Pacific Flyway Management Plan for the

Emperor Goose

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PACIFIC FLYWAY MANAGEMENT PLAN

FOR THE

EMPEROR GOOSE

Prepared for the:

Pacific Flyway Council
U.S. Fish and Wildlife Service

By the

Pacific Flyway Study Committee
Emperor Goose Subcommittee

And

Alaska Migratory Bird Co-Management Council
Emperor Goose Subcommittee

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I. INTRODUCTION

Emperor geese (C*hen canagica*) are distributed in remote maritime habitats of Alaska and the Russian Far East (Figure 1, Appendix A). Most emperor geese winter along the Alaska Peninsula and in the eastern Aleutian Islands. Spring and fall migrants use staging areas along the Alaska Peninsula (Figure 2). Emperor geese nest in western and southwestern Alaska and along the east and north coasts of Chukotka with the majority on the Yukon-Kuskokwim Delta, Alaska. The historical breeding range on the Alaska mainland extended from the north side of the Seward Peninsula to south of Kuskokwim River near Carter Bay (Gabrielson and Lincoln 1959). Nesting distribution is presently constricted as emperor geese are uncommon nesters on the Seward Peninsula (Kessel 1989) and they are no longer known to breed south of the Yukon-Kuskokwim Delta (Seppi 1997).

The earliest estimate of emperor goose population size was 139,000 observed during a late spring survey from Kuskokwim Bay to Port Moller on the Alaska Peninsula in 1964 (King 1965). Fall migration surveys in the late 1960's estimated a population size of 150,000 (King and Lensink 1971). Petersen and Gill (1982) estimated a 34% decline in population size from 1971 to 1980, which prompted the initiation of annual spring and fall migratory staging surveys (Dau and Mallek 2005, Mallek and Dau 2004). A 3-year running average of spring surveys from 1981 to 1986 indicated a further 36% decline (Dau and King 1986). The spring population index has continued to decline but at a much slower rate since 1986 and the 1981-2004 with the 3-year running estimate of population size declining at 0.4%/year (Appendix B).

Estimates of breeding success on the Yukon-Kuskokwim Delta remained relatively constant during the 1970's and early 1980's (Eisenhauer and Kirkpatrick 1977, Petersen 1987), and the annual estimate of total nests has gradually increased since 1985 (Fischer et al. 2004). Fall age ratios, collected along the Alaska Peninsula since 1985, average 18.3% juveniles (Anderson et al. 2004) and indicate an average decline of 4.3%/year. These recent data suggest that increased mortality of pre or post-fledging young may be a factor restricting population growth.

Hunting mortality and predation are manageable factors involved in the decline of emperor geese that must be decreased to restore the population. In 1985 the bag limit of emperor geese was reduced from 6 to 2 birds per day and the season was closed completely in 1986. Under the terms of the Yukon-Kuskokwim Delta Goose Management Plan (YDGMP), subsistence hunting of emperor geese also was closed in 1987; however, harvest continues to occur (Wentworth and Wong 2002, Wolfe et al. 1990, Wolfe and Paige 2002).

The historical lack of a system to regulate subsistence harvest has limited effective management of goose populations, including emperor geese, on the Yukon-Kuskokwim Delta of Alaska. In order to better manage these populations, an agreement was signed in January 1984 between Alaska Natives of the Yukon- Kuskokwim Delta (Association of Village Council Presidents), the U.S. Fish and Wildlife Service, the Alaska Department of Fish and Game, and the California Department of Fish and Game. The agreement was

renamed the Yukon-Kuskokwim Delta Goose Management Plan and has been updated and modified periodically to the present day. In 1993 the states of Oregon and Washington also became signatories to the Plan. Alaska Native government entities representing other areas of Alaska with interest in emperor goose populations and habitat have yet to become signatories to this plan.

The 1916 Convention for the Protection of Migratory Birds between the U.S. and Great Britain prohibited the harvest of geese and most other species between March 10 and September 1. In Russia, emperor geese are protected as a "Red Book" species of concern (Kolosov and Skarlato 1983) however, illegal harvest still occurs. The migratory bird treaties with Canada and Mexico were amended in 1997 to allow for regulated customary and traditional use during the previously closed period. In Alaska, the Alaska Migratory Bird Co-Management Council (AMBCC) was established in October 2000 to develop proposed regulations to manage harvests occurring from March 10 to September 1. Spring and summer subsistence harvest of migratory birds is now rules established in 50 CFR Part 92. The AMBCC established a standing Harvest Technical Committee to provide guidance on design and implementation of statewide migratory bird harvest assessments of all species open to subsistence hunting. The AMBCC Emperor Goose Subcommittee was formed to address species-specific issues.

The purpose of this plan is to update previous versions of this plan (Pacific Flyway Council 1988) and reemphasize established goals and strategies for management of emperor geese in the Pacific Flyway that facilitate meeting objectives presented herein. This plan identifies management actions, associated information needs, and agency responsibilities for implementation during 2006-2010.

II. GOALS AND OBJECTIVES

The goal of this management plan is to restore the emperor goose population to historical levels and maintain it for all its values to society, including ecological, educational, recreational, and scientific uses, both consumptive and non-consumptive.

Objectives:

A. Maintain a minimum population of 150,000 emperor geese based on spring surveys.

B. Protect and manage nesting and brood rearing habitats in sufficient quantity and quality necessary to achieve population objectives. Emphasis should be increased on research and management activities to improve the quality of broodrearing habitat.

C. Protect and manage migratory staging and wintering habitats in sufficient quantity and quality to achieve population objectives.

D. Reduce harvest to achieve population objectives. Hunting will be closed when the population is below 60,000 geese based on the current 3-year running average of

spring population estimates. Hunting may be considered again when the 3-year running average reaches 80,000 geese.

E. Achieve fall juvenile age ratios of ≥20%. This objective is dependent on reducing predation rates on goslings and increasing the quantity and quality of brood rearing habitat.

III STATUS

Abundance and Trends

Emperor geese inhabit remote areas of western and southwestern Alaska and the Russian Far East (Palmer 1976, Bellrose 1980), areas plagued by unfavorable climate and difficult logistics making population surveys challenging. Hence, limited historical information is available on population size or distribution. Aerial surveys of southwest Alaska in the 1960's estimated spring and autumn numbers of migratory staging emperor geese at 139,000 and 150,000, respectively (King 1965, King and Lensink 1971). Eisenhauer and Kirkpatrick (1977) summarized available survey data to the 1970's suggesting a fall population between 175,000 and 200,000 and estimated 140,000 - 160,000 survived to spring. The current 3-year running average of spring and fall population estimates are 57,492 and 83,175 geese, respectively (Dau and Mallek 2005, Mallek and Dau 2004) (Appendix B, Figure 3). Russian and Alaskan breeding emperor geese mix during migration and winter, based on observations of marked birds and band recoveries (Schmutz and Kondratyev (1995).

Kistchinski (1976) suggested up to 80% of emperor geese summering in Russia are molting non-breeders. Uspenskii (1984) reported as early as 1969 that the nesting population in Chukotka Peninsula was decreasing rapidly. Historic population estimates are 12,000 - 15,000 emperors breeding and molting in Chukotka, with 200 wintering in the Commander Islands (Kistchinski 1973 and 1976, A. Kistchinski pers. comm.). Estimates of numbers in Chukotka, prior to the arrival of molt migrants (Jones 1972, Eisenhauer and Kirkpatrick 1977), come from late June aerial surveys in 1974 (Kistchinski 1976) and 1993-95 (Hodges and Eldridge 2001). Population estimates for generally similar areas of the north Chukotka coast from Bering Strait west to Cape Shmidt were 7950 birds in 1974 and 2952 in 1993-95 (-63%). Hodges and Eldridge (2001) estimated a total Russian summering population of emperor geese at 5,079 including 2,952 in Chukotka, 223 from the Kolyma to Indigirka river deltas and 1,904 in inland areas from the Indigirka River to the Yana River. The arrival of molt migrants from Alaska enlarges the summering population in Russia. During recent aerial surveys in 2002 of “all key coastal wetlands of eastern Chukotka” 21,500 emperor geese were counted and the total population was speculated to be 25,000-30,000 (E. Syroechkovskiy, Jr. pers. comm.) The reported two-fold increase in summering emperor geese in Chukotka from 1974 to 2002 may be related to an apparent decline in molting on St. Lawrence Island (Murie 1936, Fay 1961, King and Derksen 1986, King and Butler 1987, Hogan and Rearden 1987, Eldridge and Bollinger 1988).

The U.S. Fish and Wildlife Service began annual migration surveys of emperor geese in fall 1979, and since 1981, aerial surveys have been conducted in southwest Alaska staging areas

in spring and fall. The spring survey completed from late April to early May, is used as the management index because the population is concentrated during a shorter time period than during the more protracted fall migration completed in early October. During spring, emperor geese congregate in Bristol Bay estuaries and along the northern Alaska Peninsula where the population is estimated prior to their moving north to breeding sites (Petersen and Gill 1982, Dau and Mallek 2005) (Appendix B).

Data on distribution and abundance of emperor geese in the Aleutian Islands are primarily from incidental counts made during early spring marine mammal surveys (Kenyon 1962, Eldridge 1987, T. Evans pers. comm., J. Haddix pers. comm.). Survey design and emphasis on recording emperor geese was not consistent between years so these late winter Aleutian surveys provide only a subjective indication of population trend. Counts declined from 24,712 emperor geese in 1962 to1,319 in 2000, however, distributions were similar with preferred use areas from Tanaga Island to the Krenitzin islands.

Breeding Areas

In Alaska, most emperor geese breed in the coastal zone of the Yukon-Kuskokwim Delta (Palmer 1976, Bellrose 1980, King and Dau 1981, Petersen et al. 1994) with small numbers on the Seward Peninsula (Kessel 1989). (Figure 1, Appendix A). Fay and Cade (1959) and Fay (1961) reported 1,000 to 2,000 breeding on St. Lawrence Island while earlier reports were of breeding "in large numbers" (Friedmann 1932). Small numbers of emperor geese may currently breed on Nunivak Island (H. Ivanof pers. comm.). Emperor geese breed in coastal habitats preferring slough borders, pond shorelines, peninsulas, ericaceous tundra and pingos and small islands as nesting sites (Kistchinski 1972, Mickelson 1975, Eisenhauer and Kirkpatrick 1977, Petersen 1985). Breeding chronology varies due to timing of snow melt and the availability of nest sites. Median nest initiation dates on the Yukon-Kuskokwim Delta ranged from 20 May to 3 June (Petersen 1990, 1992a).

Broods move from nest sites to coastal salt marsh and estuarine habitats within one week of hatching, partially to find refuge from predators. Laing and Raveling (1993) found that goslings selected vegetated mudflats in coastal salt marsh and spent over 80 percent of their feeding time there. Goslings initially feed on nitrogen-rich salt marsh plants (Kistchinski 1972, Laing and Raveling 1993), and crowberries (*Empetrum nigrum*) are important during fall (Mickelson 1975).

A molt migration consisting of most sub adults and failed breeders occurs in mid-June from the Yukon-Kuskokwim Delta to St. Lawrence Island and coastal lagoons of Chukotka (Murie 1936, Fay and Cade 1959, Fay 1961, Jones 1972, Kistchinski 1973, 1988). In recent years, use of St. Lawrence Island as a molting site has declined with a corresponding 100% increase in Chukotka (King and Derksen 1986, King and Butler 1987, Hogan and Rearden 1987, Eldridge and Bollinger 1988, E. Syroechkovskiy, Jr. pers comm.).

In Russia, emperor geese breed throughout coastal Chukotka from Mallen Lagoon along the Bering Sea north and west to Cape Shmidt along the Chukchi Sea (Kistchinski 1973, Portenko 1981, Schmutz and Kondratyev 1995, Dorogoi and Beaman 1997, A. Kistchinski,

pers. comm.). Nesting in Chukotka begins in mid June (Kistchinski 1972, Krechmar and Kondratyev 1982, P. Tomkovich pers. comm.).

Fall Migration

Emperor geese migrate up to 2,200 km from molting sites to staging areas in southwest Alaska (Petersen et al. 1994, Izembek NWR files) (Figure 2). Molt migrants arrive first from early to mid-August followed by successful breeders by late September. Banding and satellite telemetry data suggest most of the emperor goose population follows western Alaska migratory routes (Schmutz and Kondratyev 1995, Hupp et al. 2001, 2004). Few emperor geese are seen in fall along the Bering Sea coast of Kamchatka and wintering numbers are small there and in the Commander Islands (Kistchinski 1973, Palmer 1976, E. Lobkov pers. comm.).

Emperor geese exhibit strong fidelity of to staging lagoons within and among seasons and remain at single sites for more than one month (Schmutz 1992). Over 80 percent of the population in spring and fall stage from Cinder River Lagoon to Nelson Lagoon (Figure 2, Appendix A). Three estuaries along the south coast of the Alaska Peninsula (Ivanof Bay, Chignik Lagoon and Wide Bay), islands south of the Alaska Peninsula and Kodiak Island are important to smaller numbers of emperor geese.

Petersen (1983) observed emperor geese foraging on blue mussels (*Mytilus edulis*) and macoma clams (*Macoma* spp.) during low tide and roosting onshore at high tide. Schmutz (1994) reported that flocks with disproportionately more juveniles continued to feed during high tide due to greater nutritional demands. At Izembek Lagoon, emperor geese also feed on eelgrass (*Zostera* spp.) and crowberries (*Empetrum* spp.), roosting at high tides along beaches or adjacent uplands.

Wintering Areas

By November, most emperor geese disperse from fall staging areas to wintering sites throughout the Aleutian Islands, islands south of the Alaska Peninsula and the Kodiak Archipelago. In mild winters some birds remain in Alaska Peninsula estuaries if ice free habitat exists (Palmer 1976, Hupp et al. 2001, 2004). In Russia, emperor geese winter in the Commander Islands and along the southern Kamchatka coast. Petersen et al. (1994) report accidental winter records from Hawaii, Sundai City, Japan and Wrangel Island, Russia. The occasional single or small group of emperors sighted in British Columbia, Washington, Oregon and northern California are likely the result of parasitic laying in the nests of other species of geese which winter in these areas and breed on the Yukon-Kuskokwim Delta (Lensink 1969).

In the central and western Aleutians, emperor geese arrive from October to November, although occasional sightings occur in early September. Most wintering birds arrive by mid-December and depart in spring by mid-April. Observations of marked birds suggest strong site fidelity within and between years (Byrd 1989, Byrd et al. 1992, Hupp et al. 2001, 2004, R. McIntosh pers. comm.).

Wintering emperor geese prefer shallow estuaries and shorelines for foraging and roosting. In the Aleutian Islands larger numbers use islands with extensive intertidal habitats and small numbers use conical volcanic islands with high energy beaches (J. Williams pers. comm.). The winter diet consists of *Fucus* spp., *Ulva* spp., eelgrass, kelp and various molluscs and other marine organisms associated with intertidal habitats, and vegetation including the shoots of *Elymus* spp. and rhizomes and herbaceous parts of *Equisetum* spp. (Murie 1959).

Spring Migration

Emperor geese begin migrating from Aleutian Island wintering sites as early as March (Byrd et al. 1974, Byrd 1988) to staging areas on the Alaska Peninsula where most remain until making non-stop flights to the Yukon-Kuskokwim Delta in early May (Hupp et al. 2001, 2004) and later to more northerly breeding areas. Emperor geese arrive on the Yukon-Kuskokwim Delta in early to mid-May, with large influxes occurring two to 16 days later (Petersen 1990, 1992a). Most Russian breeders migrate along the western Alaska coastline through the Bering Strait, arriving in Chukotka in early June (Kistchinski 1972, Krechmar and Kondratyev 1982). Birds wintering in the Commander Islands and southern Kamchatka are assumed to migrate along the eastern Bering Sea coastline to Chukotka (A. Kistchinski pers. comm.).

Production and Mortality

Prior to 1985 there were no comprehensive measures of emperor goose productivity at nesting sites. Since 1985, intensive random ground plot surveys have been conducted on the Yukon-Kuskokwim Delta (Fischer et al. 2004) in conjunction with aerial surveys (Butler and Malecki 1986, Eldridge and Hodges 2004) to provide annual estimates of population size and production. Data indicate low, positive annual growth rates of +2.4% for total birds (Appendix C, Figure 4) and +1.2% for active nests (Appendix D) while the population estimate from spring surveys indicates a very low annual decline of -0.4%/year (Figure 3).

Emperor geese initiate nests on the Yukon-Kuskokwim Delta from 20 May to 3 June (Petersen 1991, Petersen et al. 1994). In Chukotka, nests were initiated from 6 to 20 June (Kistchinski 1972, Krechmar and Kondratyev 1982). Nest initiation dates for marked individuals were similar each year (Petersen 1992a). Early nest initiation is advantageous as goslings are able to attain larger body size, which is positively correlated with survival (Schmutz 1993). In climatically late years, when nest site availability was delayed, nest initiation coincides with snow melt and runoff (Petersen 1990).

Normal clutch size is four to six eggs (average 4.9 eggs) (Petersen 1991). Kistchinski (1972) and Krechmar and Kondratyev (1982) report clutch sizes of two to nine eggs (average 4.2 eggs) in Chukotka. Climatically late springs can result in reduced clutch size and non-breeding in the Arctic (Barry 1960, 1967). On the subarctic Yukon-Kuskokwim Delta, emperor goose clutch size did not vary between early and late seasons, averaging 5.0 eggs (Fischer et al. 2004) (Appendix D). However, clutch size did decline later in the nesting season due to one or more factors including continuation of partially destroyed clutches, re-

nesting, first attempts by inexperienced individuals, and depletion of nutrient reserves during climatically late years (Petersen 1992a).

Female emperor geese often parasitically lay eggs in nests of other females and less commonly in the nests of other goose species. Petersen (1991) found over 62% of emperor goose nests were parasitized, and over 14% of goslings produced were from parasitic eggs. Costs of accepting parasitic eggs included slightly reduced hatching success of host eggs. Parasitic females were not known to incubate clutches in seasons they laid parasitically.

Petersen (1992a) reported 43-70% of marked female emperor geese nested each year. Nesting propensity was independent of the previous year's nest fate, clutch size, nest initiation date, and arrival date, and the current year's arrival date or timing of habitat availability. Low nesting rates may be related to variability in annual adult mortality rates. The proportion of adult females that survived to the following summer was significantly higher among geese that did not nest than among geese that nested suggesting that non-nesting is a strategy used by emperor geese when nesting increases the risk of adult mortality (Petersen 1992b).

Nesting success varied from 90.6% in 1982 to 0.1% in 1986 (n=746 nests) (Petersen 1992a). Predation by arctic foxes was the primary cause of nest loss (Stickney 1989, Petersen 1992a). Stehn (1991) concluded that factors other than nest success, clutch size, nesting chronology, and egg production may be more important determinants of fall population size. Most important factors affecting population size are the number of pairs (i.e. adult survival), the proportion of breeding pairs that attempt to nest, and the survival of goslings to fledging. Glaucous gulls (*Larus hyperboreus*) are a primary factor limiting juvenile survival on the Yukon-Kuskokwim Delta consuming from 21,000 to 52,000 goslings in 1994 (Bowman et al. 1997). Predation by gulls, exclusive of other mortality factors, exceeded the estimated 16,000 goslings surviving to early August (Bowman et al. (1997).

Prior to 1985, fall age ratio counts to estimate emperor goose productivity were conducted by the Izembek NWR (Izembek NWR files). Comprehensive annual fall photographic age ratio surveys in estuaries on the north side of the Alaska Peninsula where begun in 1985 (Butler et al. 1985) providing a 20-year average of 18.3% young (Anderson et al. 2004) (Appendix E). The proportion of juveniles has declined by an average of 4.3% per year since 1985. Estimates of fall age ratio and family group size at the Izembek NWR since 1966 provide averages of 23.2% juveniles (Appendix F) and family group size of 2.8 juveniles per family (Appendix G). Juvenile age ratios at Izembek NWR have declined at 1.7% per year since 1966. Winter age ratio estimates in the Aleutian Islands (Byrd et al. 1992, Alaska Maritime NWR, files) averaged 14.5% juveniles, an average of 37.8% below corresponding fall estimates; this may provide an index of juvenile mortality (Figure 5, Appendix H). Byrd et al. (1992) suggested that there is proportionally more mortality among juveniles than adults and suggested eagle predation and oiling were among possible causes.

Seasonal and annual survival estimates of emperor geese, based on mark resightings, were found to be low compared to other goose species (Petersen et al. 1994, Schmutz et al. 1994). Adult monthly winter survival rate was 0.940, whereas monthly over-summer survival varied

among years from 0.940 to 0.980 (Schmutz et al. 1994). Estimates of monthly survival of juveniles during their first winter period averaged 0.710. Subsequent monthly survival of juveniles was 0.943, similar to adults. Annual adult survival, estimated at 0.631 after adjustment for collar loss, was similar to the 0.587 reported by Petersen (1992b). Schmutz and Morse (2000) suggest that neck collared geese have lower return rates than tarsus-banded birds, and Schmutz et al. (1997) indicate average annual survival rates just over 0.80 are more realistic.

Natural mortality among juveniles is high during brood rearing (Bowman et al. 1997) and over their first winter, with survival positively correlated with body condition during fledging (Schmutz 1993). Heavy goslings had significantly higher survival than lighter goslings between late pre-fledging and arrival on fall staging areas. Results suggest that body mass affected the ability of juveniles to depart breeding areas, and/or affected survival during the first phase of migration. Differences in body mass may be caused by variable hatch dates, growth rates and forage qualities (Schmutz 1993), or differential energetic demands. Schmutz et al. (1994) point out that lack of agricultural foods, and relatively high latitude and inclement weather of winter habitat may lead to high natural mortality for juvenile and adult emperor geese in comparison to other goose species. Bowman et al. (1997) found glaucous gull predation was higher on emperor goose goslings than on other goose species.

Emperor geese have shown a variable but slow increase in population trend on the Yukon-Kuskokwim Delta since regulations stopped sport hunting and a combination of regulations and negotiations were initiated to slow subsistence harvest (Figure 6). Sport and subsistence harvest reductions throughout the Pacific Flyway increased survival, recruitment and population sizes of both cackling Canada geese and greater white-fronted geese that also nest on the Yukon-Kuskokwim (Trost and Drut 2004). However, similar harvest restrictions on emperor geese have failed to increase population size (Figure 3). Continued population decline is precipitated by low productivity rates and continued illegal harvest, which appears to be exceeding the recruitment of breeding adults into the population.

Eliminating or reducing illegal harvest and managing predators on breeding areas are the most realistic strategies for increasing survival and recruitment of emperor geese and increasing total population size. Adequate quantitative data on size of the illegal harvest are lacking (Wolfe and Paige 2002), and harvest is likely to be completely additive to natural mortality, particularly when the proportion of juveniles is low (Schmutz et al. 1994).

Little is known about the winter ecology of emperor geese. The relationship of habitat conditions to winter survival, nutritional and energy requirements, food availability, importance of winter conditions to reproductive capabilities, effects of pollution, predation rates and disturbance all require further study. Oil-stained emperor geese have been observed in the Aleutian Islands suggesting there may be a chronic problem with oil contamination from vessel sinkings and fuel discharges. Emperor geese are susceptible because they spend approximately 5 months each year foraging and roosting in the intertidal zone where oil deposits were found (Byrd et al. 1992). Emperor geese surviving contact with oil may experience reduced fitness, either due to ingestion or loss of insulation coupled with common adverse weather conditions (Byrd et al. 1992). Due to their remote and dispersed

winter distribution and the nature of known mortality factors (e.g. eagle predation, chronic oiling, etc.), management options to improve winter survival for emperor geese are limited.

The impacts of long-term environmental changes in emperor goose habitats, while unknown, are likely negative (e.g., warming Bering Sea temperatures, reduced sea ice, increased rates and impacts of storm surges, vegetation changes) (Owen 1980, Petersen 1985, Schmutz et al. 1994). Predator populations, increasing seasonally or in the long-term, adversely impact emperor geese. Predatory gull populations on Yukon-Kuskokwim Delta are increasing at a rate of >4% per year (Platte and Stehn unpubl. data). Gulls may be benefiting from increased productivity and survival related to expanded fisheries and at-sea processing in the North Pacific and Bering Sea (Hamilton-Paterson 1992). Arctic foxes are important nest predators that may be increasing due anthropogenic factors that have increased over-winter survival and reduced harvest.

Banding

Approximately 9,782 emperor geese had been banded and 145 recoveries had been reported as of August 2004 (J. Schmutz, pers. comm.). The majority of recoveries came from Alaska with a few reports from British Columbia and Washington. Limited banding of molting emperor geese in Russia has resulted in two recoveries, both in Alaska; one near Cold Bay and one on St. Lawrence Island. Two birds with Russian bands were sighted in Cold Bay in the fall of 1993 (Schmutz and Kondratyev 1995). There is one report of a young of the year bird banded on the Yukon-Kuskokwim Delta in August 1968 and recovered in July 1973 in Chukotka.

Sport Harvest

Sport harvest of emperor geese was reduced from a bag limit of 6 to 2 per day in 1985 and has been completely closed since 1986. Estimates of annual sport harvest by the Alaska Department of Fish and Game from 1970-1980 (Appendix I) averaged 2,100 emperor geese (1,400-3,000) and seldom exceed two percent of the estimated total population size. Most sport harvest occurred at staging areas along the north side of the Alaska Peninsula, most notably the Izembek State Game Refuge and Izembek National Wildlife Refuge.

Subsistence Harvest

In Alaska, harvest of emperor geese and their eggs is a traditional and customary use (Wolfe et al. 1990). Wolfe and Paige (2002) estimate over 4,500 birds were taken annually during the early 1990's, representing nearly 8% of the spring population index. Geographic coverage and sampling intensity suggest this estimate may be low

Subsistence harvest surveys estimate magnitude and timing of take relying on the trust and cooperation of subsistence hunters sampled anonymously (Wentworth and Wong 2001). The first study of subsistence waterfowl take on the Yukon-Kuskokwim Delta was made in 1964 (Klein 1966) and the estimated 8,200 emperor geese reported accounted for approximately 6% of the estimated spring population (King 1965). From 1985 to 2000, harvest estimates

averaged 2,119 emperor geese shot (1616-4031) and 290 eggs collected (40-518) however, these data underestimate harvest because several villages where harvest is known to occur, did not initially participate in most years (Wentworth and Wong 2001, Wentworth, unpubl. data) (Figure 6, Appendix J).

Historically, emperor geese have been taken on St. Lawrence Island by shooting during migration or driving of molting birds, a practice reported to be declining (Fay and Cade 1959, Fay 1961). Preliminary harvest surveys on St. Lawrence Island in 2002 estimated over 1,700 emperor geese were taken (A. Ahmasuk pers. comm.).

A 12-month survey in 1986-1987 at three Alaska Peninsula communities (Pilot Point, Ugashik, and Port Heiden) identified two distinct periods of waterfowl hunting. At Pilot Point, Ugashik and Port Heiden a total harvest of 205 emperors (64 in the spring and 141 in the fall) was reported (Fall and Morris 1987). Wentworth and Wong (2001) reported an average of 379 emperor geese take annually by Bristol Bay villages from 1995-2000. Fall surveys conducted in False Pass and Nelson Lagoon reported 26 and 44 emperors harvested for each respective community (Stanek 1990). The magnitude, timing, and location of the subsistence harvest needs to be more accurately documented and monitored to facilitate management efforts to restore the population.

Predation and over-winter mortality causes most of the losses in juveniles while most adult mortality is attributed to subsistence harvest during spring and summer. In Alaska an estimated 70% of the subsistence harvest of emperor geese is during spring and summer (Wentworth and Wong 2001). Low first year juvenile survival and first breeding at 3 years old, suggests recruitment rate of breeding adults is low. Current best estimates suggest spring and summer harvest exceeds recruitment of breeding adults and is therefore a factor in the continued decline in population size.

In 1997, the governments of Canada, Mexico and the United States amended the 1916 MBTA and the subsequent 1936 Mexico Convention for the Protection of Migratory Birds and Game Mammals. These amendments allowed harvests of migratory birds and their eggs during the previously closed period. The Alaska Migratory Bird Co-Management Council (AMBCC) was established in October 2000 to recommend subsistence harvest regulations to the Service and to the Flyway Councils for implantation in Alaska. The AMBCC consists of Alaska Native, Federal and State of Alaska representatives with equal voting responsibilities. Recommended regulations were expedited and the first legal season openings took place in 2003. The AMBCC followed agreements from the Yukon Delta Goose Management Plan and recommended continued closed season for emperor geese

Nonconsumptive Use

The extent of nonconsumptive use of emperor geese is unknown but likely limited due to their remote distribution. Limited viewing and photographic opportunities exist near Kodiak, Cold Bay, Shemya and Adak, as well as near many villages throughout their range. A public information program on arctic nesting geese (Teach About Geese), with an emphasis on emperor geese, prepared by the Fish and Wildlife Service received limited use in schools

throughout Alaska.

IV. MANAGEMENT ISSUES

A. Emperor goose spring survey estimates since 1981 indicate greater than a 50% decline in population size from the historic level and a long-term decline of 0.4% per year.

B. Illegal harvest of emperor geese continues to occur in Alaska at an undetermined rate. Although the MBTA Protocol has resulted in legal spring and summer subsistence hunting of migratory birds, current regulations have kept all seasons closed. Efforts to explain the need for hunting closures and encourage compliance should be increased, particularly in emperor goose staging and wintering areas.

C. Regional or Statewide surveys to estimate timing and magnitude of emperor goose harvest need to be fully funded and implemented. The MBTA Protocol stipulates that harvest will not increase in relation to the continental population. Comprehensive harvest surveys are necessary to assure this mandate is met.

D. Harvest of emperor geese occurs in Russia but information on the timing and magnitude are lacking.

E. An estimated mortality of up to 40% of goslings produced on the Yukon-Kuskokwim Delta, due to predation by an increasing numbers of glaucous gulls, is a primary factor preventing growth of the emperor goose population. A study proposed to evaluate management strategies to reduce this predation has not been implemented.

F. Fox predation on emperor goose eggs, goslings and adults is poorly documented and may be increasing. Information on the magnitude of losses is needed to determine appropriate management strategies.

G. The emperor goose population would face increased risks during migration and winter by proposed oil exploration and development in Bristol Bay and along the Alaska Peninsula.

H. Cooperative management agreements, easements, land exchanges or purchases of refuge in holdings and adjacent properties are needed to insure protection of key nesting, molting and staging areas of emperor geese. Management plans are lacking for some State and Federal owned coastal habitats important to emperor geese. Land use plans and regulations are necessary to avoid impacts of habitat loss and disturbance on emperor geese.

I. Habitat changes on the Yukon-Kuskokwim Delta may impact survival of emperor goose goslings. Historically, goose populations and productivity were higher and they maintained larger expanses of grazed habitats. Lower numbers of geese since the 1980's may have reduced the amount and quality of preferred brood rearing

habitat by over grazing.

J. Insufficient data on wintering ecology is hindering understanding of winter survival factors and needs for management actions.

K. Aerial and ground inventories of Russian breeding and molting habitats are needed to understand emperor goose ecology and monitor population trends.

L. Habitat losses and disturbance from human activities include commercial fishing, oil spills and chronic oil pollution, introduced animals such as foxes and rats, and disturbances from aircraft, boats, all-terrain vehicles, and commercial/industrial activities.

M. Band return rates of emperor geese are low. Lack of data hampers analysis of seasonal distribution of harvest and estimation of survival rates and longevity.

V. RECOMMENDED MANAGEMENT STRATEGIES

The following management procedures are recommended and assigned a priority rating. Their implementation will be influenced by staff availability, fiscal and legislative constraints. When possible, management procedures in this plan should be coordinated and incorporated into those recommended in plans for other species and populations in the Pacific Flyway. Agencies should involve local residents in management activities, where feasible, throughout the range of the species.

A. Harvest Management

1. Implement provisions of this plan and the Yukon-Kuskokwim Delta Goose Management Plan requiring closure of all hunting if the current 3-year running average of spring population estimates is below 60,000 birds. Resumption of harvest may be considered when the population reaches a current 3-year index of 80,000 birds.

   Responsibility: USFWS, ADFG, AMBCC (AVCP-WCC)
   Priority: I
   Schedule: Continuing

2. Continue to implement and enforce federal regulations for harvest of emperor geese and their eggs.

   Responsibility: USFWS, ADFG, ADPS-ABWE, AMBCC
   Priority: I
   Schedule: Continuing

3. Continue support of the Yukon-Kuskokwim Delta Goose Management Plan.

   Responsibility: USFWS, USGS, AMBCC (AVCP), ADFG, CDFG, ODFW, WDFW
   Priority: I
   Schedule: Continuing

4. Conduct annual subsistence harvest surveys throughout habitats used by emperor geese to determine magnitude and timing of emperor goose subsistence harvest in Alaska and monitor trends.

   Responsibility: USFWS, ADFG, AMBCC
   Priority: I
   Schedule: New Start

5. Continue education and outreach programs designed to increase awareness of emperor goose management and biology with the goal of reducing both deliberate and incidental harvest.

Responsibility: USFWS, AMBCC, ADFG
Priority: I
Schedule: Continuing

B. Management and Research (Incorporate Traditional Ecological Knowledge into ongoing management and research activities as appropriate.)

1. Continue annual spring aerial population survey of migratory staging areas to produce the primary population management index.

Responsibility: USFWS
Priority: I
Schedule: Continuing

2. Continue annual fall aerial population survey of migratory staging areas. These data are used in conjunction with photographic age ratio surveys (B.3) to estimate the proportion of juveniles in the fall population.

Responsibility: USFWS
Priority: II
Schedule: Continuing

3. Continue fall aerial photographic survey to determine the proportion of juveniles at staging sites. Continue ground sampling to estimate age ratios and average family group size at Izembek NWR to maintain historic database.

Responsibility: USFWS
Priority: I
Schedule: Continuing

4. Continue aerial breeding population survey in the coastal zone of the Yukon-Kuskokwim Delta. Use in conjunction with random nest plot survey to estimate total nests and potential production.

Responsibility: USFWS
Priority: I
Schedule: Continuing

5. Continue annual random nest plot survey on the Yukon-Kuskokwim Delta coastal zone to index productivity.

Responsibility: USFWS
Priority: I
Schedule: Continuing

6. Conduct an aerial photographic survey of brood flocks on the Yukon-Kuskokwim Delta to compare family size during late brood rearing to family group sizes during migration on the Alaska Peninsula and to assess the effects of potential predator management procedures (Procedure 7).

Responsibility: USFWS
Priority: II
Schedule: Intermittent

7. Initiate studies to determine the effects of predator management designed to reduce emperor goose egg and gosling mortality on the Yukon-Kuskokwim Delta. Evaluate the effectiveness of these actions by estimating juvenile survival rates in relation to other factors influencing gosling mortality. Determine the effect of increased juvenile recruitment on population size.

Responsibility: USFWS
Priority: I
Schedule: New start

8. Communicate with Russians to obtain breeding, molting and migrating information throughout the Russian Far East. Arrange opportunities for cooperative aerial and ground surveys.

Responsibility: USFWS, Russia
Priority: I
Schedule: Continuing

9. Complete population model using best available information to estimate how survival and reproduction effect population change and how manipulations might affect these changes.

Responsibility: USGS-ASC, USFWS
Priority: I
Schedule: Continuing

10. Initiate a study of emperor goose ecology in winter to determine habitat requirements, physiological and nutritional requirements, and mortality factors.

Responsibility: USFWS, USGS-ASC
Priority: I
Schedule: Undetermined

11. Support establishment of protective measures and retain existing ones to maintain adequate breeding and molting areas. Develop cooperative management agreements and public use plans with landowners to protect emperor goose habitat.

Responsibility:	USFWS, ADFG, local governments, Alaska Native organizations, conservation organizations
Priority:	II
Schedule:	Ongoing

12. Support establishment of protective measures and retain existing ones to maintain adequate migratory staging and wintering areas. Develop cooperative management agreements and public use plans with landowners to protect emperor goose habitat.

Responsibility:	USFWS, ADFG, local governments, Alaska Native organizations, conservation organizations
Priority:	II
Schedule:	Ongoing

13. Determine contaminant levels in emperor geese, examining both juveniles and adults, and assess potential effects on health and survival.

Responsibility:	USFWS
Priority:	II
Schedule:	Undetermined

14. Continue cooperative educational and volunteer programs associated with the Yukon-Kuskokwim Delta Goose Management Plan with Alaska Native organizations. Expand education and information programs on emperor goose conservation to include villages in Bristol Bay, Alaska Peninsula, St. Lawrence Island, Seward Peninsula and Aleutian Islands.

Responsibility:	USFWS, ADFG, AVCP, AMBCC
Priority:	I
Schedule:	Ongoing

VI. PLAN IMPLEMENTATION AND REVIEW

An Emperor Goose Subcommittee of the Pacific Flyway Study Committee shall monitor the status of the population, coordinate management activities, and review progress toward achieving the goal and objectives of this plan. The subcommittee shall coordinate with the AMBCC Emperor Goose committee to revise this plan as needed and report, through the Pacific Flyway Study Committee, accomplishments and shortcomings of management efforts to the Pacific Flyway Council, state and federal agencies having relevant management responsibilities, and organizations interested in emperor goose management.

The subcommittee shall be responsible for integrating plan provisions with other plans and programs for waterfowl management. In addition, the subcommittee will ensure that emperor goose management and research guidelines complement the goals of the North American Waterfowl Management Plan.

The subcommittee shall be composed of a representative from each federal and state agency having management responsibility for this goose population. Chairmanship shall be appointed biannually and rotated among member agencies. The subcommittee will exercise its prerogative to invite participation (ex officio) at meetings by any individual, group, agency or representative whose expertise, counsel or managerial capacity is required for coordination and implementation of management programs.

Rotation of the chair shall alternate between USFWS Region 7 and ADFG. Terms begin October 1 and continue for 2 years.

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Emperor Geese

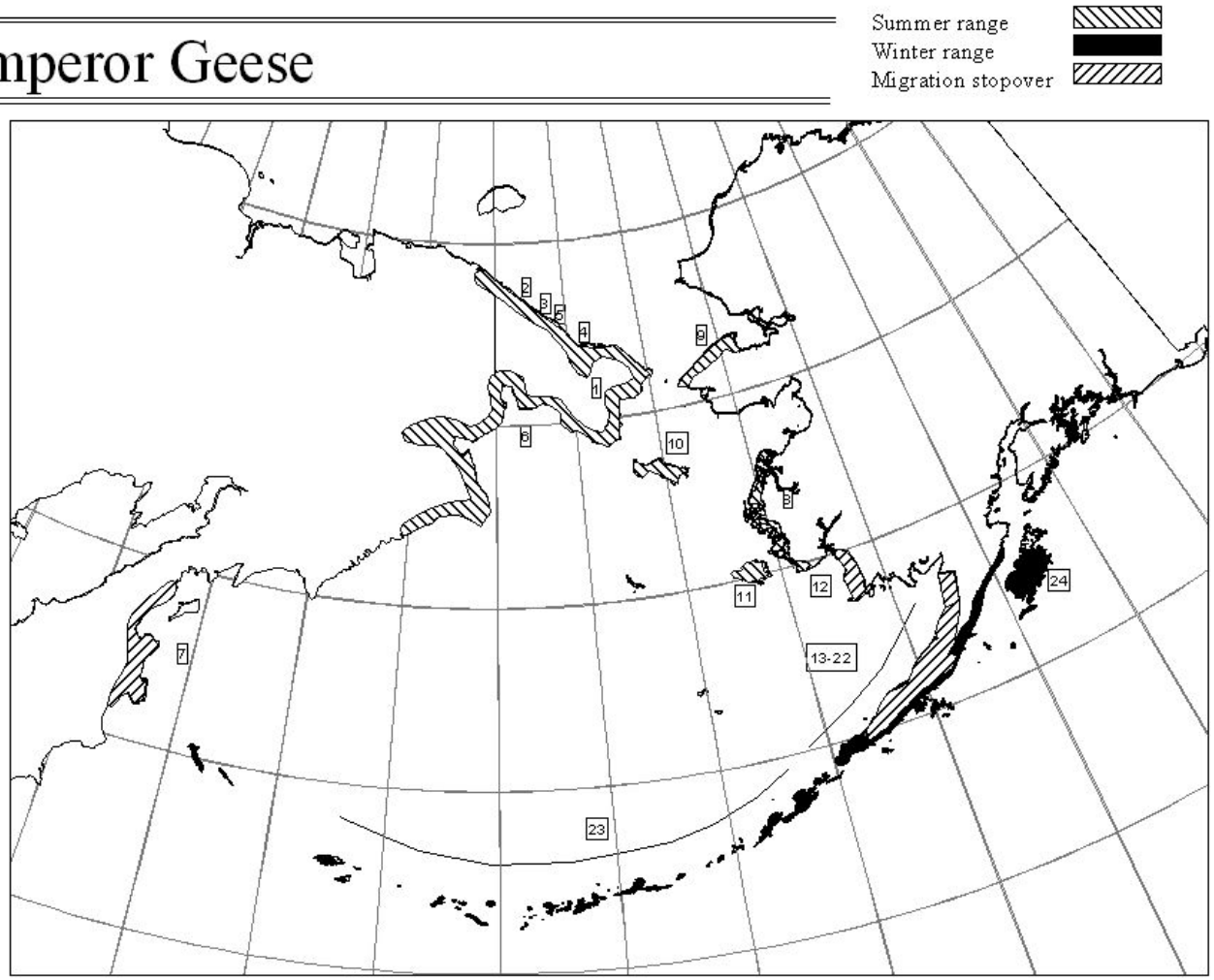

Figure 1. Range of the emperor goose (Numbers refer to Appendix A).

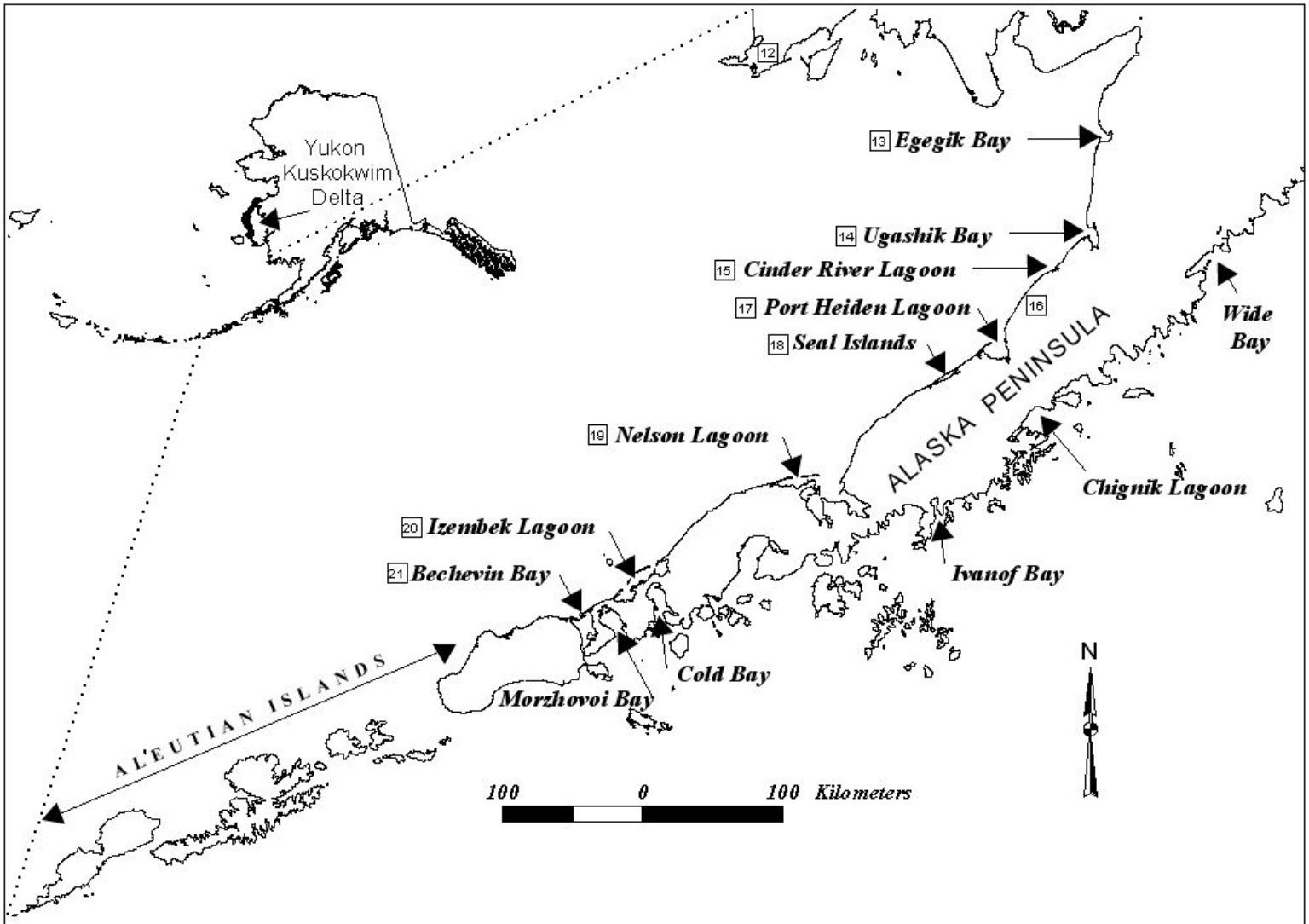

Figure 2. Important estuaries on the Alaska Peninsula used by migrating Emperor geese (Numbers refer to Appendix A).

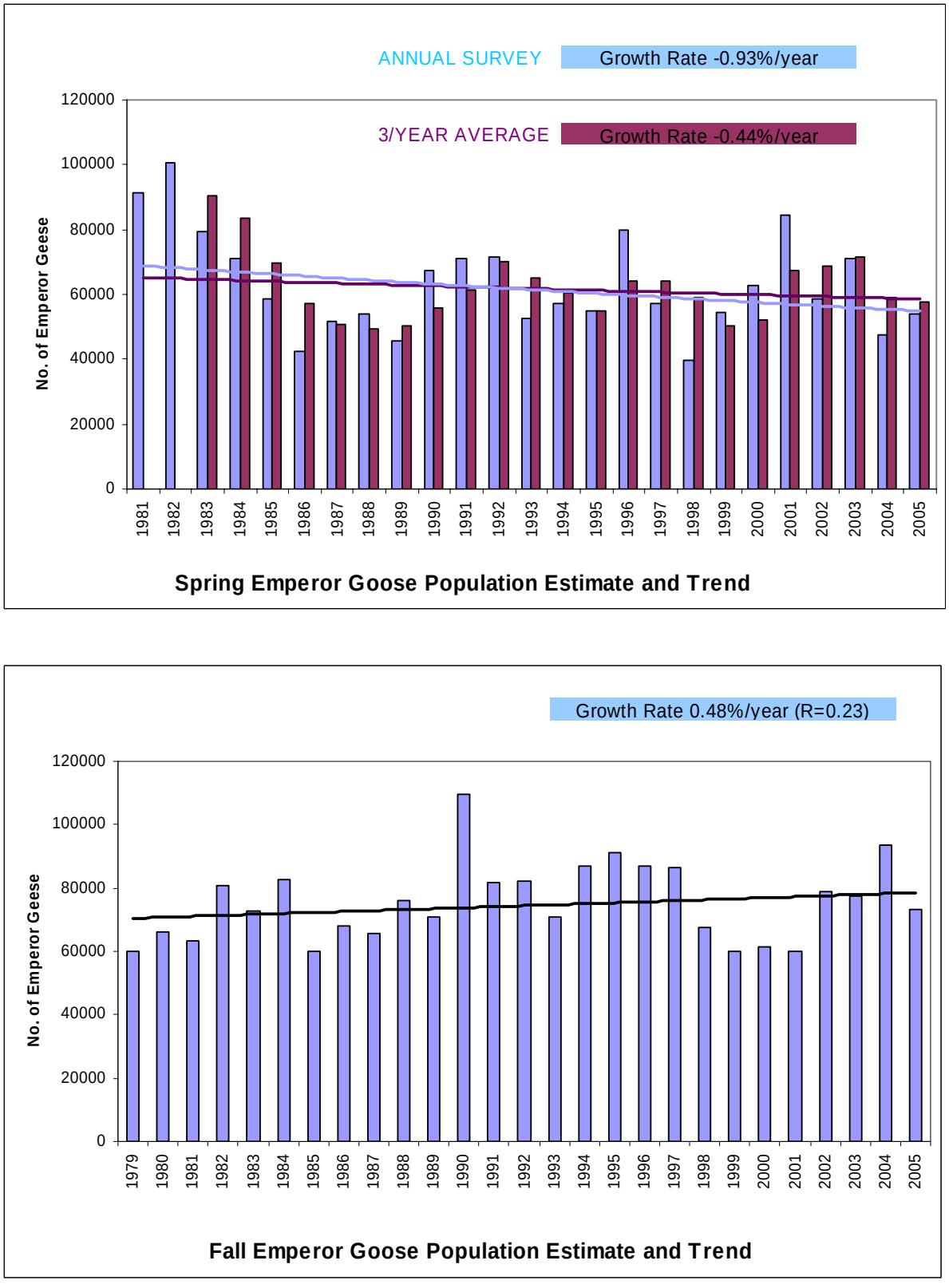

Figure 3. Emperor goose population estimates during spring and fall migration.

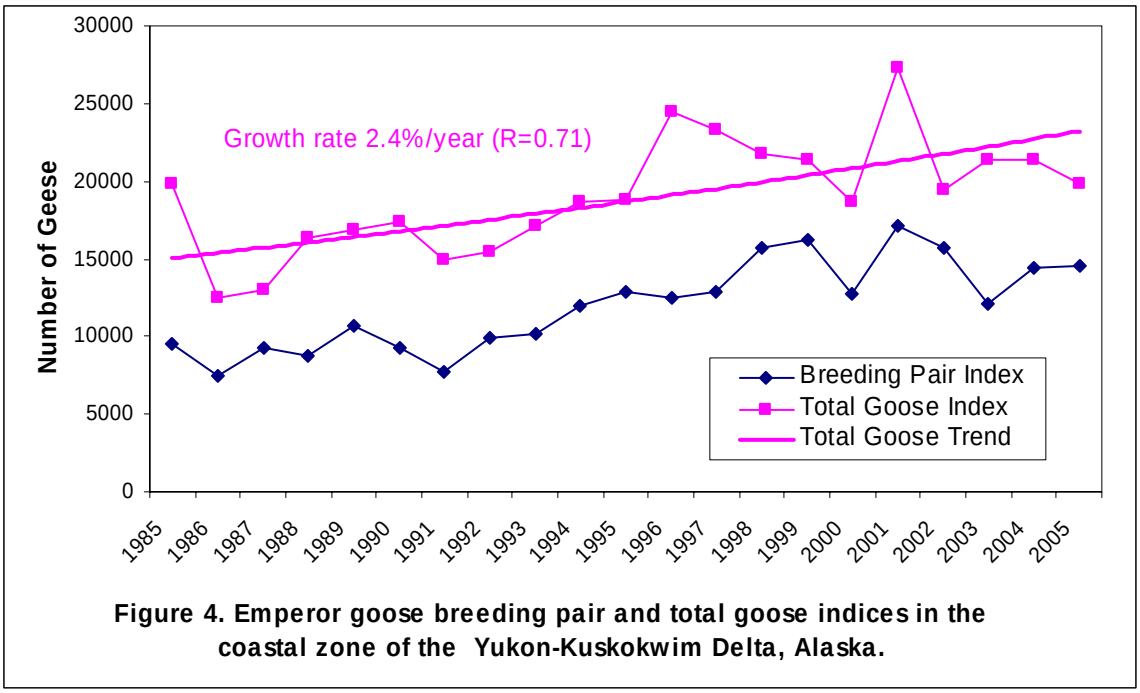

Figure 4. Emperor goose breeding pair and total goose indices in the coastal zone of the Yukon-Kuskokwim Delta, Alaska.

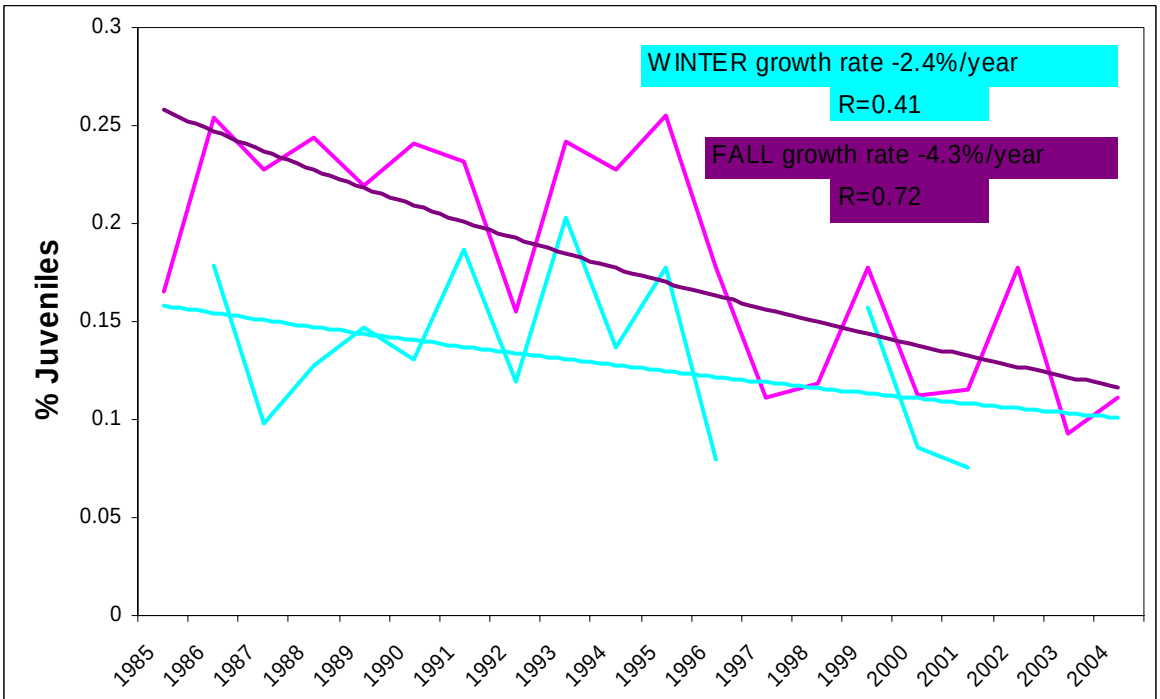

Figure 5. Emperor goose winter age ratios, Aleutian Islands.

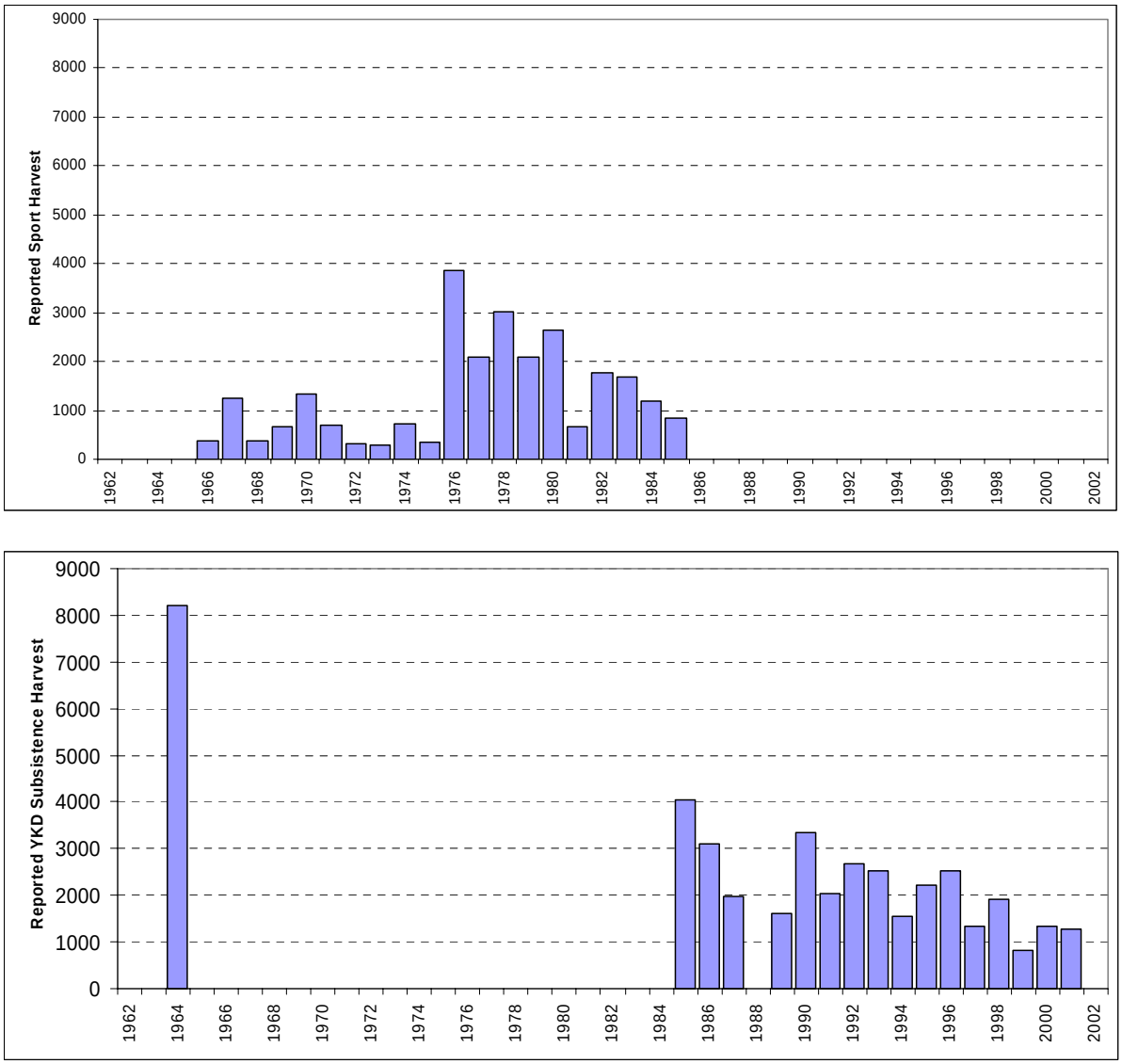

Figure 6. Emperor goose harvest estimates.

Appendix 1. Descriptions of key emperor goose use areas in Alaska and the Russian Far East.

	Area	Use	Number[1]	Season	Ownership	Threats
	RUSSIA					
1.	Chukotsk coastal areas (Cape Shmidt to Mallen Lagoon)	Nesting	3,000-8,000	Spring-Summer		Hunting/Oil Spill/Unknown
		Molting	>21,500			
2.	Tenkergynpilken Lagoon	Molting	<21,500	Summer		Hunting/Oil Spill/Unknown
3.	Ukouge Lagoon	Molting	>2,000	Summer		Hunting/Oil Spill/Unknown
4.	Kolyuchinskaya Bay	Nesting Molting	Unknown <21,500	Spring-Summer		Hunting/Oil Spill/Unknown
5.	Vankarem Lagoon	Nesting	Unknown	Spring-Summer		Hunting/Oil Spill/Unknown
6.	Kresta Bay	Nesting	Unknown	Spring-Summer		Hunting/Oil Spill/Unknown
7.	Kamchatka Peninsula/ Commander Islands	Wintering	Unknown	Winter	Nature Reserves	Oil Spill/Unknown
	ALASKA					
8.	Yukon-Kuskokwim Delta	Nesting	80-90% of pop	Spring-Summer	Yukon Delta NWR, 22(g) lands	Hunting/Oil Spill/Predation
		Molting	80-90% of pop			
9.	Kotzebue Sound coastal	Nesting	+1,000	Spring-Summer	50% Bering Land Bridge NP	Hunting/Oil Spill/Unknown
10.	St. Lawrence Island	Nesting Molting	≤300-1,000 3,000-10,000	Spring-Summer Summer	Native owned	Hunting/Oil Spill/Unknown
11.	Nunivak Island	Nesting	Unknown	Spring-Summer	Yukon Delta NWR, 22(g) lands	Hunting/Oil Spill/Unknown
		Staging	2,000/2,000	Spring/Fall	Yukon Delta NWR, 22(g) lands	Hunting/Oil Spill/Unknown
12.	Chagvan Bay/Nanvak Bay	Staging	11,200/200	Spring/Fall	Togiak NWR	Hunting/Oil Spill/Unknown

Appendix 1. Continued.

	Area	Use	Number[1]	Season	Ownership	Threats
13.	Egegik Bay	Staging	1,800/2,300	Spring/Fall	Part Egegik State CHA	Hunting/Oil Spill/Unknown
14.	Ugashik Bay	Staging	4,275/2,500	Spring/Fall	Part Pilot Point State CHA	Hunting/Oil Spill/Unknown
15.	Cinder River Lagoon	Staging	13,825/24,000	Spring/Fall/Winter	Cinder River State CHA	Hunting/Oil Spill/Unknown
16.	Hook Lagoon	Staging	1,000/2,000	Spring/Fall/Winter	Private Lands	Hunting/Oil Spill/Unknown
17.	Port Heiden	Staging	33,187/28,600	Spring/Fall/Winter	Port Heiden State CHA	Hunting/Oil Spill/Unknown
18.	Seal Island	Staging	14,000/20,000	Spring/Fall/Winter	Private Lands	Hunting/Oil Spill/Unknown
19.	Nelson Lagoon	Staging	60,000/39,400	Spring/Fall/Winter	Part Port Moller State CHA	Hunting/Oil Spill/Unknown
20.	Izembek Lagoon	Staging	18,300/9,100	Spring/Fall/Winter	Izembek NWR/SGR, 22(g) land	Hunting/Oil Spill/Unknown
21.	Unimak/False Pass	Staging	120/4,000	Spring/Fall/Winter	Izembek NWR, 22(g) land	Hunting/Oil Spill/Unknown
22.	Alaska Peninsula (south side)	Staging	4,200/9,600	Spring/Fall/Winter	Alaska Peninsula, Becharof, and Izembek NWRs	Hunting/Oil Spill/Unknown
23.	Aleutian Islands	Wintering	Unknown	Winter	Alaska Maritime NWR, DOD land	Hunting/Oil Spill/Unknown
24.	Kodiak Island	Wintering	Unknown	Winter	Kodiak NWR, 22(g) land	Hunting/Oil Spill/Unknown

[1] Areas 12-22, numbers are averages for Spring/Fall emperor goose surveys.

Appendix 2. Population indices for emperor geese - spring and fall surveys, 1979-2005.

Year	Spring Survey	3/Year Spring Average	Fall Survey
1979			59808
1980			65971
1981	91267		63130
1982	100643		80708
1983	79155	90355	72551
1984	71217	83672	82842
1985	58833	69735	59790
1986	42231	57427	68116
1987	51633	50899	65663
1988	53776	49213	76165
1989	45800	50403	70729
1990	67581	55719	109531
1991	70962	61448	81782
1992	71319	69954	82295
1993	52546	64942	71051
1994	57267	60377	87086
1995	54852	54888	91009
1996	80034	64051	87018
1997	57059	63982	86669
1998	39749	58947	67744
1999	54600	50469	60226
2000	62565	52305	61626
2001	84396	67187	59987
2002	58743	68568	78692
2003	71160	71433	77290
2004	47352	59085	93544
2005	53965	57492	73212

Data provided by USFWS, Migratory Bird Management, Anchorage.

Appendix 3. Indicated total and pair indices for emperor geese from the coastal zone of the Yukon-Kuskokwim Delta, Alaska, 1985-2005.

Year	**Pairs**[1]	**Indicated Total Geese**	SE
1985	**9,542**	**19,805**	1,960
1986	**7,413**	**12,430**	1008
1987	**9,312**	**13,035**	1,121
1988	**8,695**	**16,392**	1,402
1989	**10,737**	**16,855**	1,220
1990	**9,282**	**17,347**	1,401
1991	**7,758**	**14,888**	1,284
1992	**9,879**	**15,416**	994
1993	**10,183**	**17,147**	1,230
1994	**12,007**	**18,733**	1,059
1995	**12,892**	**18,764**	1,072
1996	**12,433**	**24,413**	2,476
1997	**12,820**	**23,287**	1,451
1998	**15,686**	**21,741**	1,541
1999	**16,208**	**21,406**	1,591
2000	**12,798**	**18,667**	949
2001	**17,112**	**27,297**	1,473
2002	**15,646**	**19,504**	1,326
2003	**12,141**	**21,378**	1,746
2004	**14,410**	**21,396**	1,097
2005	**14,490**	**19,798**	1,190

[1] Indicated pairs = 2 x (singles + pairs)

Appendix 4. Population size estimates of nests and eggs on the Yukon-Kuskokwim Delta (YKD), Alaska 1985-2005. The number of nests and eggs outside the ground sampled area was calculated by multiplying the ground sampled estimate by the ratio of indicated breeding pairs outside/inside the ground sampled area, as determined by aerial surveys. Indicated breeding pairs were based on twice the number of singles plus the number of birds in pairs observed.

Year	# plots	Total Nests	SE	Active Nests	SE	Active Eggs	SE	Clutch Size	n
1985	48	**19941**	4653	**9452**	2967	**49422**	15312	**5.2**	113
1986	101	**25432**	2447	**17830**	1752	**90482**	8933	**5.2**	218
1987	125	**24569**	2491	**22728**	2320	**114672**	12048	**5.1**	361
1988	95	**16480**	2133	**15033**	2081	**77714**	11937	**5.1**	192
1989	89	**25862**	3236	**23089**	2816	**116311**	14387	**5.1**	292
1990	101	**24239**	2015	**21438**	1957	**107902**	9741	**4.9**	288
1991	97	**33066**	3232	**31432**	3076	**155655**	16039	**5.0**	356
1992	66	**26807**	2645	**25548**	2608	**127809**	13305	**5.0**	259
1993	99	**24085**	2524	**22851**	2428	**108142**	11652	**4.9**	285
1994	43	**38294**	4053	**36231**	3949	**179393**	20344	**4.9**	308
1995	50	**31388**	3431	**30367**	3363	**147737**	16140	**4.9**	297
1996	54	**32086**	3031	**30264**	2947	**155068**	15507	**5.1**	280
1997	75	**22062**	2227	**21142**	2184	**101024**	10497	**4.8**	230
1998	72	**26890**	2653	**25515**	2583	**119215**	12226	**4.7**	266
1999	59	**31391**	3087	**28971**	2878	**128247**	12718	**4.5**	224
2000	80	**35490**	3607	**34982**	3549	**174409**	17979	**5.0**	344
2001	81	**14174**	1390	**10995**	1207	**52486**	6179	**4.8**	127
2002	84	**36062**	4226	**33546**	3952	**168609**	19806	**5.0**	303
2003	83	**24166**	2784	**19334**	2407	**92930**	12085	**4.8**	211
2004	81	**32324**	3085	**30866**	2991	**150507**	14764	**4.9**	338
2005	83	**37645**	3438	**35448**	3228	**178427**	16361	**5.0**	380

Appendix 5. Fall age ratio estimates from aerial photographs of emperor geese on the north side of the Alaska Peninsula, 1985-2005.

Year	Age Ratio	SE	No. Geese Classified	No. Photos
1985	0.165	0.026	3,193	155
1986	0.254	0.051	6,830	311
1987	0.228	0.008	10,177	703
1988	0.244	0.009	11,180	483
1989	0.219	0.011	12,718	390
1990	0.241	0.009	13,541	474
1991	0.232	0.009	14,569	412
1992	0.155	0.008	14,832	403
1993	0.242	0.013	5,735	255
1994	0.228	0.01	16,881	479
1995	0.255	0.013	11,664	361
1996	0.178	0.014	10,793	182
1997	0.111	0.008	11,138	205
1998	0.118	0.007	16,544	336
1999	0.178	0.01	13,489	392
2000	0.112	0.009	7,748	263
2001	0.115	0.008	11,186	365
2002	0.178	0.01	6,458	402
2003	0.093	0.007	8,686	421
2004	0.111	0.007	6,237	370
2005	Waiting data.			

Appendix 6. Emperor goose annual production estimates, Izembek NWR, 1966-2005.

Year	Adults	Juveniles	Total Classified	% Juveniles
1966	699	265	964	27.5
1967	1,457	585	2,042	28.6
1968	1,195	585	1,780	32.9
1969	4,149	2,980	7,129	41.8
1970	9,722	4,933	14,655	33.7
1971	1,842	3,458	11,600	29.8
1972	4,680	2,270	6,950	32.7
1974	2,025	377	2,402	15.7
1975	744	405	1,149	35.2
1976	1,923	324	2,247	14.4
1977	996	683	1,679	40.7
1978	1,395	495	1,890	26.2
1979	841	113	954	11.8
1980	1,777	586	2,363	24.8
1981	1,067	495	1,562	31.7
1982	1,653	140	1,793	7.8
1983	1,058	393	1,451	27.1
1984	2,753	795	3,548	22.4
1985	2,245	503	2,748	18.3
1986	3,283	1,381	4,664	29.6
1987	2,926	1,523	4,512	33.8
1988	3,884	1,242	5,126	24.2
1989	3,811	1,136	4,947	23.0
1990	4,002	1,068	5,070	21.1
1991	8,599	2,882	11,481	25.1
1992	9,291	1,347	10,638	12.7
1993	13,976	2,176	16,152	13.5
1994	4,658	792	5,450	14.5
1995	6,434	1,618	8,052	20.1
1996	3,128	631	3,759	16.8
1997	1,345	144	1,489	10.0
1998	1,595	432	2,027	21.4
1999	2,395	527	2,922	18.0
2000	1,870	410	2,280	18.0
2001	1,232	228	1,460	15.6
2002	4,789	1,842	6,631	27.8
2003	5,744	785	6,529	12.0
2004	4,600	1,288	5,888	21.9
2005	2,844	1,139	3,983	28.6

Appendix 7. Emperor goose family group counts at the Izembek NWR, 1966-2005.

Year	Total Families	Total Juveniles	Avg. Family Group Size
1966	132	331	2.51
1967	66	215	3.26
1968	40	112	2.80
1969	161	530	3.29
1970	383	1,115	2.91
1971	484	1,318	2.72
1972	210	641	3.05
1974	50	130	2.60
1975	51	149	2.92
1976	207	567	2.74
1977	108	302	2.80
1978	62	188	3.03
1979	53	175	3.30
1980	40	93	2.33
1981	181	571	3.15
1982	32	85	2.66
1983	192	612	3.19
1984	80	230	2.88
1985	125	354	2.83
1986	266	794	2.98
1987	186	577	3.10
1988	200	616	3.08
1989	145	455	3.14
1990	97	309	3.19
1991	147	487	3.31
1992	151	451	2.99
1993	161	441	2.74
1994	301	703	2.34
1995	99	319	3.22
1996	125	330	2.64
1997	43	114	2.65
1998	97	239	2.46
1999	82	200	2.44
2000	105	229	2.18
2001	42	103	2.45
2002	260	696	2.68
2003	218	439	2.01
2004	235	568	2.42
2005	131	365	2.79

Appendix 8. Emperor goose winter productivity estimates, Aleutian Islands, Alaska[1].

	Estimates[2]			
Year	**Adults**	**Juveniles**	**Total**	**% Juveniles**
1988/89	4142	597	4739	12.6
1989/90	5249	923	6172	15
1990/91	3595	537	4132	13
1991/92	13424	2925	16349	17.9
Sum	26410	4982	31392	
Average	6603	1249	7849	15.9

[1] Data supplied by the Alaska Maritime NWR - Aleutians Islands Unit.
[2] Estimates represent cumulative totals from multiple surveys.

Appendix 9. Reported fall harvest of emperor geese in Alaska, 1970-1986.

Year	Harvest[1]
1970	1,400
1971	715
1972	1,840
1973	2,373
1974	2,067
1975	2,891
1976	2,592
1977	2,198
1978	2,968
1979	2,055
1980	2,306
1981	700
1982	1,770
1983	1,674
1984	1,188
1985	835
1986-Present	Closed

[1] Harvest information based on ADF&G mail questionnaire surveys (1970-76 and 1982-85) and USFWS harvest surveys (1977-81).

Appendix 10. Emperor goose spring population and subsistence harvest estimates, 1985-2002.

Year	Population Size	Y-K Delta	Bristol Bay	Togiak	Alaska Peninsula
		Number (%)	Number (%)	Number (%)	Number (%)
1985	58,833	4031 (6.9)			
1986	42,231	3091 (7.3)			
1987	51,633	1352 (2.6)			
1988	53,776	No Survey			
1989	45,800	1616 (3.5)			
1990	67,581	3440 (5.1)			
1991	70,962	2394 (3.4)			
1992	71,319	2669 (3.9)			
1993	52,546	2602 (5.0)			
1994	57,267	1493 (2.6)			
1995	54,852	2041 (3.7)	123 (0.22)	187 (0.34)	144 (0.26)
1996	80,034	2374 (3.0)	No Survey	32 (0.04)	148 (0.18)
1997	57,059	1469 (2.6)	16 (0.03)	97 (0.17)	236 (0.41)
1998	39,749	1899 (4.8)	No Survey	481 (1.20)	126 (0.32)
1999	54,600	818 (1.5)	37 (0.07)	113 (0.21)	No Survey
2000	62,565	1352 (2.2)	No Survey	59 (0.09)	249 (0.40)
2001	84,396	1078 (1.3)	45 (0.05)	8 (0.01)	173 (0.20)
2002	58,743	1250 (2.1)	NA	NA	NA