in the Willamette Valley-Lower Columbia River region of Washington and Oregon has increased markedly. This shift coincided with drought conditions in California during 1986-92, which may have affected winter habitat quality and use by cacklers. Since 1993, the vast majority of cackling geese have wintered in Oregon and Washington (Figure 3).

Washington and Oregon

Primary winter areas used in southwest Washington include the Ridgefield NWR and surrounding private lands, Vancouver Lowlands, Woodland Bottoms, Willow Grove, Puget Island, Willapa Bay, and Grays Harbor areas. Use of other areas in Washington is low, but cacklers are known to occasionally winter in eastern Washington. Most cacklers currently winter in Oregon, and can be found throughout the Willamette Valley and along the lower Columbia River. Additionally, a small number of cacklers still pass through the Klamath Basin in southern Oregon and northern California on their way to the historical wintering areas in central California.

California

The Central Valley of California, composed of the Sacramento and San Joaquin Valleys and the Sacramento-San Joaquin River Delta, was the major wintering area for cackling geese prior to the late 1980s. Areas in the Sacramento Valley with medium to high cackler use include the Sacramento, Delevan, Sutter, and Colusa National Wildlife Refuges (NWRs). Geese feed extensively in privately owned agricultural (rice, corn, beans, wheat) fields and short grass uplands on and near these refuges. In addition, both public and private lands in the Butte Sink, Llano Seco Ranch, Vina Plains, Colusa Trough and foothill regions west of the towns of Willows and Maxwell have historically held large numbers of birds.

Areas used in the San Joaquin Valley include the East Grasslands, especially Crane Ranches, Flynn Ranch, Modesto Properties, Snobird Ranch, Greenhouse Gun Club, San Joaquin NWR, Merced NWR, and the eastern foothills of Merced, Stanislaus, and Madera Counties.

E. Spring Migration

Migration from the San Joaquin and Sacramento Valleys begins in February and continues through mid-April (Johnson and Raveling 1983, 1984, Raveling et al. 1985).

Sixty percent of all cacklers using the San Joaquin Valley during winter are still present as of 1 April. Major stopover areas are in the Pit River flood plain between Adin and Fall River Mills in northeastern California, where Big Valley receives the heaviest use. The number of cacklers using the Klamath Basin in spring have declined markedly, 29% and 52% for the months of March and April respectively, for the period 1975-80 compared with 1970-74 (McCollum 1980). The largest flock seen in the Klamath Basin in spring 1986 was about 6,500 at Klamath Wildlife Area in southern Oregon (Raveling et al. 1986). Since the mid-1980s, the number of cacklers migrating through northern California has continued to decline, along with decreasing use of the Klamath Basin. Modoc NWR in northeastern California and Klamath Basin Wildlife Area in Oregon are also used during the spring.

Cacklers begin leaving northeastern California between the first and third week of April (Raveling, Silveira and Zezulak, unpubl. data). Historic observations summarized by Timm (1982) indicated major movements of cacklers through the Klamath Basin and Willamette Valley at the end of April. Cackling geese disperse from Big Valley through April and major departures occur from late April to very early May. Some cacklers are believed to bypass northeastern California.

The majority of cacklers wintering in the Willamette Valley-Lower Columbia River region of Washington and Oregon begin their trip northward in late April. Subsequent sightings have been made on the coast of British Columbia and the Gulf of Alaska. Cacklers generally pass by the Copper River Delta enroute to Cook Inlet, although small flocks have been sighted there since the population expansion in the early 1990s (W.E. Eldridge, S. Babler, T.C. Rothe, pers. comm).

Based on timing of arrival in Alaska, most cacklers appear to travel directly to Cook Inlet, near Anchorage, appearing during the last week of April and peaking during the first 10 days of May. Annual variations in cackler abundance are related to snow cover and habitat availability on coastal marshes (Timm 1982; Loranger and Eldridge 1986; Butler and Gill 1985, 1987). The cackling Canada goose population appears to "roll through" the Cook Inlet region. That is, the entire population does not use the area at one time, but early migrants leave before others arrive, and some may bypass the area entirely (Butler and Gill 1987, Campbell and Rothe 1985). Repeated sightings of marked individuals are not common (Loranger and Eldridge 1986; Nysewander et al. 1986; Slater and Sharpe 1986), suggesting that individual birds use the area for short periods.

Small flocks of cacklers depart Cook Inlet overland through passes in the Alaska Range en route to the Yukon Delta. Substantial numbers of cacklers stop at Whitefish and Pike Lakes on the edge of the Y-K Delta plain, and on sandbars of the Yukon River

below Holy Cross before proceeding to their coastal nesting grounds (J. Morgart, M. Rearden, pers. comm.). Some cacklers reach the Bering Sea south of the Y-K Delta and follow the coast northward to the nesting grounds (C. Ely, pers. comm.).

IV. HABITAT USE AND MANAGEMENT

A. Alaska.

Cackling Canada geese depend on intertidal coastal marshes of Cook Inlet as a primary spring stopover to develop energy reserves for breeding (Raveling 1979a, b). Cacklers feed intensively, in association with snow geese, on the outer marsh zone, containing *Puccinellia* and *Triglochin*, as well as *Carex ramenskii* meadows of the inner marsh as they become available. During years of heavy snow cover in coastal marshes, cackling Canada geese make extensive use of pasture, grain stubble and other agricultural fields near Palmer, which are generally snow free early. Nearly all of the primary spring habitats in Cook Inlet are within protected state wildlife areas, including Palmer Hay Flats, Goose Bay, Susitna Flats, and Trading Bay State Game Refuges, and the Redoubt Bay Critical Habitat Area. Some cacklers also forage on grass fields within the Municipality of Anchorage.

Cackling geese prefer to nest in the extensive pond and meadow mosaic habitats of the outer Y-K Delta (Mickelson 1975; Ely et al. 1996). Nest densities are somewhat clumped, and most nests are established on small islands. During brood-rearing, cackler families utilize pond edges with *Carex mackenziei* and *C. subspathacea*, *Triglochin palustris*, and *Puccinellia phryganodes*. Cacklers also make extensive use of wet tundra and river/slough bank meadows of *C. ramenskii* and *C. rariflora* (Babcock and Ely 1994). These areas are maintained by grazing year-to-year (Sedinger and Raveling 1984, Sedinger 1988).

The intertidal marshes and coastal wetlands on the north side of the Alaska Peninsula are vital fall staging habitats where cackling geese add substantial body mass for migration. Cacklers feed intensively on pond shorelines with *Puccinellia* and *Triglochin*, as well as tide flats where *Puccinellia* and *Hippuris* dominate. Exposed intertidal bars are used extensively for roosting (Gill et al. 1986; Sedinger and Bollinger 1987). Most of the primary use area at Ugashik Bay is protected in the Pilot Point State Critical Habitat Area, and portions of cackler habitats are within Cinder River State Critical Habitat Area.

B. Washington and Oregon

Most cacklers currently winter in Oregon, and can be found throughout the Willamette Valley and along the lower Columbia River. Cacklers tend to shift southward in the Willamette Valley during late fall and early winter, and then move northward to the lower Columbia as winter progresses. Cacklers and other Canada geese make

extensive use of agricultural crops, including ryegrass and other grass seed production varieties in the Willamette Valley. Winter wheat, pasture (clover, alfalfa, perennial grasses), and specialty crops such as carrots are used in the lower Columbia River areas (Pacific Flyway Council 1998). Winter habitat use by cacklers in the Willamette Valley has not been studied in detail, but cacklers tend to feed in stubble fields (e.g. wheat, corn, barley, oats) after arrival and then shift to grass seed farms (e.g. perennial rye, fescue, annual rye) as the winter progresses (M. Naughton, pers. comm.). Permanent natural wetlands (e.g. rivers, lakes, and ponds), as well as temporary field sheetwater areas produced by abundant rainfall, provide important habitat components for geese throughout the wintering area.

Habitat Management and Public Use Objectives. The dramatic increase of all Canada geese in the region has resulted in increasing complaints of crop depredation on private lands. Geese are utilizing new areas and the growing number of cacklers is adding to concerns about increasing Taverner's, lesser, and western Canada geese. Goals, objectives and strategies for habitat management and public use have been identified in the NW Oregon/SW Washington Canada Goose Agricultural Depredation Control Plan (Pacific Flyway Council 1998). These goals, while focused on minimizing overall Canada goose depredation problems, offer opportunities for increased management for cackling Canada geese. This plan should be referenced for further details.

Wildlife refuges and wildlife areas are vitally important wintering areas for Canada geese. These areas provide considerable goose foraging habitat, and human activity (disturbance) is usually regulated. Goose habitat management efforts (dependent upon personnel and funding) are geared to maximize food production. Practices include creating, enhancing or restoring wetlands to provide natural (moist soil) vegetation, planting and flooding of managed areas, and providing agricultural crops and pastures. In addition, portions of these areas provide sanctuary from human disturbance.

Sanctuaries on public lands that provide food and roosting areas free from human disturbance are essential for successful Canada goose management and help alleviate depredation on private lands. Sanctuary benefits can be attained through a combination of spatial and temporal closures that are essentially or totally free from all human disturbances. Disturbance from hunting, vehicle and foot traffic, viewing, and management activities can change habitat use, behavior and food habits of geese.

Public access on federal refuges and state wildlife areas varies greatly. The type and level of regulated public use is determined by the compatibility of that activity with the goals and objectives of individual refuges and wildlife areas. Some of the major public uses of refuges and wildlife areas include hunting, fishing, bird watching, hiking, photography, dog training and environmental research and education.

Ten federal National Wildlife Refuges (NWR) (Willapa, Ankeny, Baskett Slough, Julia B. Hansen, Lewis and Clark, Ridgefield, Steigerwald Lake, Tualatin River, Wapato Lake and William L. Finley); three state of Oregon wildlife areas (E.E. Wilson, Fern Ridge and Sauvie Island); and two state of Washington wildlife areas (Shillapoo and Vancouver Lake) lie within the primary cackler wintering area in southwest Washington and northwest Oregon. Habitat management and public use programs are mandated by established policies and/or approved area management plans.

Federal Lands. The USFWS administers approximately 60,000 acres within SW Washington and NW Oregon; however, not all of this area is capable of providing habitat suitable for Canada goose management. The USFWS provides agricultural habitats on some of the refuges through cooperative farming agreements with local landowners.

Western Oregon NWR Complex (Ankeny, Baskett Slough, Tualatin River, Wapato Lake and William L. Finley). Ankeny, Baskett Slough and William L. Finley NWRs were initially established in the mid-1960's to provide wintering habitat for the dusky Canada goose. These three Willamette Valley refuges encompass approximately 10,613 acres, of which over 5,000 acres are farmed to provide winter food for geese (Appendix A). Under the cooperative farming program on Ankeny, Baskett Slough and Finley NWRs, farmers plant grass, pasture and grains and then harvest all of the grass seed. All of the forage provided by these crops is available to wintering waterfowl during the fall-spring period. The farmers harvest grass seed and hay from these areas during the summer, after the geese have migrated north to their breeding grounds. Cooperative farming agreements on other NWRs vary, but generally allow the farmer to remove a significant portion (75%) of the crop while leaving a small portion (25%) of the harvest behind for foraging geese. In recent years, these refuges also have been developing several hundred acres of moist soil units, which are heavily used by geese.

Wildlife observation, photography, hiking, hunting, interpretation and environmental education are the major public use activities on these refuges. Large portions of Ankeny, Baskett Slough and Finley NWRs are closed to public access when the geese arrive in the fall and remain closed until geese migrate out of the area in the spring. Refuge management and farming activities are also minimized during the winter to reduce disturbance to geese.

The Tualatin River and Wapato Lake NWRs are located in the north end of the Willamette Valley and currently total 913 acres, with an approved future boundary of 3,166 acres. Although small and largely undeveloped for refuge purposes, these two refuges could provide significant wintering goose habitat in future years.

Ridgefield NWR Complex (Ridgefield and Steigerwald Lake). This 5,149-acre refuge provides a wintering area for migratory waterfowl, especially dusky Canada geese. Farming on the refuge is through a cooperative farming program and limited cattle grazing occurs on the area. Steigerwald Lake NWR is a 900-acre winter waterfowl

area that provides approximately 150 acres of goose foraging habitat. No farming program exists for this refuge; public use is managed to protect waterfowl.

Major public use activities on Ridgefield NWR include waterfowl hunting, wildlife observation and photography and environmental education. Public entry onto the refuge varies by management units (River S, Roth, Bachelor and Bridgeport Dairy). Portions of the River S unit are closed to all public use from October 1 - April 15. The remaining portion is open to hunting only on waterfowl hunt days. The Bridgeport Dairy and Bachelor units are closed year-round to all public use, with the exception of vehicle use along the Lower River Road. Public use on Steigerwald Lake NWR is prohibited except for group tours conducted by refuge staff.

Lower Columbia River NWRs (Julia Butler Hansen and Lewis and Clark NWRs). The Julia Butler Hansen NWR encompasses approximately 5,516 acres. This refuge was established for the protection of the endangered Columbia white-tailed deer. The 38,214-acre Lewis and Clark NWR was established to provide habitat for migratory birds, primarily waterfowl. Currently, the farming and grazing programs on the two refuges are geared towards providing green forage for white-tailed deer and wintering waterfowl.

State Lands - Oregon: Sauvie Island Wildlife Area. Established in 1948 as a wintering waterfowl area, the Sauvie Island Wildlife Area is located at the confluence of the Columbia and Willamette Rivers. This 12,000-acre area is located 10 miles from downtown Portland and approximately 4,359 acres are currently available for goose food production.

Located so close to the Portland metropolitan area, the Sauvie Island Wildlife Area is very popular with the public for outdoor-related activities. Public access restrictions vary among management units, but generally call for areas to be closed to public access from October 1 through February 1. Beginning in 1999, closures were extended to April 15 in all units except the Columbia River beaches to improve goose use.

Fern Ridge Wildlife Area. Fern Ridge Wildlife Area is located adjacent to the Fern Ridge Reservoir near Eugene. This 5,103-acre area has approximately 150 acres of cropland that are annually planted and 450 acres of moist soil impoundments are actively managed for waterfowl forage. Seasonal restrictions (Nov. 1 - March 30) affect public access.

State Lands - Washington: Shillapoo and Vancouver Lake Wildlife Areas. Shillapoo and Vancouver Lake Wildlife Areas are located in Clark County in southwest Washington. The combined 1,549-acre area, established in 1952, extends along the Columbia River floodplain from the city of Vancouver to the mouth of the Lewis River. WDFW has recently been expanding these areas through an extensive acquisition program in the Vancouver Lowlands in cooperation with Bonneville Power

Administration (BPA) and the Washington Wildlife and Recreation Program. Approximately 880 acres of food crops and green forage are provided for wintering waterfowl through sharecropping agreements with local farmers. Like the Sauvie Island Wildlife Area, the Shillapoo and Vancouver Lake Wildlife Areas are very popular due to their proximity to the Portland metropolitan area.

C. California.

In current use areas in the Central Valley of California, cacklers feed primarily in agricultural fields (rice, corn, beans, wheat) and short grass uplands. Roosting occurs on seasonally flooded marshes and vernal pools on refuges and other shallow water habitats on private lands (seasonally flooded wetlands, flooded agricultural lands, stock ponds and vernal pools). The majority of suitable cackler habitat in California occurs on private lands. Key public and private lands for cacklers are shown in Appendix A).

Marsh management, the planting of some agricultural crops, prescribed burning, and livestock grazing, enhances habitat at some federal (e.g., Sacramento NWR and San Luis NWR complexes) and state-managed areas (e.g. Los Banos and Ash Creek Wildlife Areas). Land use practices on some private lands enhance cackling goose use (e.g., maintaining winter grazing areas, enhancing these areas by burning and fertilization). Some livestock ranches with annual grasslands, managed pastures, alkali meadows and vernal pools have been incorporated into state and federal refuges and easements, and management of these short-grass habitats as such continues.

V. HARVEST

Experience over the past 30 years has illustrated that harvest (adult mortality) is the most important factor regulating the size of the cackling Canada goose population. Excessive harvest from the 1960s to the 1980s throughout their range caused a serious population decline that necessitated 15 years of restoration effort. Beginning in 1984, the Pacific Flyway wildlife agencies, Alaska Natives, and other public interest groups have cooperatively developed flywaywide harvest guidelines and strategies in the Yukon-Kuskokwim Delta Goose Management Plan.

Given the importance of harvest management in regulating the cackling goose population, the Council has established the following harvest guidelines, in cooperation with resource users throughout the flyway:

A. Harvest Guidelines

1. Harvest strategies should allow the population to increase to a pre-season level of 250,000 geese, based on a 3-year moving average of the breeding population index. Thereafter, regulations should promote a stable population. The current harvest strategy is shown in Appendix H.

2. If the population index drops below objective levels after attaining the objective of 250,000, then necessary restrictions should be applied to regain the objective.
3. If the 3-year average population index drops below 80,000 geese (about 1/3 of the objective), all hunting should be suspended throughout the flyway.
4. After a closure and when the population increases above a 3-year average index of 110,000, limited hunting may be considered.

B. Estimation of Harvests and Survival Rates.

Harvests of cackling geese have been poorly measured in the flyway, although a variety of means has been used. There is little historic information on subsistence harvest of cacklers or other geese in western Alaska, and early harvest surveys suffered from inadequate sampling of the Y-K Delta region (Copp 1985).

Traditional state and federal harvest surveys of hunters have not provided information on the harvest of Canada geese by subspecies. Most historical data on the harvest of cacklers has come from analyses of band recoveries (Rienecker 1983; Raveling 1983) and numbers and trends of Canada geese classified at check stations on public hunting areas in California (Raveling 1984). Intensive harvest monitoring under special Canada goose restrictions in Washington and Oregon since 1984 has yielded increasingly valuable check station data on harvest of cacklers in their current primary winter range.

Recent analyses of Canada goose tail fans from the Waterfowl Parts Collection Survey (Drut and Trost 1999) indicate that cackling geese can be distinguished by tail feather measurements from other races of Canada geese in the Pacific Flyway with reasonable accuracy. Combined with the operational harvest survey, these data provide rough estimates of fall and winter cackler harvest in the flyway (Appendix I).

Raveling et al. (1992) estimated annual survival rates of cackling Canada geese at 81% from population and production data for the period 1985-86. This estimate was derived from an annual neck band re-observation rate of 61% and inference that neck band loss rates were approximately 25%. A large number of factors that could influence the accuracy and interpretation of these estimates are discussed by Raveling et al. (1992).

Annual and periodic survival rates from neckband observations have continued to be estimated (Drut and Trost 1999). Recent data do not suggest differences in survival rates between adult males and females, nor have annual differences been detected during the period 1990-1997. The average estimated survival rate for the 1990-97 period, as indexed by neckband observations, was 73%. If an annual neck band loss rate of 1.9%, measured from breeding ground recaptures (Schmutz et al. 1994), is applied to these estimates, average annual survival has been approximately 75%.

These recent survival estimates are significantly higher than those of the mid-1980s. When re-observation rates by Raveling et al. (1992) are adjusted for 2% neck band loss, survival rates may have been only 62%. However, numerous factors such as potential changes in neckband loss rates, differing observational efforts between the two studies, and the accuracy with which all of the parameters can be estimated make rigorous conclusions difficult at this time. This information is being further analyzed by the Pacific Flyway Representative and a final report will be completed during the period of this plan.

C. Alaska

Early efforts to monitor subsistence waterfowl harvests in western Alaska have provided only crude insights on the harvest of cackling geese. Klein (1966) reported that a total of about 83,000 geese were taken on the Y-K Delta during 1964, and that the spring harvest included about 20,000 Canada geese (all subspecies). By 1980, Copp and Smith (1981) estimated a spring harvest of only 6,100 cacklers. Systematic, stratified household surveys were initiated in sample villages in 1985 (Copp and Roy 1986). Results of these surveys from 1985 – 1997 are summarized by Wentworth and Seim (1996, 1998). Subsistence harvest of cacklers on the Y-K Delta averaged 7,845 birds from 1985 to 1997, with a peak harvest of nearly 15,000 in 1996 (Appendix J). About half of the Y-K Delta subsistence harvest occurs in spring. Supplemental village surveys of the Bristol Bay-Alaska Peninsula region have indicated harvests of 900 cacklers in 1996 and 1,100 cacklers in 1998 (Seim and Wentworth 1996, 1998).

Historically, the most significant fall harvest of cackling geese in Alaska has occurred on the Alaska Peninsula near Pilot Point (Ugashik Bay) and the Cinder River Delta. Although harvest was not recorded by subspecies, D.E. Timm (pers. comm.) estimated that 90% of an average 1,800 Canada geese taken from this area during 1974-1981 were cacklers. The Canada goose limit was reduced to 1 daily on the central Alaska Peninsula (Game Management Unit 9E) in 1982, and was changed to 2 daily in possession in Units 9E and 18 (Y-K Delta) in 1983. Canada goose hunting was closed in both units from 1984 through 1993, in accordance with the Y-K Delta Goose Management Plan. Hunting was re-opened in these units in 1994, with Canada goose limits of 1 daily / 1 in possession. Canada goose bag limits were increased to 3 daily / 6 in possession in 1998.

D. California

Historically, the distribution of band recoveries as an indicator of cackler harvest has shown that northeastern California, Sacramento Valley and San Joaquin Valley accounted for about 81% of recoveries from in-season banding at Tule Lake (Rienecker 1983). Nelson and Hansen (1959) estimated that 75.3% of recoveries of birds banded on the Y-K Delta during 1949-57 occurred in California. Distribution of band recoveries in California changed significantly after the 1950s, most noticeably

reductions in northeastern California and increases in Sacramento Valley (Rienecker 1983).

In 1975, cackling, lesser (*B.c. parvipes*) and western (Pacific and Rocky Mountain, *B.c. moffitti*) Canada geese became unintentional beneficiaries of zone closures in the Sacramento and San Joaquin Valleys that were established to protect endangered Aleutian Canada geese (*B.c. leucopareia*). During 1965-74, when no special regulations were employed, average annual harvest at public hunting areas (state and federal) in California was about 5,000 cacklers (Appendix K). During 1975-78, when Aleutian goose closures were in effect, average annual harvest on public hunting areas dropped 39% and declined by 78% in the Central Valley, to less than 500 cacklers (Raveling 1984, Pamplin 1986).

In 1979, additional restrictions were imposed on the taking of cacklers and white-fronted geese (*Anser albifrons frontalis*) in the Northeastern and Balance-of-State zones in California. Cackler harvest in the Klamath Basin declined by 51% between the periods 1970-78 and 1979-82 (Raveling 1984).

In response to growing concern and development of the Y-K Delta Goose Plan, California instituted an emergency closure on all Canada geese for the end of the 1983-84 season. A flywaywide closure on the take of cackling geese was implemented in the 1984-85 hunting season, resulting in a reduction of apparent mortality by 31% during early winter (Raveling et al. 1986). Some incidental/illegal harvest did occur, over 200 in initial years of the closure, but declining afterward. A total of 43 band recoveries were recorded during the period of closure, 34 (80%) from the Klamath Basin of California, suggesting that cacklers still exhibited their historical fall-winter distribution during most of this period. Since limited seasons were re-instituted in 1994, only 8 band recoveries have been reported. At the present time, the small number of recoveries has little utility in assessing harvest in California.

E. Washington and Oregon

Canada goose hunting seasons have been dramatically restricted in southwest Washington and northwest Oregon since 1985 to protect dusky Canada geese (*B.c. occidentalis*). Since that time all hunters have been required to receive training on goose identification, including differentiation of dusky, cackling, Taverner's, lesser, western, Vancouver (*B.c. fulva*), and Aleutian Canada geese. In 1996, hunters in Washington were required to pass a goose identification test to obtain a permit, which is revoked if a dusky Canada goose is taken or the hunter fails to follow check-in procedures. During the 1987-89 seasons, the permit was also revoked for taking a cackler. Current regulations require that all Canada geese must be brought to check stations, where culmen, total tarsus, age, sex, and breast color measurements are taken. Seasons are closed in designated hunt areas if dusky goose harvest quotas are exceeded.

Canada goose season length in southwest Washington was 93 days prior to the 1984 flywaywide closure on cackling geese, and few cacklers were harvested. Since that time, the regular season has ranged from 2-40 days between November and late January, with season length determined by attainment of dusky Canada goose quotas. The cackler season was reopened in Washington in 1994, with a daily/possession limit of 1/2 in southwest Washington, and 3/6 or 4/8 as part of the general goose bag elsewhere in the state. Beginning in 1995, the cackler limits in southwest Washington were increased to 2/4, and a special late agricultural damage hunt was added during February and March of 1996. Cackler bag limits were raised to 4/8 in 1998 in this zone. Cackler harvest has increased annually since 1994 and now comprises 28% of the region's Canada goose bag. During regular and late winter seasons, cackler harvest was 320 in 1995-96, 1027 in 1996-97, and 1311 in 1997-98 (Appendix L).

In Oregon, restrictions on cacklers and white-fronts were implemented in Lake and Klamath Counties in 1979. Since 1984, Canada goose seasons in northwest Oregon have mirrored those in southwest Washington. During cackling Canada goose closures 1984-93, small numbers of cacklers were recorded at check stations. In 1994, cackler season was reopened in Oregon and harvest increased to 1,220. As in Washington, Oregon's cackler harvest has increased each year: 1758 in 1995, 2503 in 1996, 3113 in 1997, and 5641 in 1998 (Appendix M). In 1998, cacklers comprised over 49% of Canada geese taken in northwest Oregon. No restrictions currently apply to cacklers in the overall Oregon bag limits. As the number of wintering cacklers increases in Oregon, they are purposefully targeted because they are easier for hunters to identify.

VI. NON-CONSUMPTIVE USE

Canada geese are objects of public interest wherever they occur, and cacklers are of interest to the public because of their diminutive size, gregarious behavior, and local abundance. Non-consumptive use of California State waterfowl areas estimated by Calliga (1983) increased from 53,966 visits in 1973-74 to 149,753 in 1981-82. Total non-consumptive use at Sacramento NWR complex, alone, in 1997 was 63,316 visits (D. Dachner, Sacramento NWR, pers. comm.). Public use of many other wildlife areas to watch waterfowl is extensive, but visitation data are not routinely compiled.

VII. CURRENT MANAGEMENT PROCEDURES

The following procedures are currently being used for management of cackling geese at the flyway, state or local levels:

A. Production Assessments

1. Nest plots on the Y-K Delta breeding grounds.

2. Age ratios of geese in the harvest from check station data.
3. Tail-fan collection of all Canada geese from federal Waterfowl Parts Collection Survey.

B. Population Size and Distribution

1. Yukon-Kuskokwim Delta aerial breeding goose survey.
2. Neck-collar marking of birds on Y-K Delta; resighting WA, OR, CA.
3. North American Breeding Pair Survey.
4. Trends in nesting densities on Y-K Delta study plots.
5. Annual Dark Goose Inventory in November.
6. Mid-winter inventories.

C. Mortality Estimates and Regulations

1. Federal and State harvest HIP surveys.
2. Subspecies composition from tail fans in Parts Collection Survey
3. Federal and State monitoring of harvest at check stations and on public hunting areas.
4. Survival rate information from mark-resighting of neck collars.
5. Subsistence harvest surveys on the Y-K Delta.
6. Monitoring of losses to diseases and investigation of ways to reduce losses.
7. Establishment and enforcement of hunting seasons and bag limits.
8. Zoning of areas within states to obtain goose harvest objectives.
9. Y-K Delta Goose Management Plan.

D. Habitat Management

1. Special protection for habitat and wildlife is afforded by designation and

- active management of state and federal refuges and management areas, and through cooperative agreements with various land managers. Areas important to cackling geese are presented in Appendix A.
2. Various federal and state laws provide special protection through use permits and coastal zone planning for lands important to cackling geese.
 3. Marsh restoration and management, prescribed burning, grazing and cropping enhance habitat on some federal refuges and state managed areas. Land use practices, such as grazing, and production of small cereal grains and grass seed crops on some private lands enhance cackling goose use.
 4. Federal, state, and non-governmental programs, such as the Wetland Reserve Program, provide incentives on private lands to retain wetland habitat on wintering areas. These are delivered through a variety of approaches, from acquisition of easements to technical assistance and cooperative management. Legislative passage of the Central Valley Project Improvement Act has increased dependability and amount of water supplies for habitat management on federal, state and private lands in California.

VIII. PROBLEMS

- A. The cackling Canada goose population is below the objective of 250,000.
- B. Rapid increase in sympatric nesting white-fronted geese may be creating interspecific competition, degradation of cackler habitats, and reduced gosling growth rates.
- C. Cackling Canada geese wintered mainly in California prior to the 1990's, but as the population recovered, most cackling geese began wintering in southwest Washington and western Oregon. There are no apparent feasible methods to affect winter redistribution of the population.
- D. With increasing Canada goose numbers in southwest Washington and western Oregon, complaints of crop depredation have increased significantly.
- E. There is insufficient goose habitat on public lands in Washington and Oregon to ameliorate conflicts with agricultural interests and provide for long-term winter habitat needs.
- F. Increasing human activity on the Y-K Delta has potential for significant increases in disturbance during the critical nesting and brood-rearing period. Increasing human disturbance may adversely affect these geese throughout their range.

- G. During years of drought on the California wintering grounds, foraging habitat becomes limited.
- H. Concentration of geese, particularly during droughts in California, may lead to mortality from fowl cholera and other diseases.
- I. Habitat conversion and management changes are adversely affecting the quantity and distribution of foraging habitat. Loss of wintering habitat in Washington and Oregon concentrates geese on remaining lands, increasing depredation concerns.
- J. Current total harvest of cackling geese is estimated to be at or above levels required to meet objectives for average annual growth of 5-10%.
- K. Operational harvest survey programs provide only crude estimates of Canada goose harvest by subspecies. Data from the various state and federal surveys provide inconsistent results.
- L. Estimates of subsistence harvest are lacking from some areas, particularly areas other than the Y-K Delta.
- M. Hunting area closures in California to protect Aleutian Canada geese and constraints on hunting in southwest Washington and Oregon to protect dusky Canada geese have complicated harvest management.

IX. RECOMMENDED MANAGEMENT PROCEDURES

The following management procedures are recommended even though the degree and timing of their implementation by the agencies involved will be influenced by fiscal and legislative constraints. Whenever possible, management procedures in this plan should be coordinated with and incorporated into those recommended in other management plans, including the Northwest Oregon/Southwest Washington Canada Goose Agricultural Depredation Control Plan (Pacific Flyway Council 1998).

A. Habitat

1. Winter Habitat Protection: Identify preferred cackling goose use areas not currently being protected and determine desirability and feasibility of protecting those areas through fee title acquisition or easement programs. Priority areas include preservation of cackler habitats in areas of the Willamette and Columbia River floodplains in Oregon and Washington and in the East Grasslands of California.

Lead Agency: **USFWS, ODFW, WDFW, and CDFG**
 Participating: Central Valley, Pacific Coast, Intermountain West JVs
 Priority: 1

Schedule: Ongoing

2. Winter Habitat Management: Encourage beneficial land use and management practices on public lands and cooperatively managed private lands in wintering areas. In Washington and Oregon, implement habitat management recommendations of the Northwest Oregon/Southwest Washington Canada Goose Agricultural Depredation Control Plan (Pacific Flyway Council 1998).

Lead Agency: **USFWS, ODFW, WDFW, and CDFG**
Participating:
Priority: 1
Schedule: Ongoing

3. Winter Habitat Needs Assessment: Quantify the kinds and quality of habitats to meet the nutritional requirements of cackling geese during winter. In Washington and Oregon, conduct assessments needed to implement the Northwest Oregon/Southwest Washington Canada Goose Agricultural Depredation Control Plan (Pacific Flyway Council 1998).

Lead Agency: USFWS
Participating:
Priority: 1
Schedule: Ongoing

B. Population Inventory and Management

1. Population Monitoring: Conduct the annual Y-K Delta aerial breeding population survey as the annual management index for the population.

Lead Agency: USFWS – Region 7
Participating:
Priority: 1
Schedule: Ongoing

2. Marking-Observing Programs: Maintain and improve distribution of banding and marking of cackling geese on the Y-K Delta to support development of indirect population estimates, survival rates and distribution information. Efforts to acquire sufficient observations of marked birds throughout their winter range is an essential aspect of this program.

Lead Agency: USFWS
Participating: USGS-BRD, ADFG, CDFG, ODFW, WDFW
Priority: 1
Schedule: Ongoing

3. Breeding ground nest plot survey: Continue the random nest plot survey on the Y-K Delta to monitor density and distribution of breeding birds, develop air-

ground comparison data, and monitor annual production.

Lead Agency: USFWS
Participating: USGS-BRD
Priority: 2
Schedule: Ongoing

4. Fall and winter surveys: Continue annual coordinated fall surveys for dark geese and the Pacific Flyway Midwinter survey to monitor seasonal distribution.

Lead Agency: USFWS
Participating: CDFG, ODFW, WDFW
Priority: 3
Schedule: Ongoing

C. Harvest Management

1. Harvest Strategy: Maintain a rangewide cooperative harvest strategy for cackling Canada geese (Appendix H). The strategy will be reviewed and revised biannually (1999-2001 and 2001-2003) and coordinated with review and revision of the Y-K Delta Goose Management Plan.

Lead Agency: Study Committee, Association of Village Council Presidents – Waterfowl Conservation Committee
Participating: USFWS
Priority: 1
Schedule: Ongoing

2. Fall/winter Harvest Surveys: Continue operational harvest surveys, including mail surveys, parts collection and state and federal check stations to provide more accurate estimates of magnitude and distribution of sport harvest.

Lead Agency: USFWS, States
Participating:
Priority: 1
Schedule: Ongoing

3. Subsistence Harvest Surveys: Continue village harvest surveys in Alaska to estimate seasonal subsistence harvest on breeding and staging areas.

Lead Agency: USFWS
Participating: ADFG
Priority: 1
Schedule: Ongoing

4. Migratory Bird Treaty Implementation: Participate in establishing a cooperative system to increase involvement of subsistence hunters in migratory bird management and create regulations for spring hunting in Alaska. Assist in

designing a regulatory process for subsistence regulations that includes development of proposals within Alaska, coordination and review by the Flyway Council, and integration with national harvest management.

Lead Agency: USFWS
Participating: Study Committee and Council
Priority: 1
Schedule: Ongoing

D. Crop Depredation Control

Due to expanding regional goose populations in southwest Washington and northwest Oregon, crop depredation control is a major management concern. This issue affects numerous landowners and involves populations of seven subspecies of Canada geese wintering in the region. Activities to manage agricultural depredation issues involving cackling Canada geese in Washington and Oregon will be guided by the Northwest Oregon/Southwest Washington Canada Goose Agricultural Depredation Control Plan (Pacific Flyway Council 1998).

Lead Agencies: USFWS, ODFW, WDFW
Participating: USDA-WS, Farm Bureaus, ADFG, AVCP
Priority: 1
Schedule: Ongoing

E. Research and Education

1. Population Survey Assessment: Continue evaluation of the relation of the number of indicated breeding pairs and total number of cackling Canada geese on breeding ground aerial surveys.

Lead Agency: USFWS
Participating:
Priority: 2
Schedule: Ongoing

2. Reconcile methods for estimating harvest: Resolve discrepancies between results of harvest surveys, including mail questionnaire and parts collection data, hunter check station data, and band recovery information.

Lead Agency: USFWS, USGS-BRD
Participating: ADFG, WDFW, ODFW, CDFG
Priority: 2
Schedule: by 2004

3. Methods for Winter Redistribution: Determine effective and efficient means to re-distribute cackling geese on their wintering grounds.

Lead Agency: USGS-BRD
Participating: USFWS, ODFW, WDFW, CDFG
Priority: 2
Schedule: by 2004

4. Evaluation of Disturbance: Evaluate the impacts of human disturbance on population behavior and distribution of cackling Canada geese throughout their range.

Lead Agency: USGS-BRD
Participating: USFWS
Priority: 3
Schedule: 2004

5. Disease Mortality: Continue investigation of factors contributing to mortality from disease, including fowl cholera and botulism.

Lead Agency: USGS-BRD
Participating: CDFG
Priority: 3
Schedule: 2004

6. Education: Continue education programs to facilitate dissemination of population information, basic biological concepts on migratory waterfowl, and management program with sportsmen and Alaska Native groups to foster support and understanding among user groups. Coordinate with objectives of the Northwest Oregon/Southwest Washington Canada Goose Agricultural Depredation Control Plan (Pacific Flyway Council 1998).

Lead Agency: USFWS
Participating: ADFG, CDFG, ODFW, WDFW
Cooperating: AVCP
Priority: 1
Schedule: Ongoing

F. Plan Implementation and Review

1. Cackling Canada Goose Subcommittee. The Subcommittee shall meet twice annually or as needed to review progress toward achieving the goal and objectives of this plan and to recommend actions and revisions. The Subcommittee shall report to the Pacific Flyway Council, through the Pacific Flyway Study Committee, on accomplishments and shortcomings of management efforts, and shall share its findings with parties responsible for or interested in cackling Canada geese. This Subcommittee shall coordinate management activities with those for Lesser/ Taverner's, Pacific Population of Western, Rocky Mountain Population and Aleutian Canada Geese. The Subcommittee shall be comprised of one representative from each federal

and state agency having management responsibility for this population. It shall be the responsibility of those members to assure that the objectives and procedures of this plan are integrated and coordinated with those plans and activities of the various wildlife and land management agencies and local planning systems within their agency's purview. Chairmanship shall be appointed biannually and rotated among member agencies. The Subcommittee may invite *ex officio* participation by individuals, groups, and agencies whose expertise, counsel or managerial capacity is required for the coordination and implementation of management programs.

Lead Group: Subcommittee
Priority: 1
Meetings: Twice annually, at the March and July meetings of the Pacific Flyway Study Committee.

Schedule for rotation of the chair, beginning October 1:

1998 - Alaska
2000 - California
2002 - USFWS Region 1
2004 - Washington
2006 – Oregon
2008 – USFWS Region 7

2. AVCP Waterfowl Conservation Committee: Continued coordination with this Committee will benefit cackling geese and other Y-K Delta goose populations through cooperative management planning, information exchange, and implementation of conservation measures in the Yukon-Kuskokwim Delta Goose Management Plan.

Lead Agency: AVCP
Participating: USFWS, ADFG, WDFW, ODFW, CDFG
Priority: 1
Schedule: Ongoing

X. ACKNOWLEDGEMENTS

The Cackling Canada Goose Subcommittee appreciates the efforts of previous subcommittee chairs, agency personnel, and cooperators who have promoted development of this much belated revision of the 1986 plan. Most recently, Russ Oates and Tim Bowman of USFWS in Anchorage invested great energy to add current biological information and edit historical material for a working draft. Bob Stehn, also of USFWS in Anchorage, produced a valuable compendium and analysis of population indices that illustrates the value of survey improvements in the flyway. Bob Trost, Pacific Flyway Representative, summarized important data sets on population indices, harvest estimation, and the neck band observation program. The subcommittee hopes that readers of this plan will appreciate the advances in knowledge about the cackler resulting from intensive research programs and improvements in management procedures since 1986.

The subcommittee especially acknowledges the commitment of leaders, present and departed, who strove to understand the cackling goose and its problems, fought for conservation action, and arduously built unprecedented cooperation throughout the flyway to restore the population. The subcommittee and agencies of the Pacific Flyway deeply appreciate the energy and sacrifices of hunters, landowners, conservationists of all types, biologists and administrators who helped bring the cackling Canada goose back from the edge of disaster.

XI. LITERATURE CITED

- Babcock, C.A. and C.R. Ely. 1994. Classification of vegetation communities in which geese rear broods on the Yukon-Kuskokwim Delta, Alaska. *Can. J. Bot.* 72: 1294-1301.
- Bellrose, F.C. 1980. Ducks, geese, and swans of North America. Stackpole Books, Harrisburg, PA. 540pp.
- Bollinger, K.S. and J.S. Sedinger. 1985. Cackling Canada geese on the Ugashik Bay Peninsula, Alaska during fall staging/migration - 1984. Unpubl. Rept. U.S. Fish and Wildl. Serv., Anchorage. 37pp.
- Bowman, T.D., R. A. Stehn, and G. Walters. 1999. Population size and production of geese and eiders nesting on the Yukon-Kuskokwim Delta, Alaska in 1999. Unpubl. Rept. U.S. Fish and Wildl. Serv., Anchorage. 18pp.
- _____, R. A. Stehn, and K. T. Scribner. 1997. Glaucous gull predation of goslings on the Yukon-Kuskokwim Delta, Alaska. Unpubl. Rept. U.S. Fish and Wildl. Serv., Migr. Bird Mgmt., Anchorage. 59 pp.
- Butler, W.I., Jr., and R. E. Gill. 1985. Spring 1985 aerial surveys of geese and swans staging in upper Cook Inlet. Unpubl. Rept., U.S. Fish and Wildl. Serv., Anchorage, AK. 13pp. + appendices.
- _____ and _____. 1987. Spring 1986 aerial surveys of geese and swans staging in upper Cook Inlet. Unpubl. Rept., U.S. Fish and Wildl. Serv., Anchorage, AK. 20pp.
- _____, R. Stehn and W.D. Eldridge. 1988. Development of an aerial breeding pair survey for geese nesting in the coastal zone of the Yukon Delta. Unpubl. Prog. Rept. U.S. Fish and Wildl. Serv., Anchorage. 19pp.
- _____, _____ and G.R. Balogh. 1995a. GIS for mapping waterfowl density and distribution from aerial surveys. *Wildl. Soc. Bull.* 23: 140-147.
- _____, J.I. Hodges and R. Stehn. 1995b. Locating waterfowl observations on aerial surveys. *Wildl. Soc. Bull.* 23: 148-154.
- Calliga, L. 1983. A summary of public recreation use of State-owned or operated areas. Unpubl. Rept. Calif. Dept. of Fish and Game, Sacramento.

- Campbell, B.H., and T. C. Rothe. 1985. Annual report of survey-inventory activities, Part XIII. Waterfowl. Fed. Aid in Wildl. Restoration Proj. W-22-3, Job 11.0. Alaska Dept. Fish and Game, Juneau. 31pp.
- Conant, T.B. and J.I. Hodges. 1986. Alaska-Yukon Waterfowl breeding population survey, May 14-June 13, 1986. Unpubl. Rept. U.S. Fish and Wildl. Serv., Juneau. 23 pp.
- Copp, J.D. 1985. Critique and analysis of Eskimo waterfowl hunter surveys conducted by the U.S. Fish and Wildlife Service in the Yukon-Kuskokwim Delta, Alaska. Unpubl. Rept. Oregon State Univ., Corvallis. 69pp. + appendices.
- _____ and M. Smith. 1981. A preliminary analysis of the spring take of migratory waterfowl by Yup'ik eskimos on the Yukon-Kuskokwim Delta, Alaska. Unpubl. Rept. U.S. Fish and Wildl. Serv., Bethel. 53pp.
- _____ and G.M. Roy. 1986. Annual Report in the 1985 Yukon Delta waterfowl hunting survey. Unpubl. Rept. Oregon State Univ., Corvallis. 47pp. + appendices.
- Dau, C.P. and P.G. Mickelson. 1979. Relation of weather to spring migration and nesting of cackling geese on the Yukon-Kuskokwim Delta, Alaska. Pages 94-104 *in* R.L. Jarvis and J.C. Bartonek (eds). Management and biology of Pacific Flyway geese. OSU Bookstores, Inc. Corvallis, OR.
- Drut, M.S. and R.E. Trost. 1999. Annual summary of goose population monitoring programs in the Pacific Flyway, 1998-99. Unpubl. Rept. U.S. Fish and Wildl. Serv., Office of Migr. Bird Mgmt., Portland, OR. 51pp.
- Eldridge, W.E. and W.I. Butler, Jr. 1996. Report to the Pacific Flyway Committee and Waterfowl Conservation Committee on the 1985-1996 breeding ground surveys of geese, swans and sandhill cranes in the coastal zone, Yukon-Kuskokwim Delta, Alaska. Memo to Migratory Bird Coordinator, 17 July 1996. U.S. Fish and Wildl. Serv., Anchorage, AK.
- Ely, C.R., A.C. Fowler, T. DeMaria, M. Brice and K. Steger. 1996. Nesting ecology of geese along the Kashunuk River, Yukon-Kuskokwim Delta, Alaska. Unpubl. Rept. Nat. Biol. Survey, Alaska Science Ctr., Anchorage.
- Gabrielson, I.N. and F.C. Lincoln. 1959. The birds of Alaska. Stackpole Books, Harrisburg, PA. 922pp.
- Gill, R. E., Jr., K.S. Bollinger, and M.R. Petersen. 1986. Timing, numbers, and habitat requirements of cackling Canada geese staging along the Alaska Peninsula in fall. Unpubl. Rept. U.S. Fish and Wildl. Serv., Anchorage. 51pp.

- _____, C. A. Babcock, C. M. Handel, W. I. Butler, Jr., and D. G. Raveling. 1997. Migration, fidelity, and use of autumn staging grounds in Alaska by cackling Canada geese *Branta canadensis minima*. *Wildfowl* 47:43-61.
- Johnson, D.H., D.E. Timm and P.F. Springer. 1979. Morphological characteristics of Canada geese in the Pacific Flyway. Pages 56-80 in R.L. Jarvis and J.C. Bartonek (eds). *Management and biology of Pacific Flyway geese*. OSU Bookstores, Inc. Corvallis, OR.
- Johnson, J.C. and D.G. Raveling. 1983. Distribution and abundance of cackling geese during winter 1982-83. Unpubl. Prog. Rept. to Calif. Dept. of Fish and Game and U.S. Fish and Wildl. Serv. Univ. of Calif., Davis.
- _____ and _____. 1984. Distribution and abundance of cackling geese during winter 1983-84. Unpubl. Prog. Rept. to Calif. Dept. Fish and Game and U.S. Fish and Wildl. Serv. Univ. Calif., Davis. 18 pp.
- King, J.G. and C.S. Lensink. 1971. An evaluation of Alaskan habitat for migratory birds. Unpubl. Rept. Bur. Sport, Fish and Wildl., Anchorage. 46 pp.
- _____ and B. Conant. 1983. Alaska-Yukon waterfowl breeding pair survey, May 16 to June 11, 1983. Unpubl. Rept. U.S. Fish and Wildl. Serv., Juneau. 23pp.
- _____ and D.V. Derksen. 1986. Alaska goose populations: past, present and future. *Trans. N. Amer. Wildl. Nat. Resour. Conf.* 51: 464-479.
- Klein, D.R. 1966. Waterfowl in the economy of the Eskimo on the Yukon-Kuskokwim Delta, Alaska. *Arctic* 19 (4): 319-336.
- Loranger, A., and W.E. Eldridge. 1986. Spring goose migration survey 1985, Redoubt Bay, Alaska. Unpubl. Rept. U.S. Fish and Wildl. Serv., Anchorage. 22pp.
- McCollum, H. 1980. Recent changes in waterfowl use in the Klamath Basin. Unpubl. Rept. U.S. Fish and Wildl. Serv., Klamath Basin Nat'l. Wildl. Refuge.
- Mickelson, P.G. 1975. Breeding biology of cackling geese and associated species on the Yukon-Kuskokwim Delta, Alaska. *Wildl. Monogr.* 45. 35pp.
- Morgan, R.P., S.T. Sulkin, and C.J. Henny. 1977. Serum proteins of Canada goose (*Branta canadensis*) subspecies. *Condor* 79: 275-278.
- Nelson, E.W. 1887. Report upon natural history collections made in Alaska between the years 1871 and 1877. *Arctic Ser. No. III*. U.S. Army Signal Serv., Washington, D.C. 337pp.

- Nelson, U.D. and H.A. Hansen. 1959. The cackling goose, its migration and management. *Trans. N. Amer. Wildl. and Nat. Resour. Conf.* 24:174-186.
- Nysewander, D.R., A.R. Sows, and W.E. Eldridge. 1986. Trip report: spring goose migration, Montana Bill Creek field camp, 1986. Unpubl. Rept. U.S. Fish and Wildl. Ser., Anchorage, AK. 16pp.
- O'Neill, E.J. 1979. Fourteen years of goose populations and trends at Klamath Basin Refuges. Pages 316-321 *in* R.L. Jarvis and J.C. Bartonek (eds). *Management and biology of Pacific Flyway geese.* OSU Bookstores, Inc. Corvallis, OR.
- Pacific Flyway Council. 1998. Northwest Oregon/Southwest Washington Canada goose agricultural depredation control plan. Unpubl. Rept. c/o USFWS Pac. Flyway Representative, Portland, OR. 33pp. + appendices.
- Palmer, R. S., Ed. 1976. *Handbook of North American birds, Vol. 2. Waterfowl (Pt. 1).* Yale Univ. Press, New Haven, CT. 520 pp.
- Pamplin, W.L., Jr. 1986. Cooperative efforts to halt population declines of geese nesting on Alaska's Yukon-Kuskokwim Delta. *Trans. N. Amer. Wildl. Nat. Resour. Conf.* 51: 487-506.
- Raveling, D.G. 1978. The timing of egg laying by northern geese. *Auk* 95: 294-303.
- _____. 1979a. The annual cycle of body composition of Canada geese with special reference to control of reproduction. *Auk* 96: 234-252.
- _____. 1979b. The annual energy cycle of the cackling Canada goose. Pages 81-93 *in* R.L. Jarvis and J.C. Bartonek (eds). *Management and biology of Pacific Flyway geese.* OSU Bookstores, Inc. Corvallis, OR.
- _____. 1983. An analysis of the decline of the cackling goose (*Branta canadensis minima*) population based on banding data. Unpubl. Rept. to Calif. Dept. of Fish and Game, Sacramento. Univ. of Calif., Davis.
- _____. 1984. Geese and hunters of Alaska's Yukon Delta: management problems and political dilemmas. *Trans. N. Amer. Wildl. and Nat. Resour. Conf.* 49: 555-575.
- _____, T.W. Aldrich, J.G. Silveira and J.C. Johnson. 1985. Distribution and abundance of cackling geese during winters 1982-83 through 1984-85 and their survival during 1982-83 and 1983-84. Prog. rept. to U.S. Fish and Wildl. Serv., Anchorage and Calif. Dept. Fish and Game. Univ. of Calif., Davis. 40pp.

- _____, D.S. Zezulak and J.G. Silveira. 1986. Distribution and abundance of cackling geese during winter 1985-86 and comparisons to 1982-83, 1983-84 and 1984-85. Prog. rept. to U.S. Fish and Wildl. Serv., Anchorage and Calif. Dept. of Fish and Game. Univ. of Calif., Davis. 61 pp.
- _____ and D.S. Zezulak. 1988. Distribution, abundance and survival of cackling geese, 1982-1987. Unpubl. Prog. Rept. to U.S. Fish and Wildl. Serv., Anchorage and Calif. Dept. of Fish and Game. Univ. of Calif., Davis.
- _____, J. D. Nichols, J. E. Hines, D. S. Zezulak, J. G. Silveira, J. C. Johnson, T. W. Aldrich, and J. A. Weldon. 1992. Survival of cackling Canada geese, 1982-1988. J. Wildl. Manage. 56:63-73.
- Rienecker, W.C. 1983. Cackling goose band recovery trends, 1952-1979. Unpubl. Rept. Calif. Dept. of Fish and Game, Sacramento.
- Sedinger, J.S. 1988. Foraging behavior of cackling Canada goose goslings: implications for the roles of food availability and processing rate. Oecologia 75: 119-124.
- _____ and K.S. Bollinger. 1987. Autumn staging of cackling Canada geese on the Alaska Peninsula. Wildfowl 38: 13-18.
- _____ and D.G. Raveling. 1984. Dietary selectivity in relation to availability and quality of food for goslings of cackling Canada geese. Auk 101: 295-306.
- Schmutz, J.A., S.E. Cantor, and M.R. Petersen. 1994. Seasonal and annual survival of emperor geese. J. Wildl. Manage. 58(3): 525-535.
- Seim, S. and C. Wentworth. 1996. Subsistence migratory bird harvest survey, Bristol Bay, 1995. Unpubl. Rept. U.S. Fish and Wildl. Serv., Anchorage. 57pp.
- _____ and _____. 1998. Subsistence migratory bird harvest survey, Bristol Bay, 1997. Unpubl. Rept. U.S. Fish and Wildl. Serv., Anchorage.
- Shields, G.F. 1994. Phylogenies of North American geese: the mitochondrial DNA record. *In* Biology and management of Canada geese: Proc. 2nd Internat. Canada Goose Symp. (In press).
- _____ and A.C. Wilson. 1987. Subspecies of the Canada goose (*Branta canadensis*) have distinct mitochondrial DNAs. Evolution 41:662-666.
- Slater, L., and E. A. Sharpe. 1986. Spring goose migration survey, Trading Bay, Alaska, 1986. Unpubl. Rept. U.S. Fish and Wildl. Serv., Anchorage. 29pp.

- Spencer, D.L., U.C. Nelson and W.A. Elkins. 1951. America's greatest goose-brant nesting area. Trans. N. Am. Wildl. Conf. 16: 290-295.
- Stehn, R. 1986. Nesting success of geese in the coastal tundra region of the Yukon-Kuskokwim Delta. Unpubl. Final Rept. U.S. Fish and Wildl. Serv., Alaska Office of Fish and Wildl. Res., Anchorage.
- _____. 1998. Breeding ground surveys for monitoring cackling Canada geese. Unpubl. Rept. U.S. Fish and Wildl. Serv., Anchorage. 30pp.
- Timm, D.E. 1982. Some observations of spring migratory waterfowl during 1982. Unpubl. Rept. Alaska Dept. of Fish and Game, Anchorage.
- Trost, R.E. 1997. 1997 Pacific Flyway data book. Unpubl. Rept. U.S. Fish and Wildl. Serv., Office of Migr. Bird Mgmt., Portland, OR. 101pp.
- _____ and L.K. Harb. 1995. Observations of neckbanded cackling Canada geese - progress report - July 1995. Unpubl. Rept. U.S. Fish and Wildl. Serv., Office of Migr. Bird Mgmt., Arlington, VA.
- Van Wagner, C.E. and A.J. Baker. 1986. Genetic differentiation in populations of Canada geese (*Brant canadensis*). Can. J. Zool. 64: 940-947.
- Wentworth, C. and S. G. Seim. 1996. Subsistence waterfowl harvest survey, Yukon-Kuskokwim Delta: comprehensive report 1985-1995. Unpubl. Rept. U.S. Fish and Wildl. Serv., Anchorage. 236pp.
- _____ and _____. 1998. Subsistence waterfowl harvest survey, Yukon-Kuskokwim Delta: comprehensive report 1987-1997. Unpubl. Rept. U.S. Fish and Wildl. Serv., Anchorage. 176 pp.

APPENDIX A. Important use areas for cackling Canada geese throughout their range.

AREA	TYPE OF USE	OCCURRENCE OF CACKLERS	HABITAT CONDITION AND THREATS
Alaska			
Yukon-Kuskokwim Delta	Nesting, molting, staging	95+% of population	Federal refuge with private inholdings. Conflicting land uses around communities and human activity may impact nesting areas.
Nunivak Island	Molting, fall staging	Several thousand	Federal refuge; some private lands. Reindeer grazing may affect habitat.
Ugashik Bay/Cinder Lagoon areas	Fall staging	Nearly entire population	Major portions designated by State Critical Habitat Areas. However, only about a third of geese recorded at these areas occur on protected upland/tundra. Use of unprotected areas may become increasingly important if the population continues to increase.
Redoubt and Trading Bays	spring migration	10,000 +	Trading Bay is a state game refuge and Redoubt Bay is a State Critical Habitat Area. Offshore and onshore oil and gas production, Cook Inlet tanker traffic, and human activity pose threats.
Susitna Flats	Spring migration	Several thousand	Designated as a state game refuge. Oil and gas production and human activity pose threats.
Copper/Bering River Deltas, Prince William Sound	Spring migration	Widely scattered	Managed under state-federal cooperative agreement. USFS and BLM lands and state Critical Habitat Area. Oil transportation, other resource development, and human activity pose risks.
Southeastern Alaska	Spring migration	Widely scattered	National Forest uplands; state-owned tidelands.
Washington			
Ridgefield and Lower Columbia River NWRs; Shillapoo and Vancouver Lake WAs; Woodland Bottoms	Fall and winter	75,000+	Habitat management on public land is evolving toward production of perennial green forage crops, mixed-species pastures, and wetland developments. Acquisition of public lands continues. Private lands are a mix of pasture, winter wheat, specialty crops. Threats include land use conversion, crops not beneficial to geese.

Willow Grove, Puget Island, Willapa Bay, Grays Harbor	Fall and winter	5,000+	Most use on private pasture and forage crops. Threats of conversion to crops not beneficial to geese (e.g. hybrid cottonwood).
N. Olympic Peninsula, Skagit, eastern Washington	Fall migration	Scattered	Use of green forage, grain stubble. Threats of land use conversion to residential/commercial uses in western Washington.
British Columbia			
Queen Charlotte Islands	Fall migration		
Oregon			
Sauvie Island and other lands along Columbia River	Spring, fall staging wintering	80,000 fluctuates	State Wildlife Area managed for waterfowl; includes 4,400 acres of goose forage. Public access restricted to reduce disturbance.
Willamette Valley Western Oregon NWR complex; Fern Ridge WA	Fall, winter	150,000+	Federal refuges managed for goose winter forage (>5,000 acres), through cooperative farming; also wetlands development. Public access restricted to reduce disturbance. Private lands include grass seed, winter wheat.
Klamath Wildlife Area	Spring migration	Minimal in recent years	State wildlife management area. Managed pastures extremely important grazing areas for immature cacklers during spring stopover migration.
California			
Tule Lake/Lower Klamath	Fall staging	20,000 decreasing	Federal refuge and private croplands; land use changes and changes in cropping patterns (especially winter wheat and alfalfa) on private lands pose threat.
Big Valley	Spring staging	10,000	Important native marsh area in Big Valley purchased by State.
Fall River Valley, Canby, Modoc NWR, Devil's Garden, Goose Lake	Spring staging	Minimal in recent years	Private livestock ranches are (were) extremely important cackler grazing areas.
Sacramento Valley Sacramento NWR complex: Colusa, Delevan, Butte Sink, Llano Seco Ranch, Vina Plains. Gray Lodge WA	Wintering	10,000 Cacklers mix with Aleutians in Colusa/Butte Sink area, and with abundant white-fronts and white geese	Wetlands consisting of private duck clubs have increased in recent years, with CVJV implementation. Flooded rice sanctuary areas also increasing. Conversion to cotton reduces goose habitat. Some recent losses of grassland, pasture and winter wheat. Active habitat protection in-progress on Vina Plains and Lassen Foothills. Little pastureland remains in Sacramento Valley, but cereal grains are important in early

			winter.
Sacramento/San Joaquin Delta	Wintering	Scattered	No radical changes or threats affecting habitat have occurred in recent years. Most habitat is irrigated cropland which is often flooded during the winter months.
San Joaquin Valley San Luis complex, San Joaquin River, Merced NWRs; East Grasslands, east Merced County, Southern Sierra Foothills	Wintering, early spring	Most cacklers on San Joaquin River NWR with Aleutian geese. Still present April 1; shift to East Grasslands in early spring and migrate out through 3rd week April.	Threat of grassland/ vernal pool conversion to urban uses, and other agriculture (orchards, vineyards, row crops, poultry). Changes in grazing reducing suitable pasture. Some public and private areas converted to managed marshes for ducks. Federal acquisition and easement programs are preserving goose foraging and roost habitats in East Grasslands, and Merced and Stanislaus Counties.

Appendix B. Peak fall counts of cackling Canada geese in the Klamath Basin (1965-90) and from coordinated flyway surveys (1979-98).

Year	Klamath Basin Fall Peak	Pacific Flyway Fall		Total
		WA & OR	CA & other	
1965	384,000			
1966	351,000			
1967	322,400			
1968	376,100			
1969	143,000			
1970	314,000			
1971	289,000			
1972	234,400			
1973	244,800			
1974	136,300			
1975	217,900			
1976	212,300			
1977	62,000			
1978	118,300			
1979	60,200	200	63,900	64,100
1980	123,800	200	127,200	127,400
1981	98,700	1,100	86,000	98,700
1982	35,500	0	54,100	54,100
1983	26,200	0	26,200	26,200
1984	19,500	4,000	21,800	25,800
1985	19,200	7,400	24,700	32,100
1986	38,800	12,000	39,400	51,400
1987	30,100	11,000	43,800	54,800
1988	48,000	19,100	50,800	69,900
1989	51,000	13,000	63,800	76,800
1990	70,200	34,700	75,500	110,200
1991		27,900	76,700	104,600
1992		60,700	88,600	149,300
1993		65,700	98,600	164,300
1994		75,900	76,600	152,500
1995		114,000	47,400	161,400
1996		123,600	11,000	134600*
1997		188,900	16,200	205,100
1998		139,000	9,600	148600*

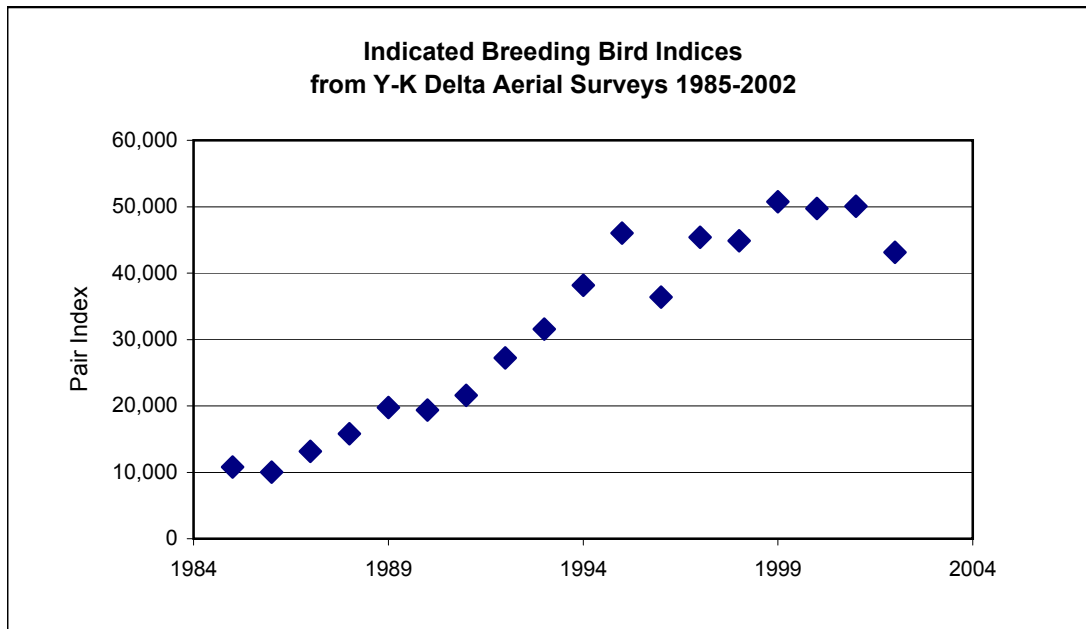
* Surveys believed to be incomplete because of coverage or weather problems.

APPENDIX C. (Revised July 2002)

Breeding bird indices of cackling Canada geese on the Yukon-Kuskokwim Delta from early June aerial surveys, 1985-2002.

Year	Indicated Breeding Birds ¹	Total Geese
1985	10,776	14,542
1986	10,030	12,828
1987	13,142	18,362
1988	15,818	23,742
1989	19,736	24,292
1990	19,372	30,482
1991	21,588	27,608
1992	27,216	43,035
1993	31,556	42,416
1994	38,172	60,183
1995	46,024	65,315
1996	36,390	69,157
1997	45,416	81,938
1998	44,868	62,192
1999	50,738	73,235
2000	49,749	71,598
2001	50,056	75,914
2002	43,141	51,194

¹ IBB = 2 x (singles + pairs)



APPENDIX D. Annual estimates of density and number of cackling Canada goose nests on the Yukon Delta, Alaska. Estimates for sampled area include a single stratum of 952 km² (1986-1994) or 670 km² (1995-96), or 3 strata totalling 854 km² (1998-1999) sampled by random plots. The expanded estimate of nests was derived from the proportion of aerial observations within the sampled stratum compared to the entire coastal YKD survey area of 12,786 km². From Bowman et al. (1999)

Year	No. Plots	Ground plot sampled area					Prop. Nests Active	% of aerial observations in sampled area of YKD	Expanded to entire coast		
		Nests /km ²	Total Nests	SE	CV	Active Nests			Active Eggs	Total Nests	Active Nests
1986	24	12.04	11465	1649	0.144	7628	0.665	0.578	19851	13207	61175
1987	33	13.27	12640	1727	0.137	11823	0.935	0.522	24194	22630	115544
1988	41	9.57	9118	1753	0.192	6623	0.726	0.560	16277	11823	54892
1989	32	9.62	18686	3821	0.204	15073	0.807	0.588	31770	25627	123463
1990	44	21.12	20117	2557	0.127	15329	0.762	0.569	35384	26962	126181
1991	53	23.79	22653	2593	0.114	19690	0.869	0.541	41877	36400	174806
1992	52	31.38	29890	3906	0.131	26237	0.878	0.564	52955	46483	222803
1993	56	27.05	25766	3197	0.124	23496	0.912	0.610	42270	38546	176392
1994	61	33.36	31776	2746	0.086	26070	0.820	0.588	54058	44350	202042
1995	50	61.08	40903	5052	0.124	35649	0.872	0.477	85751	74736	335346
1996	54	55.50	37171	4515	0.122	33933	0.913	0.491	75705	69110	313695
1997	75	50.45	33784	4122	0.122	27910	0.826	0.468	72219	59662	240829
1998	72	59.15	50749	5064	0.100	47270	0.932	0.490	103528	96431	439361
1999	59	50.70	43427	5385	0.124	37685	0.868	0.490	88591	76877	314656
Avg					0.132		0.840	0.538			

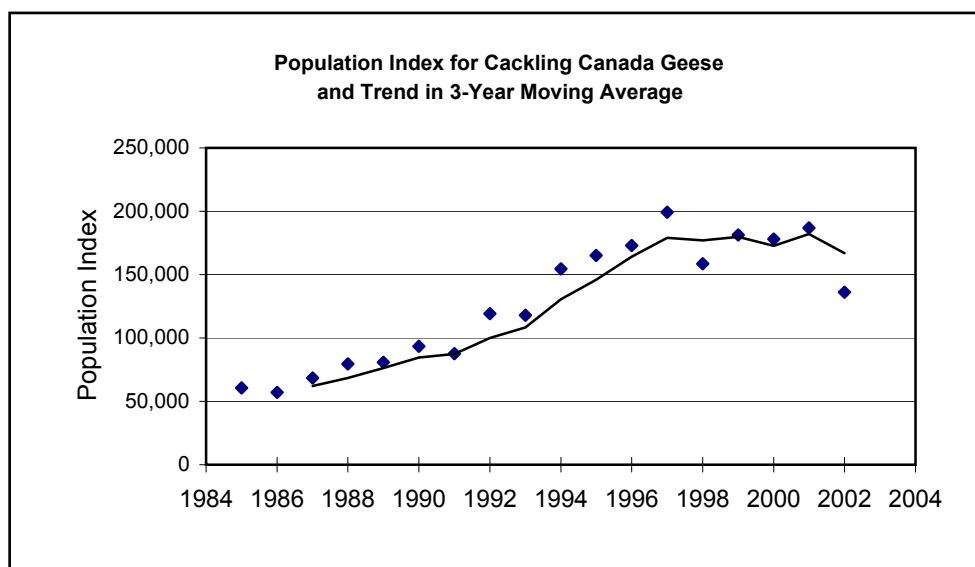
APPENDIX E. (Revised July 2002)

Derivation of the annual population index from the relationship between previous fall survey and total indicated bird (TIB) indices.

Year	Indicated Birds ¹	Fall Index	Population Index ²	3-Year Average
1985	14,542	32,100	60,684	
1986	12,828	51,400	57,159	
1987	18,362	54,800	68,540	62,128
1988	23,742	69,900	79,603	68,434
1989	24,292	76,800	80,734	76,292
1990	30,482	110,200	93,463	84,600
1991	27,608	104,600	87,553	87,250
1992	43,035	149,300	119,277	100,098
1993	42,416	164,300	118,004	108,278
1994	60,183	152,500	154,540	130,607
1995	65,315	161,400	165,094	145,879
1996	69,157	134,600	172,994	164,210
1997	81,938	205,100	199,277	179,122
1998	62,192	148,600	158,672	176,981
1999	73,235		181,380	179,776
2000	71,598		178,014	172,689
2001	75,914		186,890	176,239
2002	51,194		136,055	166,986

¹ TIB = 2 X (number of singles + number of pairs) + grouped birds

² Population Index = (2.0564 x TIB) + 30780



APPENDIX F.

Indirect estimates of population size of cackling Canada geese in the Pacific Flyway from mark-recapture data 1989-90 through 1998-99. Estimates are based on the number of unique neckbands observed during the winter observation period (Jan. 15 - Feb. 15), the average estimated probability of detection, and the unmarked:marked ratio of cacklers from field observation. (Adapted from Drut and Trost 1999).

Year	A		B		A/B		C		(A/B)*C		November Index Based	
	Number Unique Neckbands Obs	Detection Probability	Est. Total No. Neckbands	Unmarked: 1 Marked	Population Estimate	Survey	on IBP					
1989-90	522	0.5919	881.91	104.39	92,062	76,800	90,341					
1990-91	522	0.5653	923.40	102.06	94,243	110,200	88,882					
1991-92	557	0.5521	1,008.88	147.32	148,627	104,600	97,768					
1992-93	433	0.4145	1,044.63	143.14	149,529	149,300	120,336					
1993-94	793	0.6057	1,309.23	141.18	184,837	164,300	137,740					
1994-95	767	0.6623	1,158.09	171.44	198,542	152,500	164,270					
1995-96	659	0.5338	1,234.54	164.41	202,972	161,400	195,756					
1996-97	503	0.5297	949.59	203.82	193,546	Incomplete	157,124					
1997-98	535	0.4792	1,116.44	229.94	256,715	205,100	193,318					
1998-99	439	0.4621	950.01	226.99	215,644	148,564	214,659					

APPENDIX G. Proportion of nests remaining active at first plot search (mid- to late incubation), mean clutch size of apparently viable eggs found in active nests, and predicted mean date of hatch based on egg float angles for cackling Canada geese on random plots surveyed on the Y-K Delta. Means are calculated considering each nest found on a random ground plot as a sample unit rather than using cluster sampling or stratification. From Bowman et al. (1999).

Year	Proportion of Nests Active		Clutch Size (Active Nests)		Predicted Hatch Date (June1=601 July1=701)			
	prop.	n	eggs	n	avg.	min.	max.	n
1986	0.589	265	4.82	156	629.6	614	713	144
1987	0.907	270	5.08	245	628.7	621	718	83
1988	0.769	281	4.59	215	623.8	613	710	68
1989	0.853	434	4.84	370	629.9	621	710	53
1990	0.742	512	4.58	380	623.3	612	706	175
1991	0.857	669	4.66	573	622.2	611	703	351
1992	0.895	669	4.75	599	629.6	620	718	390
1993	0.885	705	4.51	624	623.8	609	706	359
1994	0.814	625	4.59	509	618.8	609	709	411
1995	0.872	1378	4.49	1201	619.8	611	703	721
1996	0.913	1079	4.54	985	616.9	608	703	754
1997	0.826	1225	4.04	1012	616.5	604	704	812
1998	0.936	1603	4.54	1482	625.2	612	639	888
1999	0.869	1113	4.07	931	626.9	617	716	772

APPENDIX H.

HARVEST STRATEGY FOR CACKLING CANADA GEESE March 1999 - March 2001

Population Status: The Yukon-Kuskokwim Delta Goose Management Plan (Y-K plan) has been successful in restoring the cackling Canada goose population from a low of 25,800 when the plan was first developed in 1984 to over 200,000. Annual cackler population indices from coordinated fall surveys have been the standard measure for the Y-K Plan and Pacific Flyway management plan. A shift in winter distribution of cacklers from California to Oregon and Washington, and mixing with other subspecies have made interpretation of the fall indices increasingly difficult. Weather and other problems prevented development of reliable estimates in 1996 and 1998.

In 1998, a new population index was adopted for management purposes, based on the annual breeding pair index (BPI) from Y-K Delta aerial surveys. The BPI may be expanded from past correlations with the fall survey to express an index of the total population. The breeding pair index increased by an average of 12.3% through 1995 and has been relatively stable since then. The current BPI of 23,000 pairs indicates that the population is about 195,500. Mark-recapture analysis of neckband observation data produced estimates of 193,500 the winter of 1996/97 and 256,700 for 1997/98.

Harvest: In 1984, the Y-K plan signatories and Pacific Flyway states agreed to close all hunting of cacklers and set a minimum population goal of 80,000 (three-year average). They also established a threshold of 110,000 geese to be reached before considering open seasons. This threshold was met in 1992, but parties agreed to keep hunting closed during the 1993 season.

During 1993, parties to the Y-K plan reviewed the growth rate of the population and harvest information to determine how many cackling Canada geese may be taken by hunters, while allowing continued annual population growth toward the goal of 250,000. This evaluation suggested that the population had grown at an average of 19.6% annually during 1984-1992, and that a harvest of no more than 14,000 to 17,000 birds (about 10%) would be appropriate for the 1993 population level of 164,300.

Restrictive seasons were re-opened in all states in 1994, producing average harvests of about 8,000 on the Y-K Delta, and 4,000-8,000 during fall and winter hunts. Under a revised harvest strategy for 1997-1999 harvests increased. Estimates derived from check stations and harvest surveys suggest that the fall and winter harvest may have reached about 10-12,000. Y-K Delta subsistence harvests increased, peaking at 14,983 in 1996 and averaging 12,100 over the past four years. A 1995 subsistence harvest survey of villages in the Bristol Bay area indicated a harvest of 990 cackling geese.

Current Strategy: This strategy continues to seek a total harvest of no more than 10 percent of the current population index to allow for additional growth. This equates to a maximum harvest level of 18,200 geese. Recent harvests have reached levels that may prevent or delay continued population growth and achievement of the overall population goal.

The shift in fall and winter distribution of cackling and other Canada geese to southwest Washington and western Oregon has created substantial complaints of crop depredation. Efforts to alleviate this depredation through hunting have been hampered by restrictions to protect diminished dusky Canada geese and efforts to restore cackling Canada geese.

Short-term Strategies

Based on recent population and harvest data, the need to re-distribute cackling Canada geese to other parts of their winter range, and recognition that cackling Canada geese are a shared resource, the parties to the plan propose continuing the harvest strategy for limited cackling Canada goose hunting in Alaska, Washington, Oregon, and California for the 1999-2001 period under the following principles:

1. Promote an average annual increase of 5-10% toward the Plan goal of 250,000;
2. Manage for a winter distribution that includes no more than 20 percent of the current population in the lower Columbia River and Willamette Valley; with an emphasis on developing depredation programs to assist Oregon and Washington landowners;
3. Maintain total subsistence and fall/winter harvest level at approximately 10% of the current 3-year population index (182,000 for 1996-1998);
4. The effects of changes in regulations and management programs should be evaluated after the two-year term of this strategy;
5. This harvest strategy must be monitored through continuation of the breeding ground aerial survey, state and federal harvest surveys, and subsistence harvest surveys;
6. Implementation of this strategy will include consideration of possible effects on other Pacific Flyway populations of Canada geese; and
7. The parties recognize the need to develop a long-term harvest strategy that will maintain equitable harvests among users.

APPENDIX I.

Estimated harvest of cackling Canada geese from measurements of tail retrices in the Parts Collection Survey applied to total Canada goose harvest. From Drut and Trost (1998).

Table 1. Total number of adult Canada goose tail retrices measured from all Pacific Flyway states and number <118.25 mm by state and year.

Year	N (PF)	Alaska	Washington	Oregon	California	Total
1992	2,837	2	1	0	1	5
1993	2,659	0	3	1	0	4
1994	2,028	1	2	3	1	7
1995	1,989	1	2	6	0	10
1996	1,850	0	5	2	1	9
1997	1,840	0	3	12	0	17

Table 2. Estimated total Canada goose harvest from the federal harvest survey by state and year.

Year	Alaska	Washington	Oregon	California	PF Total
1992	4,090	48,424	43,474	28,546	196,798
1993	4,671	48,931	63,399	21,066	223,384
1994	5,639	62,683	46,923	28,467	259,035
1995	9,672	70,959	36,580	21,566	239,096
1996	8,995	73,805	38,497	25,487	268,314
1997	13,274	71,542	48,118	23,591	242,766

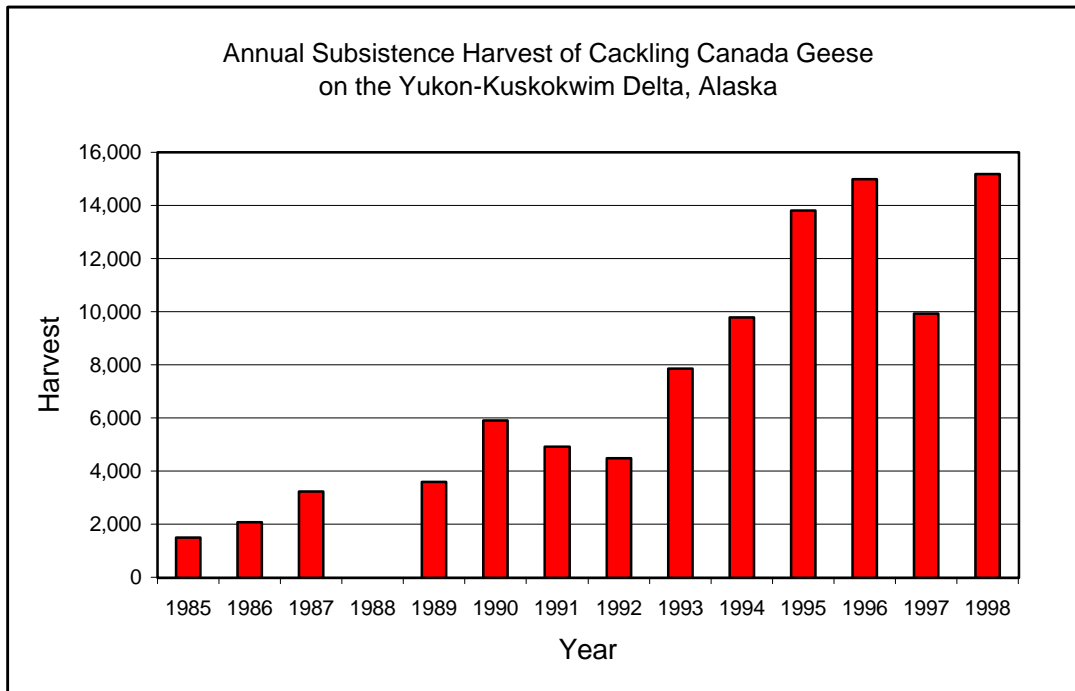
Table 3. Estimated cackling Canada goose harvest by state and year.

Year	Alaska	Washington	Oregon	California	Total
1992	678	467	0	430	1,575
1993	0	1,339	605	0	1,944
1994	605	1,329	1,950	950	4,834
1995	1,543	2,227	3,249	0	7,019
1996	0	6,053	1,449	857	8,359
1997	0	2,421	8,976	0	11,397

APPENDIX J.

Seasonal and annual subsistence harvest of cackling Canada geese on the Y-K Delta, Alaska from village household surveys, 1985-1997. From Wentworth and Seim (1996, 1998); Wentworth pers. comm..

Year	Spring	Early Summer	Mid Summer	Late Summer	Fall	Total
1985	965	375	0	28	118	1,486
1986	1,232	421	55	91	264	2,063
1987	2,002	293	80	343	501	3,219
1988						
1989	2,323	457	137	175	492	3,584
1990	2,620	330	526	1,133	1,295	5,904
1991	3,589	252	77	491	517	4,926
1992	2,867	859	125	338	298	4,487
1993	3,224	355	73	1,133	3,062	7,847
1994	4,796	983	348	1,161	2,492	9,780
1995	5,602	2,856	591	1,680	3,070	13,799
1996	7,235	991	191	2,093	4,474	14,984
1997	5,554	1,122	175	1,164	1,905	9,920
1998	8,079	1,444	412	1,860	3,378	15,173



APPENDIX K.

Harvest of cackling Canada geese on state and federal public hunting areas in California, 1962-1983. See Raveling (1984) and Pamplin (1986).

Hunting Season	Cackler Harvest	Harvest Restrictions
1962	4,352	
1963	5,599	
1964	4,258	
1965	5,411	
1966	5,465	
1967	4,105	
1968	5,723	
1969	5,482	
1970	4,414	
1971		
1972	6,336	
1973	3,966	
1974	4,084	
1975	3,728	Aleutian goose closures in Sacramento and San Joaquin Vallies.
1976	2,290	
1977	4,842	
1978	2,057	
1979	1,593	Season and bag reduction in NE and Balance Zones
1980	1,226	Bag limit reduction in NE Zone and season reduction in Balance Zone.
1981	2,300	
1982	1,109	
1983	940	Emergency closure in January.
1984		Season Closed

APPENDIX L.

Composition of Canada goose harvest in southwest Washington from hunter check station records, 1984-1998.

Season	Canada Goose Subspecies						Total	
	Cackler	Dusky	Taverner	Lesser	Western	Vancouver		Other ¹
1984-85	0	37	63	0	20	0	0	120
1985-86	11	66	113	116	67	0	25	398
1986-87	8	36	172	51	241	0	0	508
1987-88	7	45	478	225	224	4	35	1,018
1988-89	17	43	617	136	763	0	7	1,583
1989-90	37	52	455	92	391	9	0	1,036
1990-91	28	65	555	165	383	20	3	1,219
1991-92	39	88	675	295	483	14	15	1,609
1992-93	84	91	1,340	270	722	25	2	2,534
1993-94	93	90	944	299	697	8	4	2,135
1994-95	422	77	1,011	246	704	31	6	2,497
1995-96 ²	334	59	862	144	536	12	1	1,948
1996-97 ³	1,030	35	1,705	475	932	18	3	4,198
1997-98 ⁴	1,311	58	2,197	392	742	33	5	4,738
1998-99 ⁵	1,820	46	1,877	306	833	34	9	4,925
X 94-98	983	55	1,530	313	749	26	5	3,661

¹ Other includes Aleutian Canadas and unidentified Canadas.

² Includes 13 cacklers of 121 Canadas taken during the Feb.5 - March 10 late hunt.

³ Includes 29 cacklers of 341 Canadas taken during the Feb. 5 - March 10 late hunt.

⁴ Includes 153 cacklers of 398 Canadas taken during the Jan. 24 - March 8 late hunt.

⁵ Includes 232 cacklers of 504 Canadas taken during the Jan. 23 - March 10 late hunt.

APPENDIX M.

Composition of Canada goose harvest in northwest Oregon from hunter check station records, 1984-1998.

Season	Canada Goose Subspecies						Other ¹	Total
	Cackler	Dusky	Taverner	Lesser	Western	Vancouver		
1984-85	0	603	641	0	0	0	21	1,265
1985-86	8	157	1,156	257	95	2	0	1,675
1986-87	19	134	1,157	103	0	0	127	1,540
1987-88	54	118	2,524	235	258	3	1	3,193
1988-89	26	142	3,067	273	415	3	0	3,926
1989-90	16	79	2,563	346	1,623	5	2	4,634
1990-91	18	177	2,684	572	1,846	6	0	5,303
1991-92	42	121	2,287	378	1,091	9	0	3,928
1992-93	36	147	2,294	422	1,333	8	1	4,241
1993-94	72	188	2,699	748	1,348	41	4	5,100
1994-95	1,220	142	2,669	447	1,415	9	9	5,911
1995-96	1,758	83	1,885	462	598	10	20	4,816
1996-97	2,503	87	1,773	809	1,110	9	1	6,292
1997-98	3,113	112	2,439	853	1,448	26	17	8,008
1998-99	5,641	127	3,266	751	1,513	40	6	11,344
X 94-98	2,847	110	2,406	664	1,217	19	11	7,274

¹ Other includes Aleutian Canadas and unidentified Canadas.