Alaska Midcontinent Greater White-fronted Geese – Project Updates, 2010-2011 Field Seasons

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February, 2012

Keywords: *Anser albifrons frontalis*, greater white-fronted goose, Alaska, population trends, productivity, breeding biology, distribution, leg-banding, survival, body condition, management plan, disease.

The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the U.S. Fish and Wildlife Service.

Introduction

Throughout their range (Fig. 1), midcontinent greater white-fronted geese (*Anser albifrons frontalis*) are an important resource for subsistence and sport hunters and non-consumptive users. Waterfowl biologists in the U.S. Fish and Wildlife Service, Alaska Department of Fish and Game, U.S. Geological Survey, and the University of Alaska have designed numerous studies on white-fronted geese (hereafter, white-fronts) in Alaska to provide relevant data to wildlife managers. In Alaska, most of the recent work has focused on boreal forest nesting white-fronts in interior and northwest Alaska due to concerns of low survival and apparent regional declines in abundance during the 1990s (Spindler et al. 1999).

This report is a summary of recent and ongoing projects that monitor population trend, distribution, harvest, breeding biology, survival, and disease in midcontinent white-fronts that breed in Alaska. Changes in management strategies are also described.

Population Trends

Waterfowl Breeding Population and Habitat Survey, Alaska – Several aerial surveys provide data on population trends of midcontinent white-fronts in Alaska. Since 1964, the Waterfowl Breeding Population and Habitat Survey is used to monitor population trends in key waterfowl production areas in Alaska (Mallek and Groves 2011). Data from this survey provides breeding pair and total bird indices for white-fronts in boreal habitat of interior and northwest Alaska (Fig. 2). The indicated breeding pair index (2*singles + paired birds) and the indicated total bird index (2*singles + paired birds + flocks) increased ten-fold during the period of 1964-1986 (Fig. 3) outpacing more modest population increases on fall and winter surveys in the Central and Mississippi Flyways during the same period (Kruse 2010). Despite increases in the midcontinent population as a whole, white-front population indices in Alaska declined between the mid-1980s and early 1990s (Fig. 3). Since the mid 1990s, the indicated breeding pair and indicated total bird indices in Alaska have been stable to slightly increasing. In 2011, both indices were higher than the 2010 and 3-year averaged indices.

The indicated total bird index is prone to high variability resulting from occasional observations of large flocks that are on route to tundra breeding sites to the north of the survey area. This effect was apparent in 1986 and 2000 when several large flocks observed in the Yukon Flats stratum significantly inflated the total bird index for the entire interior and northwest Alaska region. This again appears to be the case in 2011. Unlike the indicated total bird index, the indicated breeding pair index tracks the

local nesting bird population. For this reason, the breeding pair index may be a more reliable long-term index to monitor the trend of midcontinent white-fronts in boreal habitats of Alaska.

Regional Breeding Pair Surveys – Regional aerial breeding pair surveys were conducted at Selawik NWR in 2005-2008 and at Kanuti NWR in 2007-2008 to determine site-specific timing of white-front arrival, peak abundance of indicated breeding pairs, and feasibility of detecting geese in a boreal habitat (Harwood, USFWS, pers. comm. 2009, Fischer et al. 2008, Fischer 2009). Results suggest that due to differences in habitat and location relative to ultimate breeding sites, surveys are feasible at Selawik NWR but not at Kanuti NWR. Specifically, habitat at Selawik NWR is tundra interspersed with patches of boreal forest that provides good visibility for survey crews. Additionally, Selawik NWR is at the terminus of the spring migration route, reducing the likelihood that counts are biased by overflight geese. In contrast, Kanuti NWR is primarily boreal forest habitat and is both a breeding site and a spring migration staging area. As a result, visibility of geese is low and it is unclear whether geese observed in this region represent local breeders or migrating geese bound for breeding sites further north. The effort at Kanuti NWR showed that paired geese can be detected but the ambiguity in their ultimate breeding location raises the question as to whether a breeding pair survey is appropriate at this site. Due to these concerns, no additional breeding pair surveys were conducted at Kanuti NWR after 2008.

The breeding population survey at Selawik NWR is integrated into the refuge monitoring plan to be conducted every three years. The survey was repeated in 2011. Survey results from Selawik NWR in 2005-2008 indicated a stable population (Fischer 2009). In 2011, almost 30% more total white-fronts were observed by Selawik NWR personnel compared to the mean of 2005-2008 (Fig. 4, USFWS, preliminary data). Results of Selawik Canada geese counts are also displayed in Fig. 4.

Arctic Coastal Plain Survey – The Waterfowl Breeding Population and Habitat Survey in Alaska provides population indices for waterfowl production areas in much of the state but does not sample waterfowl habitat on the Arctic Coastal Plain due largely to logistical issues in the early days of the survey. From 1986 to 2006, an annual survey was conducted over the entire Alaskan Arctic Coastal Plain (ACP) to fill this data gap (Mallek et al. 2007, Larned et. al. 2011). In 1992, in response to listing of spectacled eiders as Threatened under the Endangered Species Act, another survey was initiated in the northern ACP. In 2007, the surveys were merged and now provide data from 20 strata in two regions, northern and southern. The northern region, with higher waterbird densities, has consistent data from 1993.

In 2007-2011, the northern region ACP contributed 72% and 78% of the estimated breeding birds and total white-fronts. Between 2005 and 2009, the population of white-fronts in the northern region ACP grew rapidly but appears to have leveled off in 2010-2011 (Larned et al. 2011, Fig. 5a). The average annual growth rate of indicated total white-fronts in the northern region 1993-2011 was 1.069. The long-term growth rate increased in the most recent 10-year period to an average annual growth rate of 1.113. For the entire ACP, since the 2007 implementation of the new design with all areas surveyed together, the indicated total white-front estimate has been relatively stable at slightly over 200,000 birds (Fig. 5b).

Interior and Northwest Alaska Molting Surveys – Boreal nesting midcontinent white-fronts molt in predictable locations in interior and northwest Alaska including in Koyukuk-Nowitna, Kanuti, Innoko, and Selawik National Wildlife Refuges. Standardized aerial molting goose surveys have been conducted annually at Koyukuk-Nowitna NWR since 1994 (Spindler et al. 1999, Bryant 2011), Innoko NWR since 2000 (Kovach et al. 2010), and Selawik NWR from 2000-2005 (Fig. 6). In 2001, the molt survey was expanded to include Kanuti NWR, but no surveys were completed in 2004 and 2005 due to forest fires in the region (Harwood 2010). Surveys were also conducted in Noatak Flats and Seward Peninsula in 2003 and 2004, but were discontinued in 2005, as was the survey at Selawik NWR in 2006 due to implementation of a white-fronted goose breeding pair survey as an alternate to the molt survey. Innoko NWR has, by far, the highest estimates of molting white-fronts (Fig. 7); in the first 12 years of the survey (2000-2011) total numbers ranged from 9,837 to 27,260. Annual estimates of adults and young from these survey efforts are presented in Tables 1 and 2 and Figure 7a and 7b for adults. Comparable estimates were obtained for Canada geese at these sites and are reported in Table 3.

Region-wide abundance of molting white-fronts varies considerably within and among sites. The 2011 adult estimate at Innoko of 12,727 (USFWS unpubl. data) is above 2010 levels but below the 2000-2011 mean of 15,917. At Koyukuk NWR, abundance of molting white-fronted geese declined steadily from 1994 to 2001 raising concerns of local depletion, but by 2004 molt surveys there indicated an increase to levels observed in the mid 1990s. In 2011, the Koyukuk adult goose index was 2,578, the highest estimate to date and well above the previous long-term mean of 1,159 (1994-2011).

On average, Innoko NWR molting areas supports more than 70% of adult white-fronts from primary interior and northwest Alaska breeding sites (Fig. 7) but contributes relatively little towards production of young. As such, Innoko NWR is a principal molting destination for failed and non-breeding white-fronts from throughout the interior of Alaska. At Innoko and Selawik NWRs, only 0.7% and 2.6% of white-fronts observed on molt surveys are goslings and the highest estimates of adult molting geese are recorded. In contrast, estimates for molting white-fronts at Koyukuk and Kanuti NWRs, may be more reflective of local breeding populations because on average 37% and 21% of white-fronts observed, respectively, are goslings (Table 2).

Assessment of population trends using molt surveys estimates is difficult. Given the low proportion of goslings in most molt survey areas, it is likely the molt survey monitors geese that have migrated from breeding sites outside of the molting survey area. Molt migration in geese generally involves non-breeders or failed breeders (Salomonsen 1968, Hohman et al. 1992) with highest numbers expected at molt sites in years of poor breeding success (Reed et al. 2003). Thus, abundance estimates derived from molt surveys represents a combination of population size and current breeding conditions, but it is difficult to separate the two.

Teshekpuk Lake Special Area Molting Goose Survey – The area north and east of Teshekpuk Lake on the Alaskan Arctic Coastal Plain has long been known to attract large numbers of molting geese (King 1970; King and Hodges 1979). Since 1982, an aerial survey has been completed in this region annually during the July molting period to document distribution and abundance of geese (Fig. 8a). The 2011 white-front estimate was 25,225 adults and subadults and 6,747 goslings (Mallek 2011), similar to 2010 (Fig. 8b). Numbers of white-fronts at this location have increased dramatically since 1982

with a mean annual growth rate of 1.12. It is assumed that white-fronted geese that molt in this area generally breed on the arctic coastal plain of Alaska (Mallek 2011) as banding studies have shown that interior breeders rarely migrate to the North Slope to molt (Martin 1998, Marks 2011, Bird Banding Lab unpubl. data).

The Teshekpuk Lake Special Area comprises a relatively small portion of white-fronted goose molting habitat on the North Slope; thus, inferences drawn from this survey should be limited to this immediate geographic area. Because white-fronts molt in many locations on the North Slope, changes in abundance as measured by the Teshekpuk survey could be attributed to a change in distribution rather than a change in abundance. However, given the positive growth rate of white-fronts as measured on the ACP breeding pair survey (Larned et al. 2011) it follows that the molting population would reflect this increase. Distribution of molting geese in the Teshekpuk Lake Special Area is described in Flint et al. (2008).

Productivity

Float Survey - Beginning in 1983, staff at Koyukuk/Nowitna NWR conducted annual post-breeding float surveys in late June-early July to monitor trends in white-front productivity (Spindler et al. 2005). Since 1996, portions of the Dulbi, Kaiyuh, and Nowitna rivers (60, 176, and 143 miles, respectively), have been surveyed providing annual estimates of age ratios as an index to productivity. In 2011, apparent productivity as measured by the proportion of young, was much higher than the preceding 14-year average along Dulbi river (Table 4, Fig. 9). Productivity was average on the Nowitna in 2011 and the Kaiyuh River was not surveyed in 2011 due to flooding. Percentage of young for the entire survey area was 67 in 2011, almost double the 37% estimated in 2010. However, the number of young counted in 2011 was only slightly higher than the 16-year average. Corresponding data for Canada geese were also collected on the survey and are presented in Table 5 and Figure 10.

Delta Junction Fall Age Ratio –Annual population surveys and banding programs allow for state-wide monitoring of abundance and annual survival, but state-wide estimates of productivity are difficult to measure. Unlike other goose populations in Alaska whose productivity is monitored on the nesting grounds, boreal nesting white-fronted geese breed in low densities throughout the region making nesting surveys logistically difficult and expensive. Koyukuk/Nowitna NWR conducts annual float surveys to estimate productivity, but inferences from these results are limited to the local region and are not necessarily representative of the midcontinent population in Alaska. USFWS measured white-front production for the entire interior and northwest Alaska region to determine whether current survival rates were sustainable and to provide a covariate for analysis of molt surveys that may be influenced by variation in breeding success (Fischer and Schock 2010).

To obtain an index of production, age-ratios were calculated for fall migrating white-fronts near Delta Junction, Alaska 2005-2011. There, white-fronts from throughout the interior/NW Alaska region congregate in fields of waste grain in late August (Debb Webb, unpubl. satellite transmitter data; Bird Banding Lab unpubl. data). Goose arrival, departure, and duration of stay in the Delta Junction vicinity varies among years, but white-fronts may be present from early August through mid-September (Schock, USFWS, pers. comm. 2011). Leg band return data suggest that use of Delta Junction in fall is limited to the interior and northwest Alaska component of midcontinent white-fronts (unpubl. BBL data). A small portion of white-fronts that breed on the Arctic Coastal Plain use Delta Junction as a staging area, but this occurs only during spring

migration (unpubl. BBL data). Therefore, fall age-ratio estimates are expected to reflect breeding success of the interior and northwest Alaska component of the Alaska midcontinent population.

In 2005 and 2006 data on flock size, family group size, and age-ratios were collected during morning and evening feeding periods on private farmlands (Fischer 2006, 2007). Due to private land status and variability in harvesting schedules among land owners each year, access to flocks of geese was not assured. Therefore, in 2007-2009 data collection efforts were directed towards roosting flocks on the Tanana River (Fischer and Schock 2010). This effort was continued in 2010-2011.

Data from 2009 is reported in Fischer and Schock (2010) and is presented in Table 6. Analysis of 2010 and 2011 data is currently underway and will be presented in a Masters thesis and subsequent publication now in development (Wade Schock, University of Alaska, Anchorage, unpubl. data).

Fall Inventory Survey- Alberta/Saskatchewan – The management plan for midcontinent white-fronts identifies the fall staging survey in Prairie Canada as the primary tool to assess range-wide population status. As such, harvest regulations in the Central and Mississippi Flyways are directly linked to the outcome of the fall staging survey. While the survey is not an Alaskan project per se, an unknown portion of the birds counted during the survey breed in Alaska.

The 2011 fall inventory yielded 685,700 white-fronted geese with an updated 3-year running average of 659,567 birds (Warner et al. 2011; Fig.11). The 2011 point estimate and 3-year running average were 3% below the estimates reported the previous year. Based on the 3-year running average, the midcontinent population remains above the objective of 650,000. The North-western Alberta (Peace River region) area was not surveyed in 2011 due to weather conditions although the area was surveyed by ground personnel with limited area coverage (Warner, CWS, pers. comm.).

Harvest

Subsistence – In 1997 migratory bird treaties with Canada and Mexico were amended to authorize spring and summer subsistence hunting of migratory birds in Alaska. In response, the Alaska Migratory Bird Co-Management Council (AMBCC) was formed, composed of USFWS, Alaska Department of Fish and Game (ADFG), and representatives from 12 subsistence harvest regions. One responsibility of the Council is to assess and report spring and summer subsistence harvest. To meet that responsibility AMBCC designed and implemented statewide subsistence harvest survey starting in 2004.

In 2011, the AMBCC released subsistence harvest estimates by region and subregion for the years 2004-2009 (Naves 2011; Tables 7 and 8). All regions are not necessarily sampled every year; thus, inter-year comparisons are not possible within the four year period. The surveys do, however, provide an estimate of the mean harvest of midcontinent white-fronts by region. During the 2004-2009 period, subsistence hunters harvested an average of 21,213 midcontinent white-fronts annually, with 62% of the harvest occurring on the North Slope.

While 38% of the subsistence harvest of midcontinent white-fronts occurs south of the Brooks Range, an unknown proportion of these birds were on route to breed on the North Slope when they were taken. For example, within the Interior Region, the highest level of subsistence harvest occurred in the Upper Yukon Subregion; yet given the relatively low reported production of white-fronts in that subregion (Mark Bertram,

USFWS, pers. comm.) and the low proportion of indicated breeding pairs relative to other interior regions (Debbie Groves, MBM unpubl. data), it is likely that most spring migrants harvested in the Upper Yukon would have bred on the North Slope. Some historical subsistence harvest estimates are presented in Table 9.

Sport – Since 1999, state and flyway estimates of waterfowl sport harvest are generated by the Harvest Information Program (HIP; Raftovich et al. 2011). Harvest of midcontinent white-fronts has tracked well with the fall population index since 1999 (Fig. 12). Harvest estimates in the Central Flyway and the Canadian provinces of Saskatchewan and Alberta are likely most relevant to boreal nesting white fronts in Alaska because band return data suggests that 64% of sport harvest of white-fronts from interior and northwest Alaska occurs in those areas (Ely, USGS, pers. comm.; Fig. 13). The combined harvest of white-fronts in the Central and Mississippi flyways and in Alberta and Saskatchewan in 2010 was up from 2009 (Fig. 12). Harvest in Canada is not measured by the HIP survey, and thus is not directly comparable to HIP results, but CWS harvest estimates in Alberta and Saskatchewan during 2010 were also up slightly from 2009 (+8.6%) although were below the 1999-2008 mean (Raftovich et al. 2011). Harvest estimates for 2011 will be available in 2012.

Harvest Management

A substantial decline in the midcontinent white-front population from over one million birds in 1998 to about 600,000 by 2002 was addressed in the 2005 revision of the Midcontinent Greater White-fronted Goose Management Plan as reflected in a new harvest strategy with a more conservative management approach. For example, in the 2005 Plan the population objective was changed from 600,000 to 650,000 as measured by the fall staging survey in prairie Canada. The new management plan also specified three harvest frameworks – restrictive, base, and liberal. The threshold to trigger restrictive regulations is when the population index drops below 500,000 in any single year, whereas previously, the trigger was based on the 3-year running average. Once restrictive regulations are adopted, the population index must surpass 600,000 based on the 3-year running average before base regulations are restored. Further, the threshold to trigger liberal regulations was raised from 700,000 to 800,000 based on the 3-year running average. Changes to harvest guidelines in the revised management plan are expected to reduce the likelihood of rapid declines in fall indices resulting from liberal hunting regulations.

No significant changes in harvest management of midcontinent white-fronts were proposed in the last few years as the population currently remains near the objective and Alaska regional population trends are stable. A minor revision to the 2005 management plan was completed and signed by Pacific, Central, and Mississippi Flyway Councils in 2010 (Sullivan 2010).

Distribution

Leg-band and neck collar data –Leg-band and neck collar resight data indicate that midcontinent greater white-fronted geese nesting areas in interior and northwest Alaska have different migration and winter distributions than those from other portions of the breeding range (Ely and Schmutz 1999, Anderson and Haukos 2003). For example, interior/northwest Alaska birds are more likely to winter in Mexico and use spring staging grounds in northwestern Texas and Nebraska than geese from other breeding

areas. Further, geese from interior and northwest Alaska initiate fall and spring migration earlier than other segments of the midcontinent population.

Satellite transmitters – From 2001 to 2003 satellite transmitters were deployed in 51 midcontinent white-fronts in Alaska to study migration pathways and timing of movements. Principal findings of this research were that during fall staging, white-fronts from interior and northwest Alaska had very little spatial and temporal overlap with white-fronts from North Slope Alaska. Results of this research are presented in Webb (2006). No additional analyses on distribution have been completed since 2006.

Leg-Banding Program

Leg banding is an effective tool to examine survival rates, migration routes, and harvest distribution in migratory birds. A minimum annual sample of 1,000 banded white-fronts in interior/northwest Alaska is needed for 10 years to ensure a 90% chance of detecting a 5% difference in survival rate (Schmutz 2001). A total of 49,622 midcontinent white-fronts have been banded in major molting areas in interior, northwest, and North Slope Alaska since 1969 (Table 10, Figure 14). In 2011, staff from Migratory Bird Management, Innoko NWR, and Koyukuk/Nowitna NWR banded 2,095 white-fronts at three sites on the Innoko NWR (1,067 bands) and three sites on the central-eastern North Slope (1028 bands; Marks 2011).

Banding effort on the North Slope has been variable in recent decades. A total of 5,145 white-fronted geese were banded on the North Slope in 1975-1979 (King and Hodges 1979, Lobpries 1980) and an additional 1,085 geese were banded in 1990-1994 (USFWS unpubl. data). Banding on the North Slope resumed in 2003 with the goal of 1,000 geese per year in order to provide sufficient data to compare survival rates of geese in tundra habitats with boreal habitats, and to detect and quantify interchange between tundra nesting and boreal nesting geese in Alaska.

Preliminary analysis of live recapture data from 1971-2009 suggests that white-fronts are faithful to molting sites. Of geese recaptured during banding drives, 98% were in the same area where initially banded (Table 11). Moreover, less than 1% of recaptures occurred on the opposite side of the Brooks Range from where they were initially banded. These proportions are biased, however, because banding and recapture efforts have been unequal among years with 92% of banding occurring at Innoko and the North Slope since 2003. Thus, it is more likely that banded birds will be recaptured at Innoko or the North Slope simply because they are sampled more frequently and with greater effort. However, analysis of recapture data limited to the North Slope and Innoko NWR, 2004-2009, show that proportion of the recaptures in the same area where originally banded was very similar to the longer-term data set and 99% of recaptured geese were in the same area as initially banded.

Annual Survival

Joel Schmutz (USGS-ASC) generated survival estimates of adult white-fronts banded in interior and North Slope Alaska from 2000-2009 using band recoveries. Sexes and adult age classes were pooled as band recovery analyses require large sample sizes. For interior Alaska, analyses was restricted to white-fronts captured at Innoko NWR, as that area has contributed most of the banded birds, and therefore annual variation can be examined without it being confounded with spatial variation across interior Alaska. For interior Alaska and North Slope data sets, the best model was one where survival varied from year to year and that variation was modeled as a random effect, wherein the

presented standard error represents real, ecological variation around the annual mean that is not confounded with sampling variation. These models have more parameters than a time constant model or a trend model and less parameters than a fully year-specific model.

Survival estimates in 2009 are based on bands deployed at Innoko NWR, 2000-2008; and North Slope Alaska 2003-2008 and derived from adult and second-year geese of both sexes with leg-bands only. While estimates are lower for white-fronts molting in interior Alaska than those on the North Slope, the differences are not statistically significant. For interior Alaska, the mean and SE of annual survival was 0.741 +/- 0.056 (95% CI = 0.631-0.851). For North Slope, the estimate was 0.818 +/- 0.070 (95% CI = 0.681-0.955). The results presented here differ from estimates in previous summary reports in that the interior Alaska estimate is limited to Innoko NWR only.

The factors contributing to lower estimates of annual survival rates in boreal nesting white-fronts are currently unknown. Low survival rates may be related to the distinctive migration patterns and winter distribution unique to this component of the population. Unique migration timing and year-round distribution may lead to disproportionate mortality from factors such as harvest, exposure to avian disease in the Rainwater Basin of Nebraska, poor habitat conditions in Mexico, natural predation on molting grounds, and/or lower health condition during the critical molt period relative to tundra breeding white-fronts. This explanation is currently being evaluated by USFWS and USGS through analysis of blood biochemistry parameters (Wilson et al. in prep). An alternative explanation of relatively low survival of interior Alaska nesting white-fronts is that estimates are biased low if there is a higher incidence of capture-related mortality from banding activities relative to captures occurring in tundra habitats. The USFWS and USGS are currently developing modeling techniques that would account for bias in survival estimates, thereby providing unbiased estimates of survival rate (Schmutz et al. in prep.).

Disease

Three white-fronted goose disease investigations have been conducted in Alaska since 2001 and are described below: the first was a study on avian cholera, the second examined the prevalence of Highly Pathogenic Asian Avian Influenza H5N1, and a third examined the seroprevalence of Low Pathogenic Avian Influenza.

Avian Cholera - Band return data show that Alaska breeding midcontinent white-fronts migrate through Nebraska's Rainwater Basin (Ely and Schmutz 1999) where outbreaks of avian cholera are relatively common (Samuel et al. 2005). A three-year study, 2001-2003, used serum and oral swab samples collected in several sites in interior and northwest Alaska to assess whether white-fronts were exposed to avian cholera, determine the likelihood that these geese act as carriers of the disease agent, and to compare results to other goose populations. The results of this work showed that white-fronts in interior and northwest Alaska may be exposed to avian cholera during the winter or spring, but are unlikely to play a significant role as carriers of the bacterium causing avian cholera (Samuel et al. 2005). Analysis of serum samples showed that approximately 4% of the sampled geese had antibody levels to *P. multocida* indicative of recent exposure to the bacteria. While antibodies in serum samples indicated exposure to *P. multocida*, the bacteria itself was not present in swab samples indicating that the geese are not likely carriers. It is noteworthy that sampling occurred in years when there were no major outbreaks in the spring staging areas; thus, the impact of a major outbreak to the Alaska breeding population is unknown.

High Pathogenic Asian Avian Influenza H5N1 – In recent years a virulent strain of avian influenza, Asian H5N1, spread from Southeast Asia into central Asia, Europe and Africa, and has been identified in wild birds. Migratory birds are considered a possible vector for entry of the virus into the Americas and individual birds crossing between Alaska and Asia or populations mixing in staging areas are thought to pose some risk of introduction of the virus to North America. As a result, the Interagency Avian Influenza Working Group developed criteria to rank the Migratory Bird species that occur in Alaska according to the risk they pose of carrying the Asian HPAI H5N1 virus (USFWS/USGS 2011) and 29 species were targeted for surveillance. Although white-fronts were not selected as a target species, they were selected as a "Species of Interest" for surveillance sampling due to the high rate of low pathogenic avian influenza (LPAI) virus measured in 2006.

In five years of sampling, no highly pathogenic avian influenza (HPAI) was detected in any sampled white-fronts. A total of 379 live white-fronts were sampled at Innoko NWR and the North Slope during standard banding drives (USFWS/USGS 2011). Cloacal and pharyngeal samples analyzed with RT-PCR methods showed none of these birds were actively shedding any type of avian influenza. Blood serum samples from a subset of captured birds are currently being analyzed for presence of influenza antibodies to determine historical exposure rates. In addition to samples from live captured birds, 1,073 hunter-killed birds were also sampled for avian influenza using RT-PCR methods. Of these, 50 samples tested positive to low pathogenic forms of avian influenza.

Low Pathogenic Avian Influenza Seroprevalence – Pre-existing, low-pathogenic AI-specific antibodies can infer protection from mortality associated with HPAI H5N1 (Kalthoff et al. 2008) and thus there is the potential for apparently healthy birds to be carriers of HPAI. Therefore, in 2008-2009, USFWS (*Wilson et al. in prep*) examined prevalence of AI antibodies in midcontinent white-fronts in Alaska as a means of assessing historical exposure. Preliminary analyses indicate differences in AI seroprevalence rates between sexes, ages (adults vs. juveniles), and between geographic locations within Alaska (interior vs. Arctic Coastal Plain Alaska). In 2009, 195 serum samples were collected from white-fronted geese at Innoko NWR the Arctic Coastal Plain (ACP). Analysis showed that overall 38% of the greater white fronted geese sampled in 2009 were positive for non-subtype specific, low pathogenic AI antibodies, a proportion similar to that in 2008 (35%; *Wilson et al. in prep*). The 2008-2009 results from this study imply that a consistent proportion (~36%) of greater white-fronted geese molting in Alaska have the potential to be asymptomatic carriers of HPAI. Additional samples were collected in 2010 and results are pending. In addition, subtyping of LPAI antibodies from samples collected in 2008-2010 is currently underway.

Acknowledgements

This project summary relies on efforts of many individuals who collect and analyze data on midcontinent greater white-fronted geese in Alaska. Special thanks go to Paul Anderson, LeeAnne Ayres, Karen Bollinger, Jenny (Boomer) Bryant, Mike Bye, Steve Dubois, Craig Ely, Paul Flint, Deborah Groves, John Haddix, Chris Harwood, Steve Kovach, Bill Larned, Rob MacDonald, Ed Mallek, , Tina Moran, Nate Olson, Bob Platte, Ken Richardson, Joel Schmutz, Bo Sloan, Brad Scotton, Wade Schock, Mike Spindler, Bob Stehn, John Terenzi, Dara Whitworth, Kevin Whitworth, and Heather Wilson.

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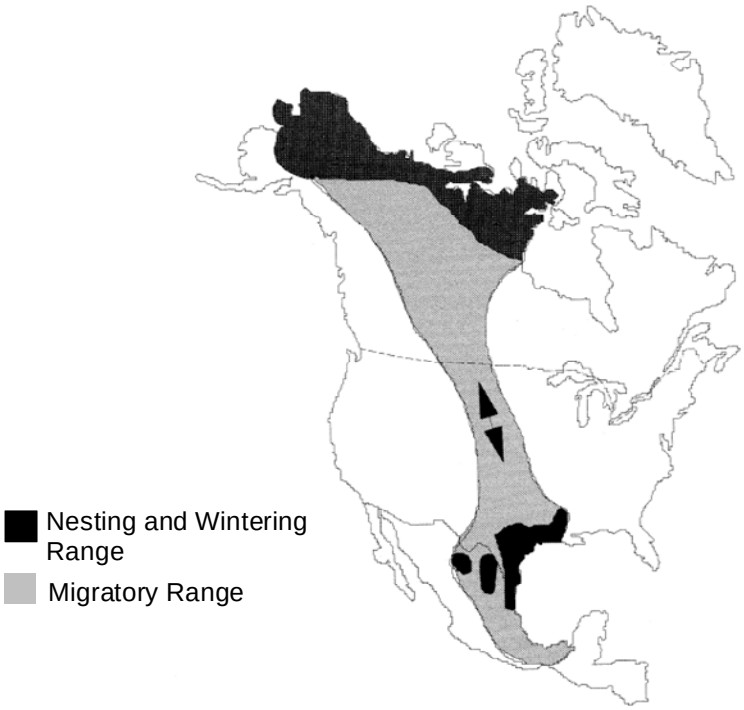


Figure 1. Range of the midcontinent greater white-fronted goose, *Anser albifrons frontalis*.

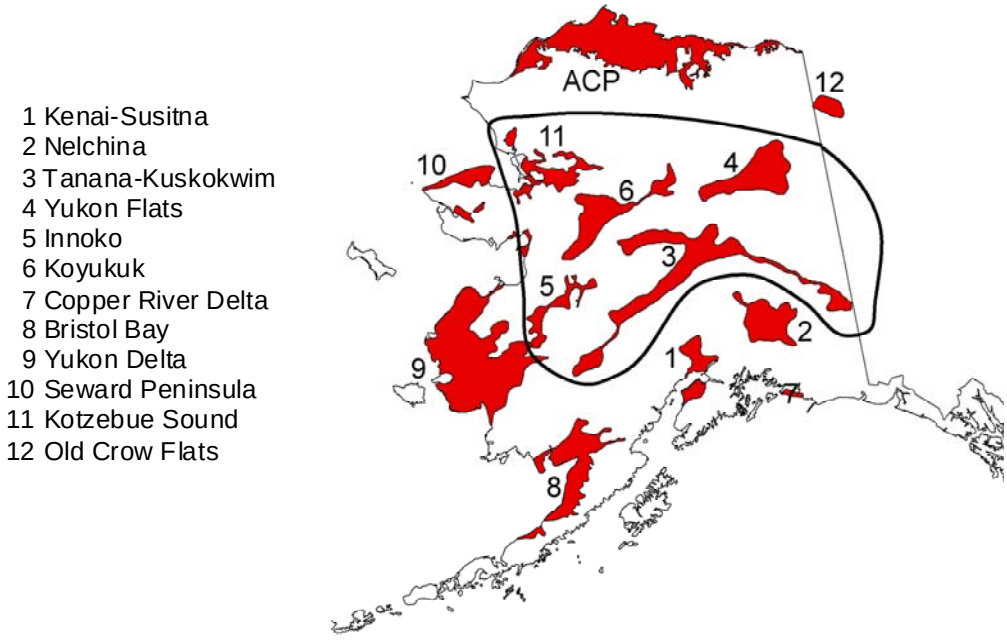


Figure 2. Location of five interior and northwest Alaska boreal habitat strata (encircled polygons) relative to all areas surveyed (red) in the Waterfowl Breeding Population and Habitat Survey (WBPHS).

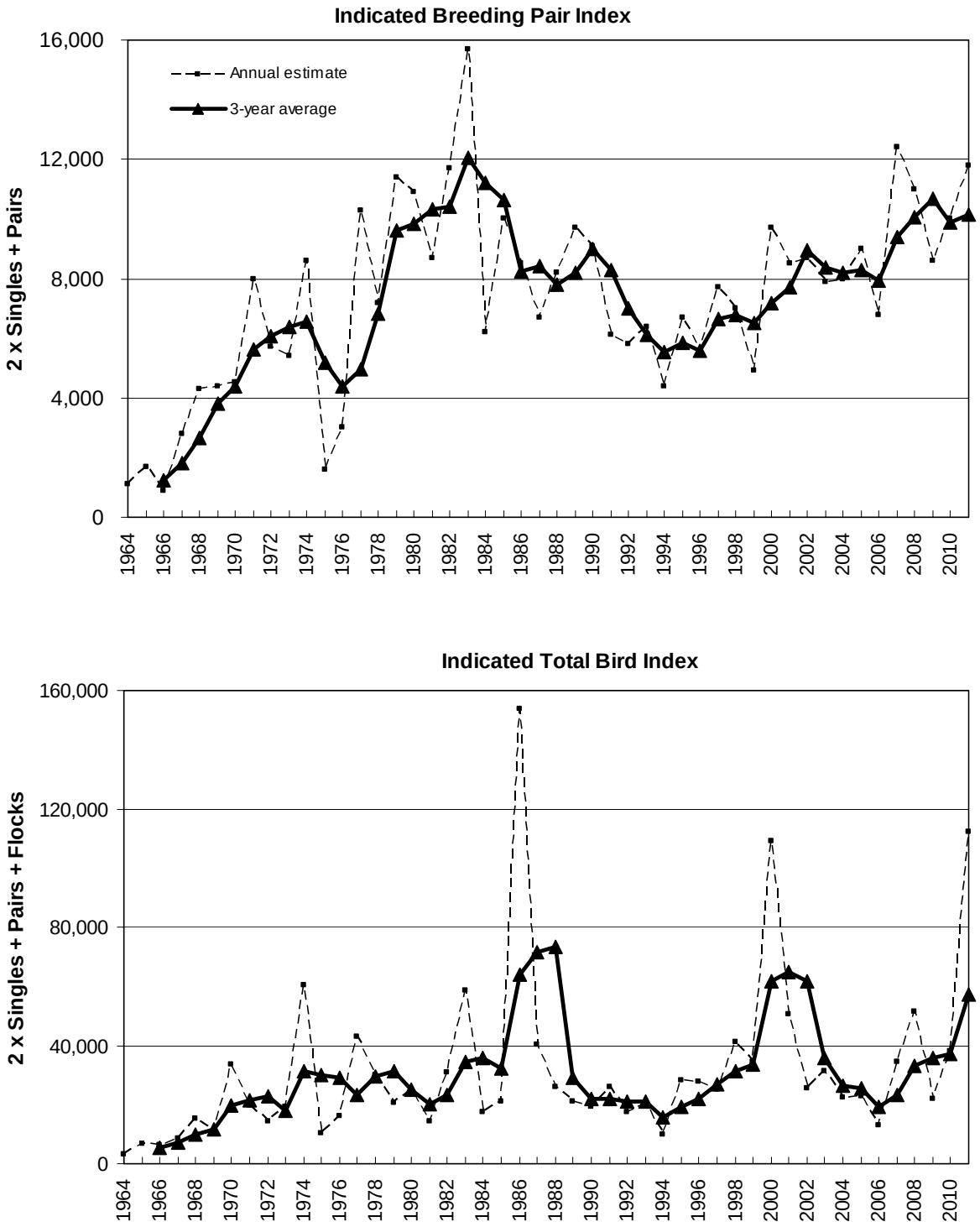


Figure 3. Indicated breeding white-front index (upper) and indicated total white-front index (lower) for the spring aerial Waterfowl Breeding Population and Habitat Survey (WBPHS) in interior and northwest Alaska, 1964-2011. Indices derived WBPHS strata 3-6 and 11, Fig. 2; Mallek and Groves 2011). Annual point estimates indicated with dashed lines, 3-year running averages indicated by solid bold lines.

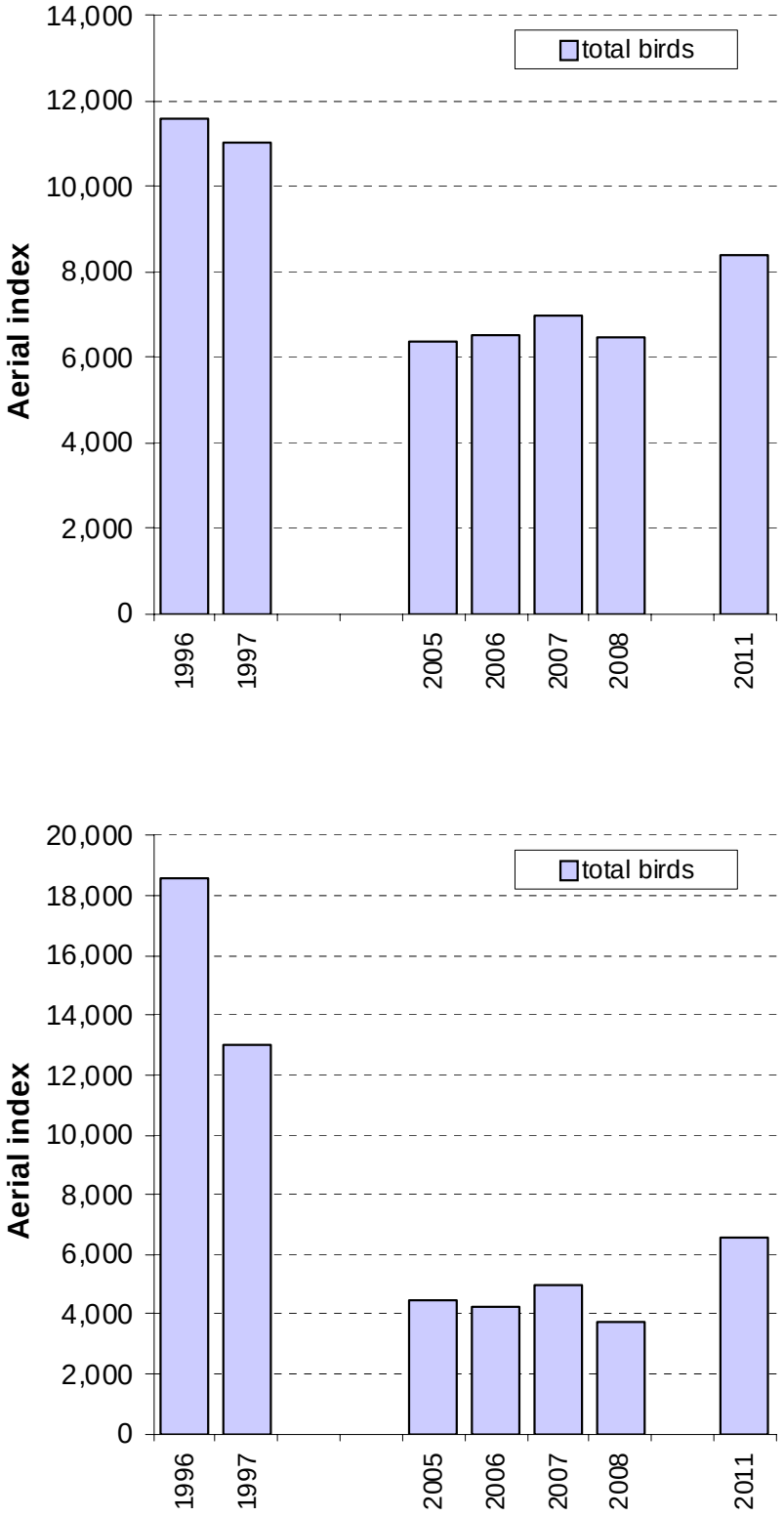
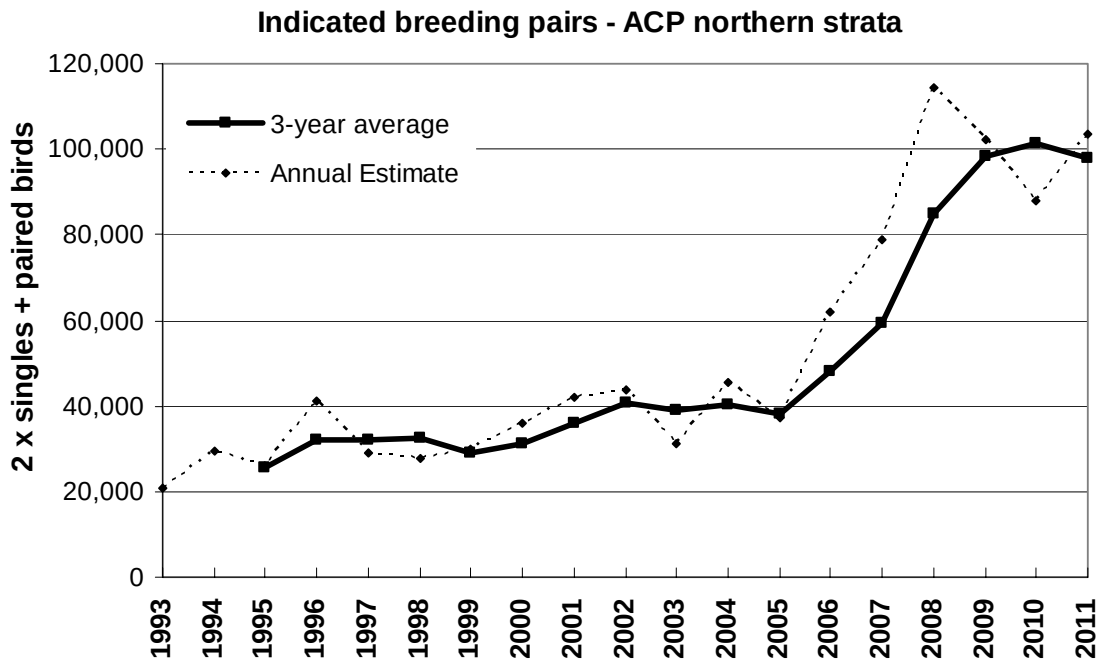


Figure 4. Total geese for white-fronts (upper) and Canada geese (lower) for aerial Selawik waterfowl breeding population surveys 1996-2011 (unpubl. Selawik NWR, USFWS data). Preliminary data presented. The "total bird index" presented here does not include multiplier for observations of single birds.



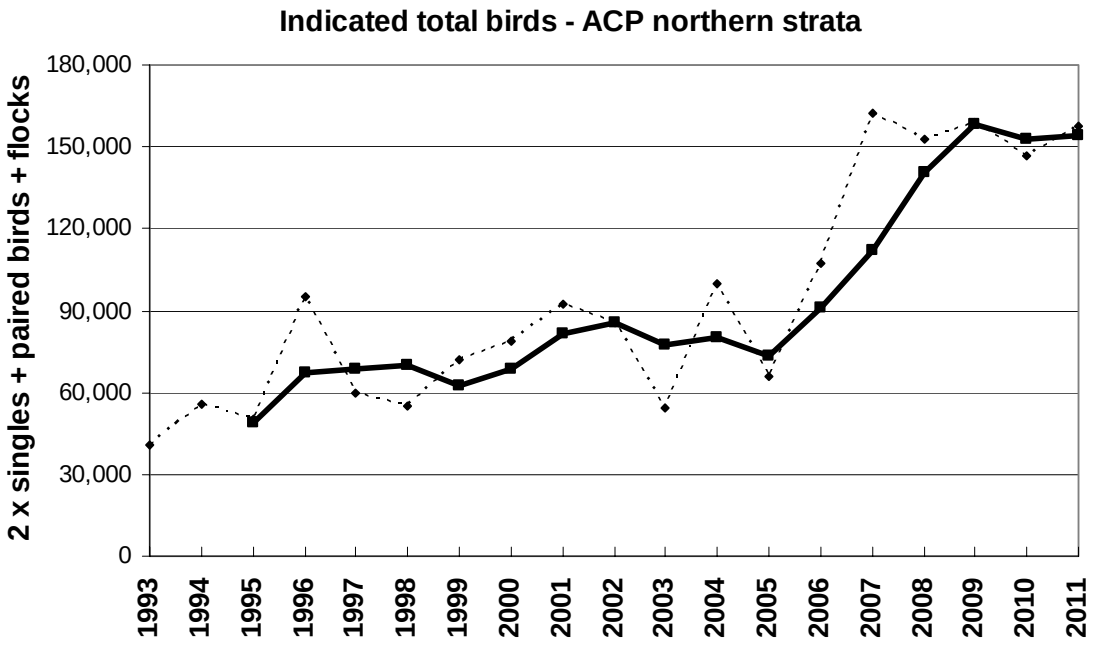


Figure 5a. Indicated breeding goose (upper) and indicated total goose (lower) indices from the northern strata of the Arctic Coastal Plain breeding pair surveys for midcontinent greater white-fronted geese. Annual estimates connected with dashed line, 3-year running average connected with solid bold lines. Northern strata contribute more than 70% to white-front estimates of entire ACP.

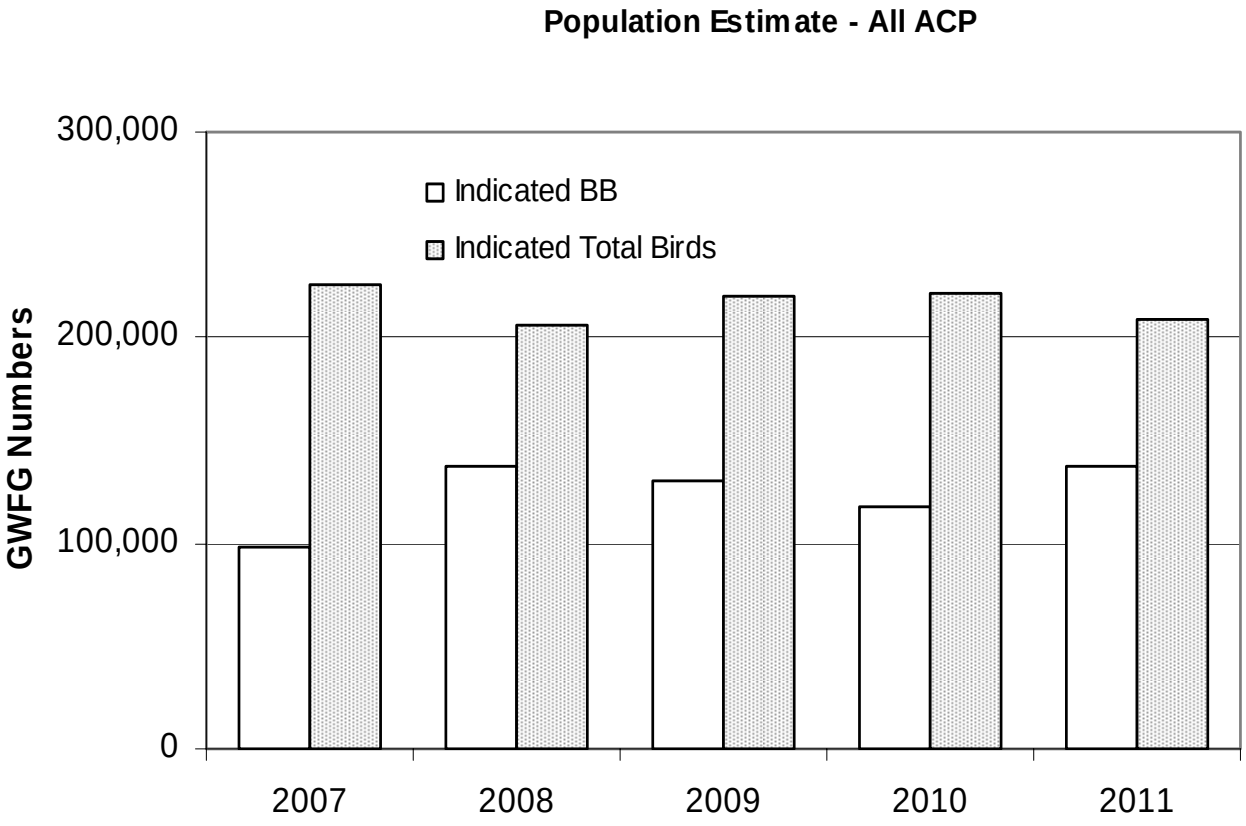


Figure 5b. Indicated breeding bird (2 x singles + paired birds) and total bird (2 x singles + paired birds + flocks) for the entire ACP survey, northern and southern regions combined, 2007- 2011. The Arctic Coastal Plain breeding pair survey covers the entire ACP, with 20 strata in two regions.

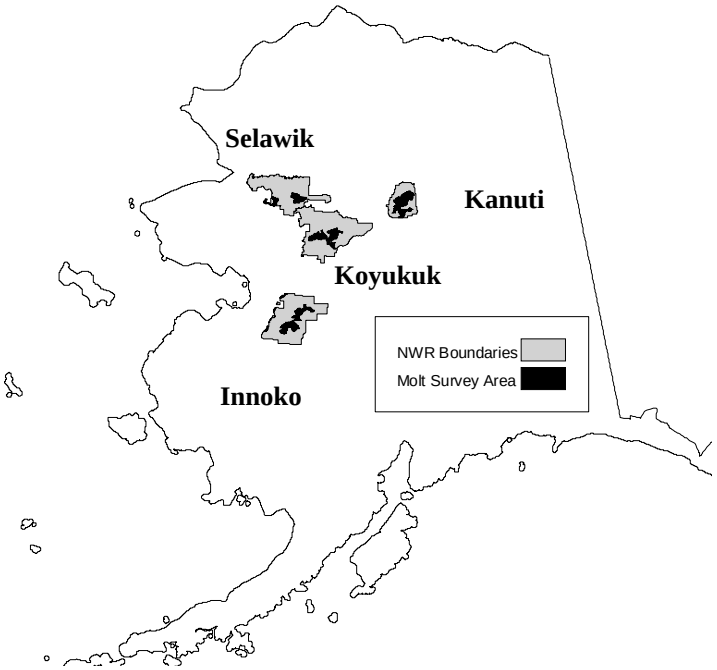


Figure 6. Coordinated molting goose survey areas, interior/northwest Alaska, 2000-2011.

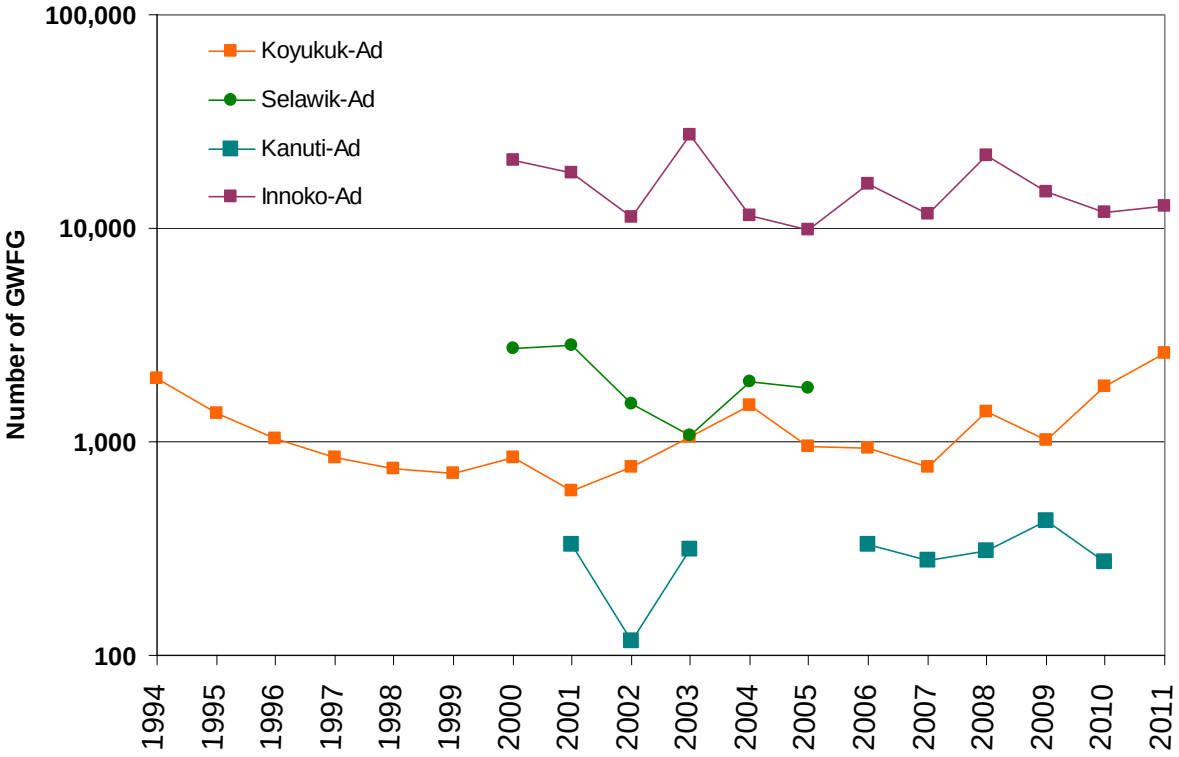


Figure 7a. Numbers of adult midcontinent greater white-fronted geese at major Alaska molting areas. Numbers of geese presented on logarithmic scale to show all surveys.

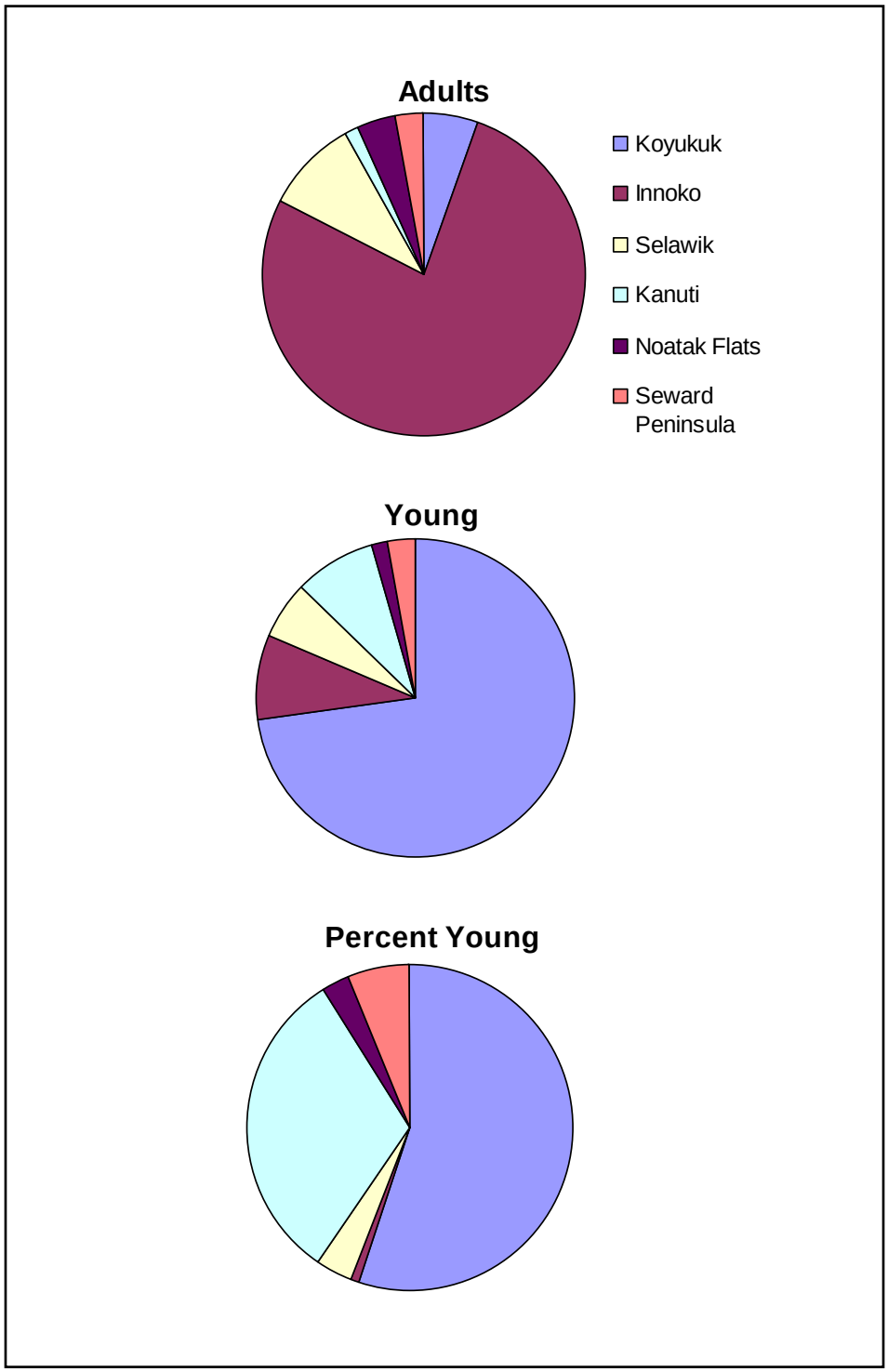


Figure 7. Distribution of midcontinent greater white-fronted geese at major Alaska molting areas . Figures based on means: 2000-2011 at Koyukuk and Innoko; 2000-2005 at Selawik; 2001-2003, 2006-2010 at Kanuti; and 2003-2004 at Noatak and Seward Peninsula.

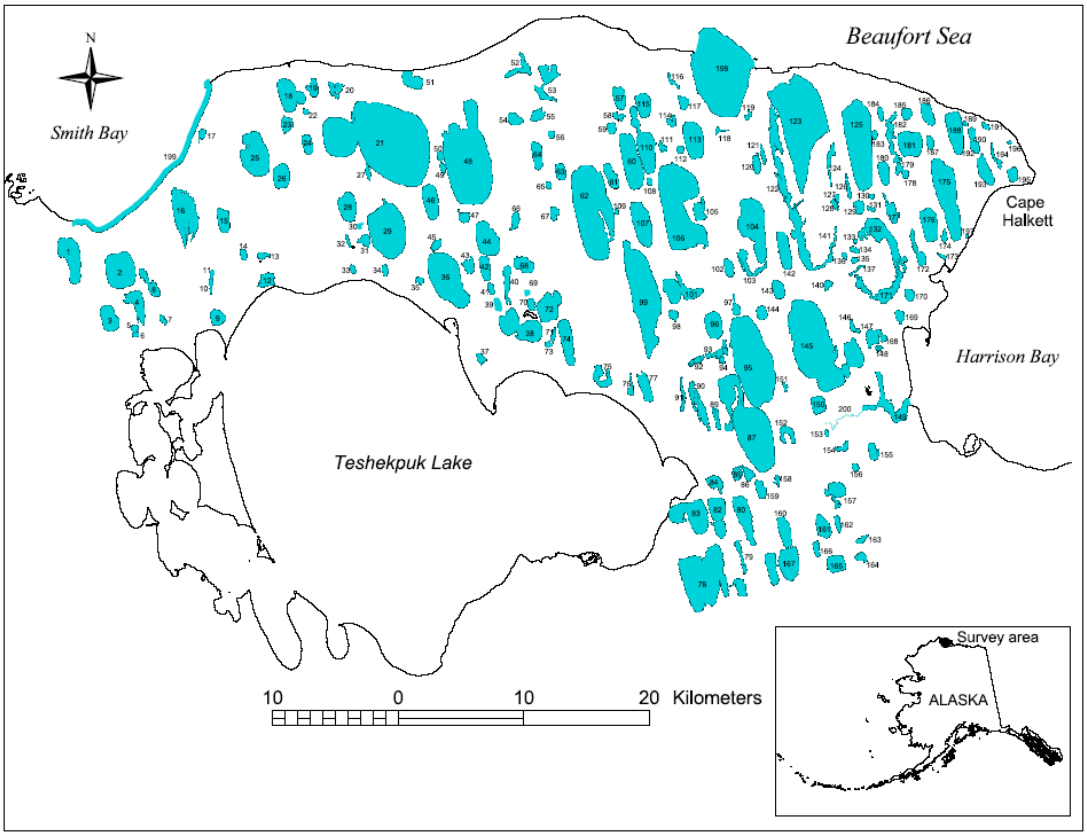


Figure 8a. Lakes sampled in the Teshekpuk Lake molting area survey (Mallek 2011).

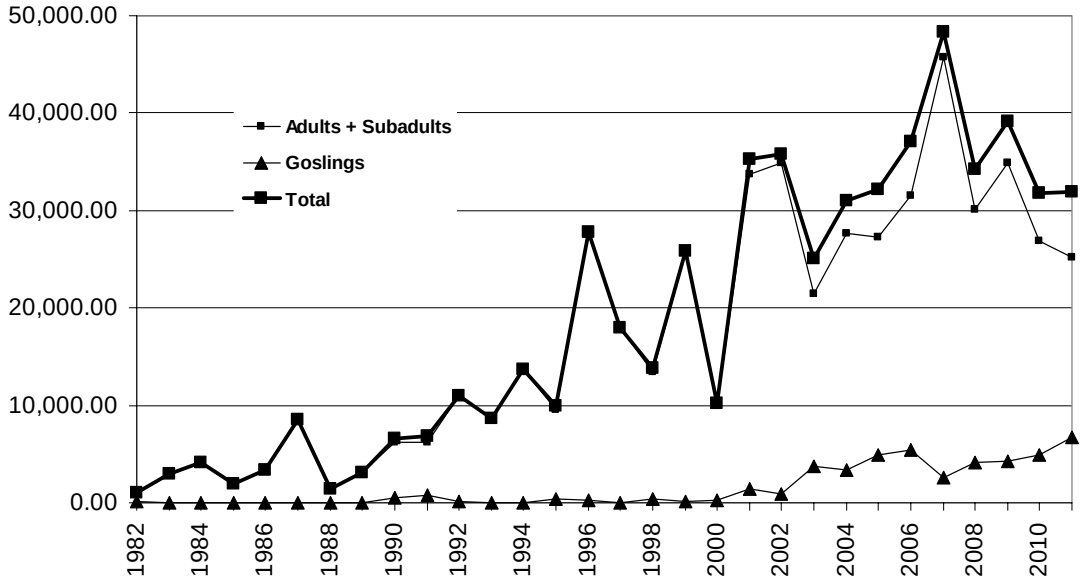


Figure 8b. Numbers of greater white-fronted geese observed in the Teshekpuk Lake molting area survey, 1982-2011 (Mallek 2011).

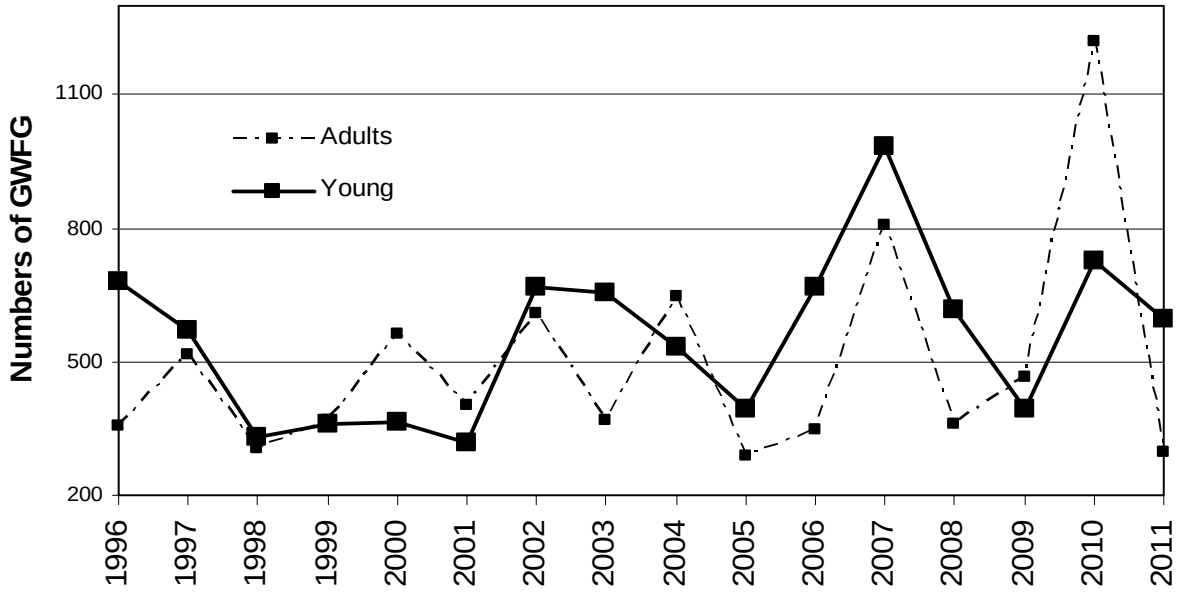


Figure 9. Numbers of adult and gosling white-fronted geese counted on float surveys of 379 river miles: Dulbi (60), Kaiyuh (176), and Nowitna (143) rivers in interior Alaska, late June-early July, 1996-2011. (Data from J. Bryant, Koyukuk/Nowitna NWR).

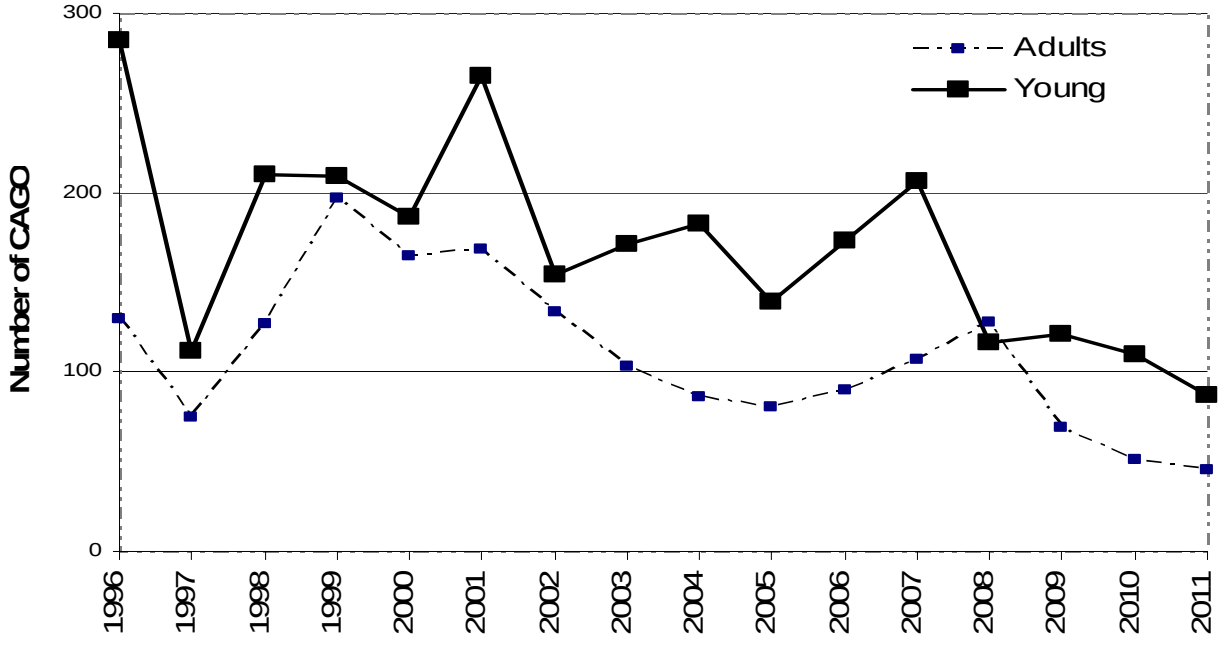


Figure. 10. Numbers of adult and gosling Canada geese counted on float surveys of 379 river miles: Dulbi (60), Kaiyuh (176), and Nowitna (143) rivers in interior Alaska, late June-early July, 1996-2011. (Data from J. Bryant, Koyukuk/Nowitna NWR).

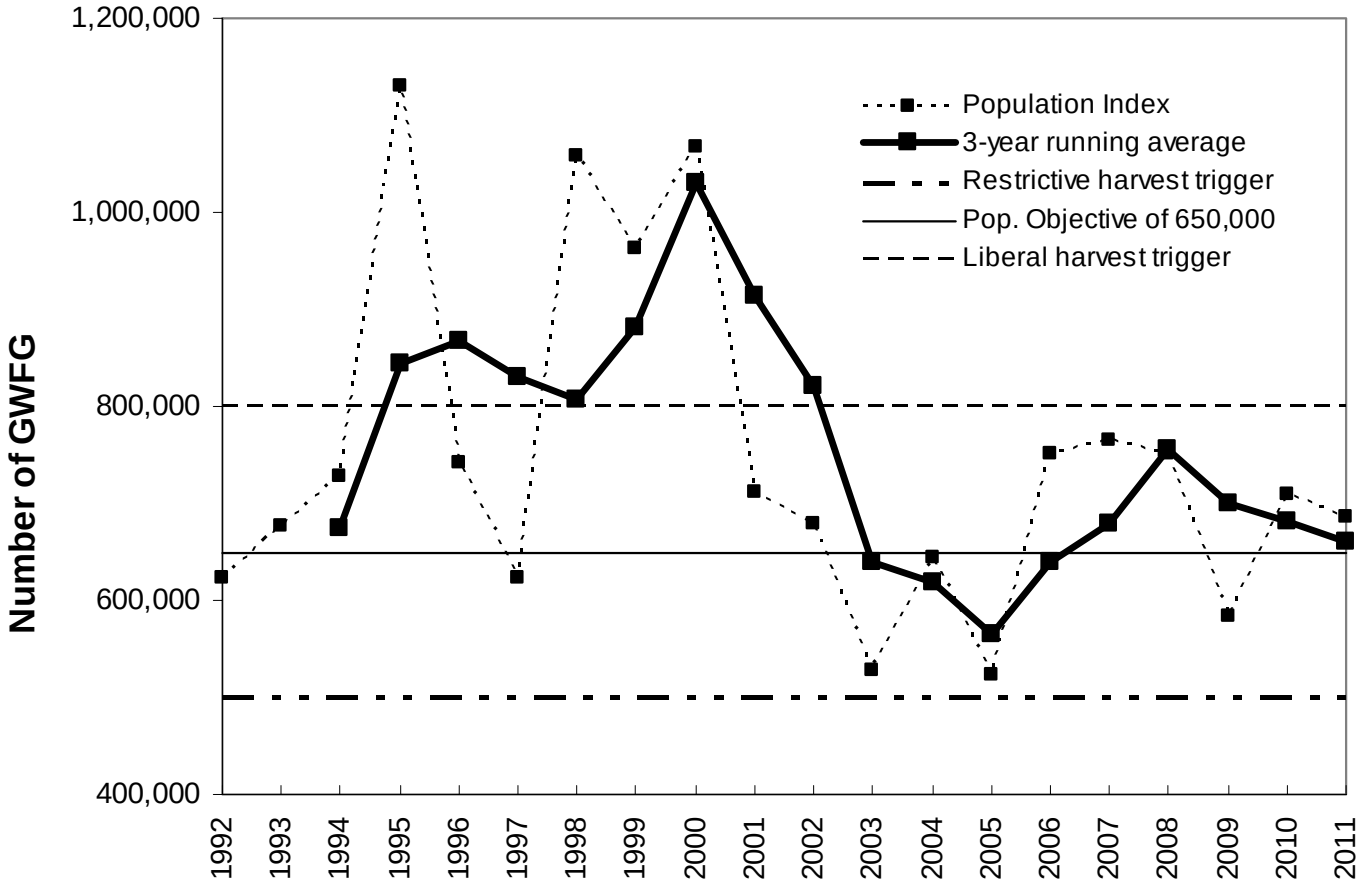


Figure 11. Fall inventory of mid-continent greater white-fronted geese, Alberta and Saskatchewan, Canada, 1992-2011 (Warner et al. 2011).

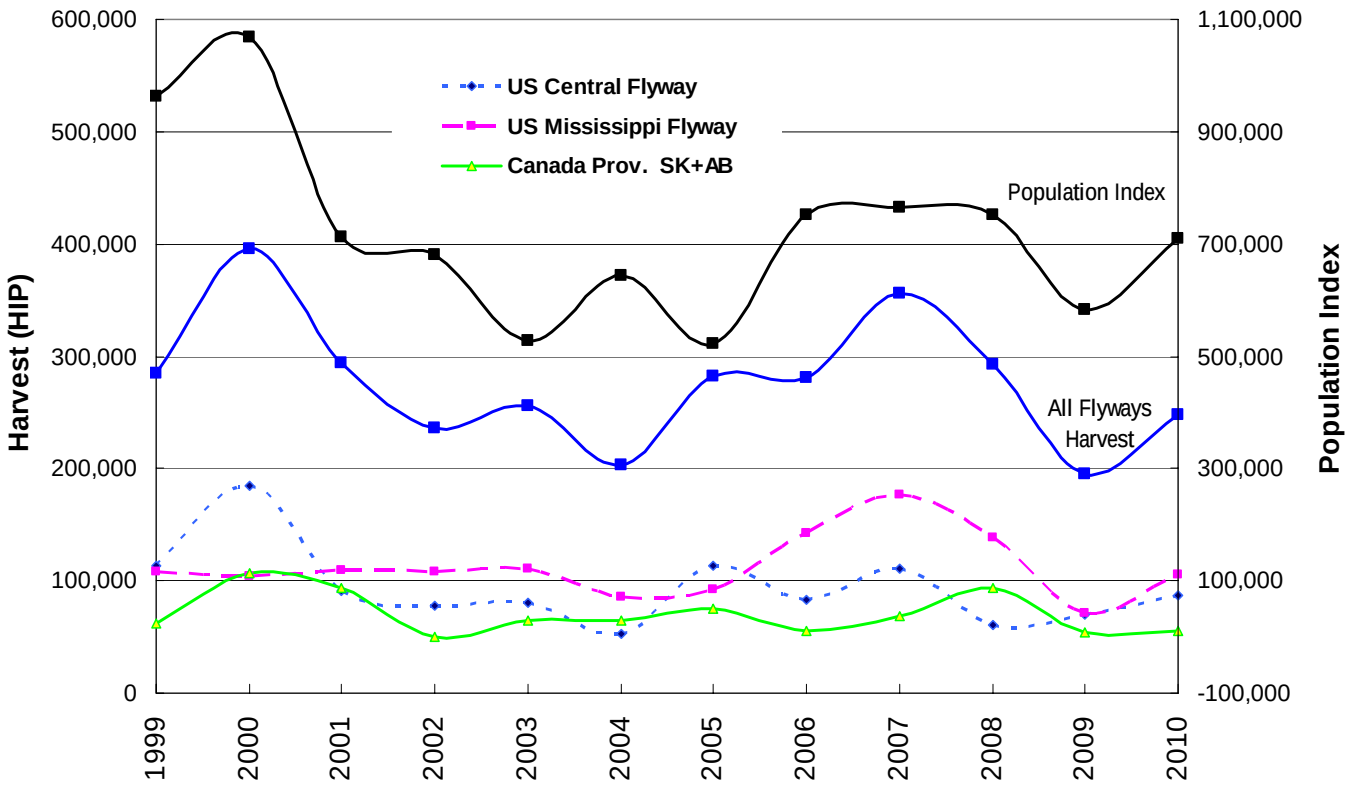


Figure 12. Estimated harvest of white-fronted geese in the U.S. portions of the Central and Mississippi Flyways and Saskatchewan and Alberta, Canada (Raftovich et al. 2011) relative to the fall population index (Warner et al. 2011), 1999-2011. Year indicates start of hunting season.

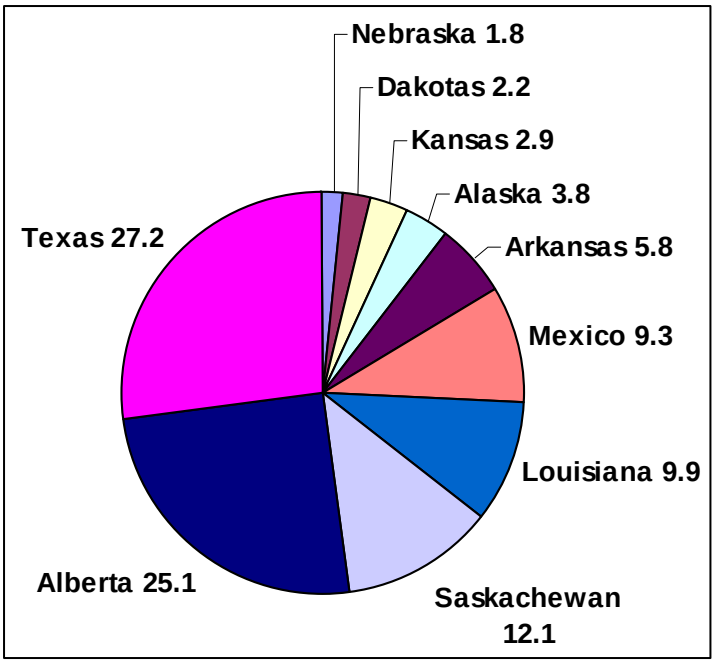


Figure 13. Distribution of sport harvest of midcontinent greater white-fronted geese that breed in interior and northwest Alaska, 1990-2002 (Ely pers. comm. 2004). Numbers indicate proportion of harvest by state or province. Results based on hunter recoveries of leg-banded geese from interior and northwest Alaska.

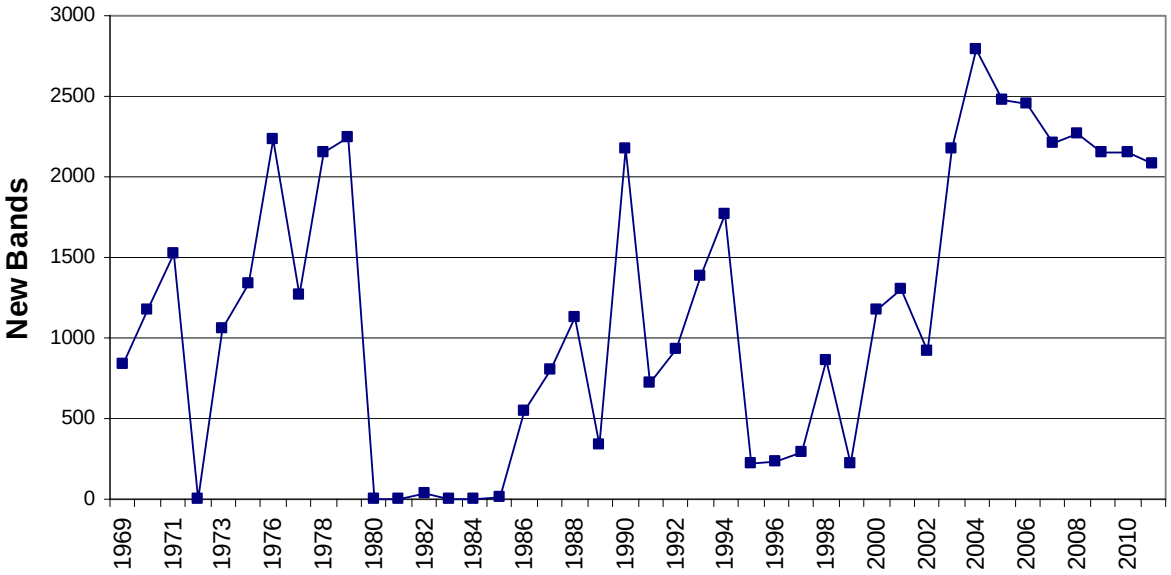


Figure 14. Numbers of midcontinent greater white-fronted geese banded by USFWS by year in Alaska 1969-2011.

Table 1. Abundance of midcontinent greater white-fronted geese during molting surveys in interior/northwest Alaska, 1994-2011 (Bryant 2011, Harwood 2010, Fischer 2010, Kovach et al. 2010, USFWS unpubl. data 2011).

Year	**Koyukuk**		**Innoko**		**Selawik**		**Kanuti**		**Noatak**		**Seward Peninsula**	
	Adults	Young	Adults	Young	Adults	Young	Adults	Young	Adults	Young	Adults	Young
1994	1988	588	--	--	--	--	--	--	--	--	--	--
1995	1358	645	--	--	--	--	--	--	--	--	--	--
1996	1037	555	--	--	--	--	--	--	--	--	--	--
1997	848	671	--	--	--	--	--	--	--	--	--	--
1998	743	219	--	--	--	--	--	--	--	--	--	--
1999	705	618	--	--	--	--	--	--	--	--	--	--
2000	840	325	20724	121	2741	129	--	--	--	--	--	--
2001	593	78	18246	137	2844	45	332	142	--	--	--	--
2002	764	663	11273	19	1518	73	117	50	--	--	--	--
2003	1053	739	27243	17	1071	36	313	65	934	16	680	43
2004	1480	680	11420	42	1907	23	--	--	650	15	486	6
2005	944	545	9761	76	1786	10	--	--	--	--	--	--
2006	936	744	16146	66	--	--	332	71	--	--	--	--
2007	763	915	11754	177	--	--	280	100	--	--	--	--
2008	1389	1100	21977	53	--	--	308	0	--	--	--	--
2009	1020	322	14717	0	--	--	425	123	--	--	--	--
2010	1823	1389	11825	180	--	--	272	89	--	--	--	--
2011	2578	1520	12727	404	--	--	--	--	--	--	--	--
Mean	1159	684	15917	108	1978	53	297	80	792	16	583	25

Table 2. Mean number of midcontinent greater white-fronted goose adults and young, and percent young at major Alaska molting areas, 1994-2011.

	Koyukuk	Innoko	Selawik	Kanuti	Noatak	Seward Peninsula
Mean Adults	1159	15917	1978	297	792	583
Mean Young	684	108	53	80	16	25
% Young	37.1	0.7	2.6	21.2	1.9	4.0

Table 3. Abundance of Canada geese during molting surveys in interior/northwest Alaska, 1994-2011 (Bryant 2010, Harwood 2010, Fischer 2010, Kovach et al. 2010).

Year	Koyukuk		Innoko		Selawik		Kanuti		Noatak		Seward Peninsula	
	Adults	Young	Adults	Young	Adults	Young	Adults	Young	Adults	Young	Adults	Young
1994	24	36	--	--	--	--	--	--	--	--	--	--
1995	60	6	--	--	--	--	--	--	--	--	--	--
1996	107	166	--	--	--	--	--	--	--	--	--	--
1997	54	97	--	--	--	--	--	--	--	--	--	--
1998	38	31	--	--	--	--	--	--	--	--	--	--
1999	68	128	--	--	--	--	--	--	--	--	--	--
2000	97	91	652	28	5143	82	--	--	--	--	--	--
2001	24	2	4814	25	4077	138	67	54	--	--	--	--
2002	25	28	3903	14	2576	224	101	128	--	--	--	--
2003	41	61	8216	132	1411	138	52	78	469	0	651	21
2004	44	39	4625	35	2803	252	--	--	346	28	753	23
2005	63	84	3153	162	988	217	--	--	--	--	--	--
2006	112	99	6027	144	--	--	108	95	--	--	--	--
2007	21	19	5414	974	--	--	124	190	--	--	--	--
2008	56	95	5208	137	--	--	116	163	--	--	--	--
2009	22	18	4470	0	--	--	134	179	--	--	--	--
2010	55	75	1727	214	--	--	141	149	--	--	--	--
2011	84	104	3168	215	--	--	--	--	--	--	--	--
Mean	55	66	4281	173	2833	175	105	130	408	14	702	22

Table 4. Greater white-fronted geese observed during float surveys of 379 river miles on the Dulbi (60), Kaiyuh (176), and Nowitna (143) rivers in interior Alaska, late June-early July, 1996-2011 (Data from J. Bryant, Koyukuk/Nowitna NWR).

	Dulbi River			Kaiyuh River			Nowitna River			Total--all surveys[1]		
Year	Adults	Young	% Young	Adults	Young	% Young	Adults	Young	% Young	Adults	Young	% Young
1996	198	207	51	50	182	78	106	290	73	354	679	66
1997	352	259	42	120	125	51	45	187	81	517	571	52
1998	130	87	40	16	38	70	159	207	57	305	332	52
1999	190	201	51	138	104	43	39	57	59	367	362	50
2000	409	149	27	61	48	44	94	168	64	564	365	39
2001	270	77	22	34	3	8	100	237	70	404	317	44
2002	382	248	39	53	131	71	175	288	62	610	667	52
2003	164	137	46	91	256	74	112	261	70	367	654	64
2004	413	312	43	158	23	13	77	200	72	648	535	45
2005	223	253	53	32	64	67	35	78	69	290	395	58
2006	187	178	49	52	128	71	108	363	77	347	669	66
2007	631	617	49	87	155	64	91	211	70	809	983	55
2008	248	280	53	23	141	86	90	196	69	361	617	63
2009	299	174	37	115	97	46	52	124	70	466	395	46
2010	608	506	45	583	100	15	29	120	81	1220	726	37
2011	209	418	67	--	--	--	90	177	66	299	595	67
Mean	307	256	45	108	106	53	88	198	69	496	554	53

[1] most years total river surveyed = 379 miles; in 2011, the Kaiyuh was flooded through the summer and was not surveyed.

Table 5. Canada geese observed during float surveys of 379 river miles on the Dulbi (60), Kaiyuh (176), and Nowitna (143) rivers in interior Alaska, late June-early July, 1996-2011 (Data from J. Bryant, Koyukuk/Nowitna NWR).

	Dulbi River			Kaiyuh River			Nowitna River			Total--all surveys		
Year	Adults	Young	% Young	Adults	Young	% Young	Adults	Young	% Young	Adults	Young	% Young
1996	49	62	56	15	95	86	66	128	66	130	285	69
1997	40	48	55	14	27	66	21	37	64	75	112	60
1998	22	28	56	42	55	57	63	127	67	127	210	62
1999	64	97	60	59	27	31	74	85	53	197	209	51
2000	15	26	63	49	47	49	101	113	53	165	186	53
2001	42	54	56	0	0	-	126	211	63	168	265	61
2002	34	33	49	35	61	64	64	60	48	133	154	54
2003	36	42	54	6	28	82	61	101	62	103	171	62
2004	33	34	51	0	0	-	53	149	74	86	183	68
2005	58	89	61	0	0	-	22	50	69	80	139	63
2006	18	28	61	11	16	59	61	129	68	90	173	66
2007	26	59	69	18	24	57	63	123	66	107	206	66
2008	33	31	48	15	15	50	80	70	47	128	116	48
2009	12	20	63	10	21	68	47	80	63	69	121	64
2010	14	47	77	6	18	75	31	45	59	51	110	68
2011	16	17	52	--	--	-	29	70	71	45	87	66
Mean	32	45	58	19	29	47	60	99	62	110	170	61

[1] most years total river surveyed = 379 miles; in 2011, the Kaiyuh was flooded through the summer and was not surveyed.

Table 6. Age-ratio of fall staging white-fronted geese in Delta Junction, Alaska, 2005-2009.

Year	Dates	Mean # Adults	Mean # Juv.	Total Geese Sampled	Mean Prop. Juv[1]	Grand Mean Proportion Juv.[2]	Mean Age Ratio[3]	Grand Mean Age Ratio[4]
2005	21-23 Aug.	64	26	812	**0.29**	**0.29**	**0.42**	**0.41**
2006	29-30 Aug.	89	58	4271	**0.41**	**0.40**	**0.72**	**0.65**
2007	30-31 Aug.	69	38	6991	**0.36**	**0.35**	**0.59**	**0.55**
2008	21-27 Aug.	31	4	1869	**0.12**	**0.10**	**0.22**	**0.11**
2009	21 Aug.- 3 Sept	10	6	2087	**0.32**	**0.35**	**0.73**	**0.55**

[1] Juveniles/total geese averaged among all flocks
[2] Total juveniles/total geese
[3] Juveniles/adults averaged among all flocks
[4] Total juveniles/total adults

Table 7. AMBCC Regional subsistence harvest estimates for midcontinent greater white-fronted geese in Alaska, 2004-2009 (Naves 2010a,b).

	Bering Strait	Northwest		Interior Alaska Subregions				
Year	Norton Sound[1]	Arctic[2]	North Slope	Mid-Yukon Upper Kuskokwim	Yukon Koyukuk	Upper Yukon	Tanana Villages	Tok
2004	400	--	--	450	370	3361	757	--
2005	957	--	6161	95	224	--	--	--
2006	--	1185	--	51	256	2551	1035	0
2007	897	--	18355	--	409	8491	--	--
2008	--	--	20187	--	881	--	--	--
2009	36	--	7825	--	--	--	--	--
Mean	751	1185	13132	199	428	4801	896	0

[1]only St. Lawrence-Diomede subregion surveyed in 2009 and not included in mean

[2]only Northwest Arctic Villages subregion surveyed in 2006 and does not include Kotzebue

Table 8. AMBCC Regional subsistence harvest estimates for midcontinent greater white-fronted goose eggs in Alaska, 2004-2008 (Naves 2010a,b).

	Bering Strait Norton Sound	Northwest Arctic	North Slope	Interior Alaska Subregions				
Year				Mid-Yukon Upper Kuskokwim	Yukon Koyukuk	Upper Yukon	Tanana Villages	Tok
2004	0	--	--	0	0	0	0	--
2005	20	--	99	0	0	--	--	--
2006	--	68	--	0	0	0	0	0
2007	47	--	370	--	0	0	--	
2008	--	--	388	--	0	--	--	--
2009	0		404					
Mean	17	68	315	0	0	0	0	0

[1]only St. Lawrence-Diomede subregion surveyed in 2009 and not included in mean

[2]only Northwest Arctic Villages subregion surveyed in 2006 and does not include Kotzebue

Table 9. Historical regional subsistence harvest estimates for midcontinent greater white-fronted geese in Alaska (Alaska Migratory Bird Co-Management Council Website 2009; USFWS AMBCC unpubl. data).

Region, Alaska	Mean Annual Harvest	Survey Year(s)
Northwest Arctic	2,871	1997-1998
Koyukuk/Nowitna	440	1998-2002
Kanuti	74	1999-2000
Innoko	396	2000
Upper Tanana River	27	2000
Yukon Flats	1,420	2000
North Slope	364	1992-1993
Total	5,592	

Table 10. Numbers of midcontinent white-fronted geese leg-banded by USFWS in interior, northwest, and North Slope, Alaska, 1969-2011.

	Innoko	Kanuti	Koyukuk	Noatak	ACP	Nowitna	Selawik	Seward Peninsula	Total
1969	500			71				266	**837**
1970					1170				**1170**
1971					1527				**1527**
1972									**0**
1973		302	761						**1063**
1975			575		761				**1336**
1976			1122		1107				**2229**
1977			282		981				**1263**
1978			1000		1146				**2146**
1979			1102		1147				**2249**
1980									**0**
1981									**0**
1982					31				**31**
1983									**0**
1984									**0**
1985	9								**9**
1986	545								**545**
1987	604	171				32			**807**
1988	944	56	2				125		**1127**
1989	22		224			4	91		**341**
1990	1158	340	443		20		217		**2178**
1991	138	302			257		25		**722**
1992	577		27		255		75		**934**
1993	686	291	171		173		64		**1385**
1994	567	141	451		407		196		**1762**
1995		73	145						**218**
1996		119	110						**229**
1997			289						**289**
1998	515		78		2		264		**859**
1999	168						52		**220**
2000	1082		92						**1174**
2001	918		132				257		**1307**
2002	628		98	176			17		**919**
2003	1311	13		56	790				**2170**
2004	976			182	1274		182	178	**2792**
2005	1150			198	921			206	**2475**
2006	1140				1069			241	**2450**
2007	1043				1169				**2212**
2008	1113				1154				**2267**
2009	1178				968				**2146**
2010	987				1160				**2147**
2011	1020				1067				**2087**
Total	**18979**	**1808**	**7104**	**683**	**18556**	**36**	**1565**	**891**	**49622**

Table 11. Numbers and locations of recaptured midcontinent white-fronted geese during banding operations in interior, northwest, and North Slope Alaska, 1971-2009.

	Recapture Location						
Banding Location	Innoko	Kanuti	Koyukuk	Noatak	N. Slope	Selawik	Seward
Innoko NWR	1182	0	12	1	4	0	1
Kanuti NWR	0	292	0	0	1	0	0
Koyukuk NWR	6	0	362	2	2	3	0
Noatak NP	12	0	0	35	0	0	0
North Slope	1	0	0	0	925	0	9
Selawik NWR	1	0	3	3	0	4	0
Seward Peninsula	0	0	0	0	0	0	32
Total Recaptures	1202	292	377	41	932	7	42
Proportion recaptured in original banding area (by area)	0.983	1.000	0.960	0.854	0.992	0.571	0.762
Proportion recaptured in original banding area (total)	**0.98**						
Proportion of recaptures on same side of the Brooks Range where originally banded	**0.99**						