Midcontinent Greater White-fronted Geese in Alaska: Annual Summary of Monitoring and Research, 2014

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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

The greater white-fronted goose (*Anser albifrons*) is one of the most widely distributed waterfowl species in North America with a breeding range extending from Hudson Bay in Canada to the Yukon-Kuskokwim Delta in western Alaska, and as far south as the Cook Inlet Basin (Ely and Takekawa 1996 and Ely et al. 2013). Within Alaska, the species is represented by two subspecies (*A. a. frontalis*, and *A. a. gambelli*) whose combined breeding distribution covers much of the state. The more numerous *A. a. frontalis* is managed as two distinct populations based on distribution and morphology: the midcontinent population (hereafter, "midcontinent white-fronts"), breeding from the North Slope through boreal and taiga habitats in central and northwestern Alaska, wintering in southern states within the Mississippi and Central Flyways and Mexico; and the Pacific population breeding on the Yukon-Kuskokwim Delta and the Bristol Bay lowlands, wintering principally in California and Mexico.

This report focuses entirely on the midcontinent white-front population that breeds in Alaska. Throughout their range (Fig. 1), midcontinent white-fronts 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 greater white-fronted geese in Alaska to provide relevant information to managers. In Alaska, much 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 has been used to monitor waterfowl population trends in primary production areas in Alaska (Groves and Shults 2015, Hodges et al 1996). 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 2014). Despite increases in the midcontinent population as a whole, white-front population indices in Alaska declined between the mid-1980s and early 1990s. From the mid-1990s to the early 2000s, the indicated breeding pair and indicated total bird indices in Alaska have been stable to slightly increasing although the 2013 and 2014 breeding pair and total bird indices were lower than 2012 estimates and well below the 3-year averaged indices for 2011-13 and 2012-14.

The indicated total bird index is prone to high variability resulting from occasional observations of large flocks that are in 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. Large flocks also inflated the 2011 total bird index although the breeding bird index was also high in 2011. Unlike the indicated total bird index, the indicated breeding pair index theoretically 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.

Arctic Coastal Plain Survey – The Waterfowl Breeding Population and Habitat Survey in Alaska provides population indices for waterfowl in much of the state but does not sample waterfowl habitat on the Alaskan Arctic Coastal Plain (ACP) due largely to logistical issues in the early days of the survey. From 1986 to 2006, an annual survey was conducted over the entire 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 portion of the ACP. In 2007, the surveys were merged and now provide data from four strata in an area that includes >97% of the original ACP survey area (Fig. 4; some very low density upland areas were eliminated). Further, the current survey preserves the timing of the North Slope Eider survey and preempts the departure of most male eiders and failed nesting birds and the arrival of non-breeding birds and others from outside the region. In 2013, Stehn et al. (2013) conducted an analysis that adjusted estimates from the two prior surveys to those of the current survey and found the methods to be reasonably precise and created no sudden discontinuities in trends when the survey design changed. Further, they concluded "that the average adjustment ratio successfully corrected for changes in timing and other differences between the early and late surveys, and therefore, provided a data set spanning 27 years with comparable data".

On average, the northern two strata of the ACP contribute around three quarters of the estimated breeding and total white-fronts within the ACP survey area. In 2012, indicated breeding birds and total birds were higher than any previous year recorded (Fig. 5). In 2013, indices were again similar to the preceding five years and in 2014 indices were the lowest since 2007 (Unpubl. USFWS data).

Other Regional Breeding Pair Surveys – Regional aerial breeding pair surveys were conducted at Selawik NWR in 2005-2008 and 2011, 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 2014,

Fischer et al. 2008). 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 both a breeding site and a spring migration staging area. As a result, it is unclear whether geese observed in this region represent local breeders or migrating geese bound for breeding sites further north. 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 conducted in 2011 but logistical issues prevented it from occurring in 2014 (T. Moran, USFWS 2014, pers. comm.). Survey results from Selawik NWR in 2005-2008 indicate a stable population (Fig. 6). In 2011, almost 30% more white-fronts were estimated in Selawik NWR, compared to the mean of 2005-2008. Results of Selawik Canada goose counts are also displayed in Fig. 6.

Interior and Northwest Alaska Molting Surveys – Boreal nesting midcontinent white-fronts molt in predictable locations in interior and northwest Alaska including Koyukuk-Nowitna, Kanuti, Innoko, and Selawik National Wildlife Refuges (Fig. 7). Standardized aerial molting goose surveys have been conducted annually at Koyukuk-Nowitna NWR since 1994 (Bryant 2014, Spindler et al. 1999), Innoko NWR since 2000 (Platte and Wilson 2015) and Selawik NWR from 2000-2005 (Fischer et al. 2008). 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 or in 2011 and 2013 due to weather and logistics. Surveys were also conducted on the 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. Region-wide abundance of molting white-fronts varies considerably within and among sites. However, Innoko NWR has, by far, the highest estimates of molting white-fronts in interior and northwest Alaska (Kovach et al. 2010, Platte and Wilson 2015; Fig. 8); in the 15 years of the survey (2000-2014) total numbers ranged from 9,009 to 27,260. Annual estimates of adults and young from these survey efforts are presented in Tables 1 and 2. Estimates were also obtained for Canada geese at these sites and are reported in Table 3.

The 2014 estimate of molting white-fronts in Innoko NWR increased from estimates of recent years and was almost 4,000 geese above the 2000-2014 mean (Table 1). At Koyukuk-Nowitna NWR, abundance of molting white-fronted geese declined from 1994 to 2001 and raised concerns of local depletion, but by 2004 molt surveys there indicated an increase to levels observed in the mid 1990s. From 2010-2013 indices were well above the long-term mean for both adults and juveniles. In 2014, the Koyukuk molting adult goose index was just 202, far below the long-term mean of 1,196 (1994-2014, Table 1) and was probably due to the extreme flooding of refuge rivers in 2014 (J. Bryant, USFWS 2014, pers. comm.). Molt counts at Kanuti NWR in 2012 were very low relative to the mean, though surveys showed a high percentage of young in that year. There was no Kanuti NWR survey in 2013, and in 2014, no white-fronts were observed on refuge survey transects (Harwood 2014). Water was exceedingly high during nesting and hatch in 2014 and traditional graminoid growth along river banks and in draw-down

lakes were under water throughout early brood-rearing (C. Harwood, USFWS 2014, pers. comm.).

On average, Innoko NWR molting areas supports more than 70% of adult white-fronts from primary interior and northwest Alaska breeding sites (Fig. 9) 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 but these locations have the highest estimates of adult molting geese. In contrast, estimates for molting white-fronts at Koyukuk-Nowitna and Kanuti NWRs, may be more reflective of local breeding populations because on average 37% and 22% 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 and Hodges 1979, King 1970). Since 1982, an aerial survey has been conducted in this region annually during the July molting period to document distribution and abundance of geese (Fig. 10). In 2010, five outlying areas where smaller numbers of white-fronts are known to molt were added to the survey area. Over the five years 2010-2014, this has added 10 and 14% on average to the adult and gosling index. The 2014 white-front estimate of 40,856 adults and subadults and 18,071 goslings (Wilson 2015), was down from the highest index in 2012-13 but still higher than the 10-year mean of 37,330 (Fig. 11). The 2014 gosling index was the highest ever and has been increasing steadily since 2010. Numbers of white-fronts at this location have increased dramatically since 1982. 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 breeding birds rarely migrate to the North Slope to molt (Martin 1998, Marks 2008, 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 (Stehn et al. 2013) 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 Surveys - 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 annually providing estimates of age ratios as an index to productivity in the region. No surveys were conducted in 2013 due to flooding of the refuge headquarters and the logistical difficulties that resulted.

In 2014, the Nowitna River was surveyed but the Dulbi and Kaiyuh were flooded over their banks and were not surveyed. Data for all rivers is presented in Tables 4 and 5 but since only the Nowitna has been surveyed consistently in recent years, only these data are presented in Fig. 12. Relative to the 10- and 19-year average, the index for number of white-fronts (adults + young) in 2014 is higher, and the index for percent goslings is approximately the same as the 19-year average at 73%, Fig 12).

Corresponding data for Canada geese were also collected on the survey and are presented in Table 5 and Figure 13.

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.

Photographic surveys of interior and northwest Alaska midcontinent white-fronts at Alaska fall staging areas are one method to generate a regional index to productivity. Band returns suggest that fall staging concentrations near Delta Junction, Alaska is limited to the interior and northwest Alaska component of midcontinent white-fronts. A small portion of white-fronts that breed on the Arctic Coastal Plain use Delta Junction as a staging area, but only during spring migration (unpubl. BBL data). Age ratios were measured in 2005-2011 to determine whether current survival rates are sustainable and to provide a covariate for analysis of molt surveys that may be influenced by variation in breeding success for the entire interior and northwest Alaska region. There, white-fronts from throughout the interior and northwest 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 2014). Therefore, fall age-ratio estimates should reflect the breeding success of the interior and northwest 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 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 2007-2012 data collection efforts were directed towards roosting flocks on the Tanana River (Fischer and Schock 2010).

Delta Junction calculations varied between 10 and 40 percent young of the year and averaged 31. Except for a low in 2008 (at 0.10), the ratio (juvenile/adults) for the other six years was relatively consistent, varied from 0.41 to 0.65 and averaged 0.53. Ratios of four of the six years varied only between 0.52 and 0.55 (Fig. 14 and Table 6).

Few photo opportunities and camera problems combined for a very small sample size in 2012 and this effort was not reported. Analysis of 2010 and 2011 data is presented in a Masters thesis (Schock 2014) and subsequent publications are now in development.

Other Productivity -- Percent young-of-the-year in w.-central Saskatchewan varied from 10.6 to 37.7 with an 18 yr unweighted mean of 23.3 (mid- to late September, 1960–1974; Ely and Dzubin 1994), though these estimates do not apply to Alaska breeding geese specifically, as Saskatchewan is a mixing ground for midcontinent white-fronts from throughout its Canada and Alaska range.

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 (DeVink et al. 2012, Warner et al. 2011). While the survey is not an Alaskan project per se, an unknown portion of the birds counted during the survey breed in Alaska.

Due to government furlough, no survey was conducted in 2013; survey flights were resumed in 2014 (K. Warner, CWS 2014, pers. comm.). As in 2011, the Peace River region in the north-western Alberta (Fig. 15) was not surveyed in 2014 due to weather conditions.

The 2014 fall index was over a million white-fronted geese for the first time since 2000 (1,005,591, Fig. 16) and the 3-year running average of 823,062 was the highest since 2002. The 2014 estimate and 3-year running average were 29% and 14% above the estimates reported for 2012. Based on the 3-year running average, the midcontinent population surpassed the liberal harvest trigger of 800,000.

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 2012) was formed, composed of USFWS, Alaska Department of Fish and Game, and representatives from 12 subsistence harvest regions. One responsibility of the Council is to assess and report spring and summer subsistence harvests. To meet that responsibility AMBCC designed and implemented a statewide subsistence harvest survey starting in 2004. In 2010, the regional rotation schedule for five regions was fully implemented.

In 2012, the AMBCC released subsistence harvest estimates by region and subregion for the years 2004-2010 (Naves 2012; Table 7, Table 8 for eggs). All regions are not sampled every year; thus, inter-year comparisons are not possible. The surveys do, however, provide an estimate of the mean harvest of midcontinent white-fronts by region. In 2011-12 (Naves 2014), none of the regions surveyed overlapped areas where midcontinent greater white-fronted geese occur. During 2004-2010, subsistence hunters statewide harvested an average of 21,181 midcontinent white-fronts annually, with 63% of the harvest occurring on the North Slope.

While an estimated 37% 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 (M. Bertram, USFWS, pers. comm.) and the low proportion of indicated breeding pairs relative to other interior regions (Deb Groves, MBM unpubl. data), it is likely that most spring migrants harvested in the Upper Yukon would have bred on the North Slope rather

than in interior Alaska. Some historical subsistence harvest estimates are presented in Table 9.

Sport – Since 1999, state and flyway estimates of waterfowl sport harvest have been generated by the Harvest Information Program (HIP; Raftovich et al. 2014 contains 2012-2013 data). Harvest of midcontinent white-fronts has tracked, to some degree, with the fall population index since 1999 (Fig. 17). Harvest estimates in the Alaska, the Central Flyway and the Canadian provinces of Saskatchewan and Alberta are likely most relevant to boreal nesting white fronts in Alaska (Fig. 18). The combined harvest of white-fronts in the Central and Mississippi flyways and in Alberta and Saskatchewan for the 2012-2013 season was up 13% from the 2011-2012 season, was 5% lower than the 15-year average, and represented 25% of the mid-continent white-front fall estimate for 2014, the lowest yet over this period (1999-2013 ranged between 29% and 54%).

Recoveries of midcontinent white-fronts banded at molting sites in Alaska (Fig. 19, 1948-2014) show a broad interest in sport hunting throughout their migratory route and wintering areas in Canada, U.S. and Mexico (Fig. 20). With special concern surrounding survival of boreal nesting white-fronts in interior Alaska, intensive annual banding in interior Alaska resumed in 1986. Banding in the Innoko NWR in interior Alaska has occurred consistently over the past 25 years and offers the most consistent long-term dataset for sport hunting encounter data for interior Alaska (Marks 2014). The intensity of the sport harvest of interior Alaska white-fronts varies by state and the number recovered each year relative to the number banded is displayed for relevant states, provinces and Mexico, in Figure 21.

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 Management Plan specified three harvest frameworks – restrictive, base, and liberal (Fig. 15). 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.

A minor revision to the 2005 management plan was completed and signed by Pacific, Central, and Mississippi Flyway Councils in 2010 (Sullivan 1998, updated in 2010) and a five year update is expected to be completed in 2015.

Climate Change

Arctic Coastal Plain -- On the Arctic Coastal Plain of Alaska, USGS is examining factors associated with the population increase in white-fronted geese as part of a larger study of how changing ecosystems in the arctic are affecting the biological community (Tom Fondell, Brandt Meixell, USGS). The primary goal is to evaluate the potential

physical and lower-trophic drivers associated with this increase. The USGS Alaska Science Center is examining clutch size, nest success and gosling growth and will identify brood rearing and molting habitats and important food plants. Finally, they will evaluate the productivity and nutritional quality of these foods and how plant productivity and nutritional quality are altered by changes in hydrologic regime, temperature, and phenology. In 2014, 131 adults and 365 goslings were banded, including nesting females caught in brood drives at two sites along the Chipp River and near Point Lonely (T. Fondell, USGS, pers. comm.). In 2013, 247 adults and 300 goslings were banded on nesting grounds near the Chipp River, and 87 adults and 160 goslings were banded near Point Lonely. In addition, 2,541 white-fronts were banded in molting areas on the Teshekpuk Lake Special Area in 2012-2013. These studies are ongoing.

Distribution

Leg-band and neck collar data –Leg-band and neck collar resight data indicate that midcontinent white-front nesting areas in interior and northwest Alaska have different migration and winter distributions than those from other portions of the breeding range (Ely et al. 2013, 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. Hunter reported recoveries of interior and North Slope Alaska midcontinent white-front bands are presented in Figs. 20-21 (Marplot, USGS Bird Banding Lab, 2014).

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 (Webb 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 53,017 midcontinent white-fronts have been banded in major molting areas in interior, northwest, and North Slope Alaska since 1969 (Table 10, Fig. 22).

A total of 5,142 white-fronted geese were banded on the Arctic Coastal Plain (ACP) in 1975-1979 (Lobpries 1980) and an additional 1,112 geese were banded in 1990-1994 (USFWS unpubl. data). From 2003-2011, the Alaska MBM banding program returned to the ACP with the goal of banding 1,000 white-fronts per year. The purpose of this expansion was to examine disease prevalence, migration timing and winter distribution, and annual survival of mid-continent white-fronts in the Alaskan ACP versus interior boreal forests of Alaska. Banding on the ACP also helped to determine the degree of interchange between boreal and tundra nesting white-fronts in Alaska, which appears to occur to only a very small degree (Table 11). With objectives on the ACP completed in 2011, MBM banding of white-fronts was restricted to interior Alaska, although USGS has maintained some banding on the ACP (see Climate Change section). From 1985-2014, all but three years (1995-97) were banded on the Innoko NWR. In

2014, staff from MBM, Innoko and Koyukuk/Nowitna NWR again banded more than 1,000 white-fronts at several sites on the Innoko NWR (Marks 2014).

Analysis of live recapture data from 1971-2009 suggests that white-fronts are faithful to molting sites (Table 11). Of geese recaptured during banding drives, 98% were in the same area where initially banded. Moreover, less than 1% of recaptures occurred on the opposite side of the Brooks Range from where they were initially banded. These proportions may be biased since banding and recapture efforts have been unequal with more than 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 because they are sampled more frequently and with greater effort. Analysis of recapture data limited to the North Slope and Innoko NWR, 2004-2009, show a similar trend and 99% of geese were recaptured in the same area as initially banded.

Annual Survival

Midcontinent white-fronts survival estimates from interior-northwest Alaska and North Slope Alaska appear to have converged over recent years. Preliminary estimates of annual survival (95% CI) of white-fronts banded at Innoko NWR during 2000-2013 and on Alaska's North Slope 2003-2011 are 0.774 (0.018) and 0.795 (0.022), respectively. Recovery rates (95% CI) of Innoko NWR and North Slope banded birds during these same time periods were 0.139 (0.008) and 0.169 (0.012), respectively. These preliminary estimates are based on a simple model with no year-to-year variation in survival or recovery rate within a population (J. Schmutz, pers. comm. USGS). Survival estimates from these two sites in earlier years indicated lower survival of interior-northwest Alaska white-fronts relative to those on the North Slope (Ely and Schmutz 1999). Additional analyses are currently being conducted that account for handling effects and will be reported soon.

The factors contributing to the lower estimates of annual survival rates in interior-northwest Alaska nesting white-fronts relative to North Slope may have been moderated during the last decade. Low survival rates may have been related to the distinctive migration patterns and winter distribution unique to this interior Alaska component of the population (Ely et al. 2013). For example, 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, and poor habitat conditions in Mexico. Other factors may include natural predation on molting grounds, and/or lower health condition during the critical molt period in interior Alaska relative to tundra breeding white-fronts.

Disease

Three white-fronted goose disease investigations have been conducted in Alaska since 2001. General results indicate disease is a major contributor to large scale changes in Alaska midcontinent white-front populations. A summary of results follows:

Avian Cholera - A three-year study, 2001-2003, was conducted 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 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).

High Pathogenic Asian Avian Influenza H5N1 – From 2006-2010 no highly pathogenic avian influenza (HPAI) was detected in any sampled white-fronts (USFWS/USGS 2011).

Low Pathogenic Avian Influenza Seroprevalence **–** Using data from 2001-2002 and 2008-2010, USFWS examined prevalence of AI antibodies in mid-continent greater white-fronted geese in Alaska as a means of assessing historical exposure (Wilson et al. 2013). Results demonstrated 47% of adult greater white-fronted geese in Alaska were positive for low pathogenic AI antibodies, while concurrent, large-scale AIV monitoring in Alaska revealed very low virus infection rates among greater white-fronted geese (1.9%).

Literature Cited

Alaska Migratory Bird Co-Management Council Website. 2012. http://alaska.fws.gov/ambcc/harvest.htm.

Anderson, J. T. and D. A. Haukos. 2003. Breeding ground affiliation and movements of greater white-fronted geese staging in northwestern Texas. Southwestern Naturalist. 48:365-372.

Bryant, J. 2014. Aerial Molting Goose Survey Report. Unpubl. U. S. Fish and Wildlife Service report, Koyukuk/Nowitna Refuge Complex, Galena.

DeVink, Jean-Michel, Keith Warner, Terry Liddick, Fred Roetker, Jason Jackson and Kevin Kraai. 2012. 2014 Fall Inventory of Greater White-fronted Geese. Unpubl. Canadian Wildlife Service report.

Ely, C. R. and A. X. Dzubin. 1994. Greater White-fronted Goose (Anser albifrons), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: doi:10.2173/bna.131. http://bna.birds.cornell.edu/bna/species/131.

Ely, C. R., D. J. Nieman, R. T. Alisauskas, J. A. Schmutz, J. E. Hines. 2013. Geographic variation in migration chronology and winter distribution of midcontinent greater white-fronted geese. Journal of Wildlife Management 77:1182-1191.

Ely, C. R. and J. A. Schmutz. 1999. Characteristics of midcontinent greater white-fronted geese from interior Alaska: distribution, migration ecology and survival. Unpubl. USGS report submitted to the Central Flyway Technical Committee.

Ely, C. R. and J. Y. Takekawa. 1996. Geographic variation in migratory behavior of greater white-fronted geese (*Anser albifrons*). Auk 113: 889-901.

Fischer, J. B. 2007. Midcontinent greater white-fronted goose age ratio survey – Delta Junction, AK, August 28-30, 2007. Unpubl. U. S. Fish and Wildlife Service report, Migratory Bird Management, Anchorage, AK.

Fischer, J. B. and W. G. Schock, 2010. Midcontinent greater white-fronted goose age ratio survey – Delta Junction, AK, August 21-September 4, 2009. Unpubl. U. S. Fish and Wildlife Service report, Migratory Bird Management, Anchorage, AK.

Fischer, J. B., R. A. Stehn, C. L. Moran, R. M. Platte, and P. D. Anderson. 2008. Midcontinent greater white-fronted goose breeding pair survey in northwest Alaska, 2007. Unpubl. U. S. Fish and Wildlife Service report, Migratory Bird Management, Anchorage, AK.

Flint, P. L., E. J. Mallek, R. J. King, J. A. Schmutz, K. S. Bollinger, and D. V. Derksen. 2008. Changes in abundance and spatial distribution of geese molting near

Teshekpuk Lake, Alaska: interspecific competition or ecological change? Polar Biology 31:549-556.
Groves, D. J. and B. S. Shults. 2015. Alaska-Yukon waterfowl breeding population survey, May 13 – June 13, 2014. Unpubl. U.S. Fish and Wildlife Service Report, Migratory Bird Management, Juneau, AK.
Harwood, C. M. 2014. Aerial surveys of molting geese on Kanuti National Wildlife Refuge, June 2014. Kanuti NWR unpubl. report. Fairbanks, AK.
Hodges, J.I., J.G. King, B. Conant, and H.A. Hanson. 1996. Aerial Surveys of Waterbirds in Alaska 1957-94: Population Trends and Observer Variability. Information and Technology Report 4. U.S. Dept. of the Interior-National Biological Service. 24pp.
Hohman, W. L., C. D. Ankney, and D. H. Gordon. 1992. Ecology and management of postbreeding waterfowl. Pp. 128-189, *in* B. D. J. Batt, A. D. Afton, M. G. Anderson, C. D. Ankney, D. H. Johnson, J. A. Kadlec, and G. L. Krapu, eds. Ecology and management of breeding waterfowl. Univ. Minnesota Press, Minneapolis, Minnesota.
King, J. G., and J. I. Hodges. 1979. A preliminary analysis of goose banding on Alaska's arctic slope. Pp. 176-188, *in* R. L. Jarvis, and J. C. Bartonek, eds. Management and biology of Pacific Flyway geese. Oregon State Univ. Book Stores, Corvallis, Oregon.
King, J. G. 1970. The swans and geese of Alaska's arctic slope. Wildfowl 21:11-17.
Kovach, S. D., R. M. Platte, E. Mallek, K. S. Bollinger. 2010. Innoko National Wildlife Refuge molting goose survey – an analysis of the first 10 years. Innoko NWR unpubl. report. McGrath, AK.
Kruse, K. L., compiler. 2014. Central Flyway harvest and population survey data book. U.S. Fish and Wildlife Service, Lakewood, CO.
Larned, W. W., R. Stehn, and R. Platte. 2011. Waterfowl breeding population survey, Arctic Coastal Plain, Alaska, 2010. Unpubl. U.S. Fish and Wildlife Service Report, Migratory Bird Management, Soldotna, AK.
Lobpries, D. S. 1980. Cooperative white-fronted goose banding in Alaska, final report. Unpubl. Federal Aid Project W-106-R-6. Texas Parks and Wildlife Dept. report, Austin, TX.
Mallek, E. J. 2011. Teshekpuk Lake area molting goose survey – 2011. Unpubl. U.S. Fish and Wildlife Service report, Migratory Bird Management, Fairbanks, AK.
Mallek, E. J., R. Platte, and R. Stehn. 2007. Aerial breeding pair survey of the Arctic Coastal Plain of Alaska-2006. Unpubl. U.S. Fish and Wildlife Service report, Migratory Bird Management, Fairbanks, AK.
Marks, D. K. 2014. Midcontinent greater white-fronted goose banding in Alaska in 2014. Unpubl. U.S. Fish and Wildlife Service Report, Migratory Bird Management, Anchorage, AK.
Marks, D. K. 2008. Midcontinent greater white-fronted goose banding in Alaska in 2008. Unpubl. U.S. Fish and Wildlife Service Report, Migratory Bird Management, Anchorage, AK.
Martin, P. A. 1998. History of greater white-fronted goose banding on and near Kanuti National Wildlife Refuge, Alaska, 1973-1997. Unpubl. U.S. Fish and Wildlife Service Report, Kanuti National Wildlife Refuge, Fairbanks, AK.
Naves, L. C. 2014. Alaska migratory bird subsistence harvest estimates, 2013, Alaska Migratory Bird Co-Management Council, DRAFT. Alaska Department of Fish and Game Division of Subsistence, Technical Paper No. 364, Anchorage.

Naves, L. C. 2012. Alaska migratory bird subsistence harvest estimates, 2010, Alaska Migratory Bird Co-Management Council. Alaska Department of Fish and Game Division of Subsistence, Technical Paper No. 376, Anchorage.

Platte, R. M., and H. M. Wilson. 2015. Aerial survey for molting white-fronted geese and Canada geese on Innoko National Wildlife Refuge, Alaska, 2010-2014. U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, Alaska, USA.

Raftovich, R.V., K.A. Wilkins, S.S Williams, and H.L. Spriggs. 2014. Migratory Bird Hunting Activity and Harvest during the 2012 and 2013 Hunting Seasons. U.S. Fish and Wildlife Service, Laurel, Maryland, USA.

Reed, E.T., J. Bety, J. Mainguy, G. Gauthier, and J.F. Giroux. 2003. Molt migration in relation to breeding success in greater snow geese. Arctic 56:76-81.

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

Samuel, M. D., D. J. Shadduck, and D. R. Goldberg. 2005. Avian cholera exposure and carriers in greater white-fronted geese breeding in Alaska, USA. Journal of Wildlife Diseases 41:498-502.

Schmutz, J. C. 2001. Note to Managers and biologists concerned about white-fronted geese in interior Alaska. Memorandum regarding sample sizes needed for monitoring survival with a banding program, 3 January 2001, USGS, Alaska Biological Science Center.

Schock, W. G. 2014. Migration dynamics of midcontinent greater white-fronted geese (*Anser albirons frontalis*) from interior and northwest Alaska. M. S. Thesis, University of Alaska, Anchorage.

Spindler, M. A., J. M. Bryant, J. Y. Fujikawa, and M. R. Hans. 2005. Evaluation of aerial and float surveys of geese on Koyukuk-Nowitna National Wildlife Refuges. Unpubl. U.S. Fish and Wildlife Service Report, Final Report FY05-03, Koyukuk/Nowitna NWR, Galena.

Spindler, M. A., J. M. Lowe, and J. Y. Fujikawa. 1999. Trends in abundance and productivity of white-fronted Geese in the taiga of northwest and interior Alaska. Report submitted to the Central Flyway Technical Committee, March 5, 1999, Lawton, Oklahoma.

Stehn, R.A., W.W. Larned, and R.M. Platte. 2013. Analysis of aerial survey indices monitoring waterbird populations of the Arctic Coastal Plain, Alaska, 1986-2012. Unpubl. U.S. Fish and Wildlife Service Report, Migratory Bird Management, Anchorage, AK.

Sullivan, B. 1998. Updated in 2010. Management plan for midcontinent greater white-fronted geese. Central Flyway Waterfowl Technical Committee. Denver, CO.

Warner, K., D. Nieman, J. Solberg, R. Bentley, S. Durham, and K. Kraii. 2011. 2010 Fall inventory of mid-continent white-fronted geese. Unpubl. Canadian Wildlife Service report.

Webb, D. D. 2006. Temporal and spatial distribution of interior Alaska white-fronted geese (Anser albifrons frontalis) during fall migration and winter staging. M. S. Thesis, University of Alaska, Fairbanks.

Wilson, H. M. 2015. Teshekpuk Lake Area Molting Goose Survey 2014. U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, Alaska, USA.

Wilson H.M., Hall J.S., Flint P.L., Franson J.C., Ely C.R. 2013. High Seroprevalence of Antibodies to Avian Influenza Viruses among Wild Waterfowl in Alaska: Implications for Surveillance. PLOS ONE 8(3): e58308. doi:10.1371/journal.pone.0058308

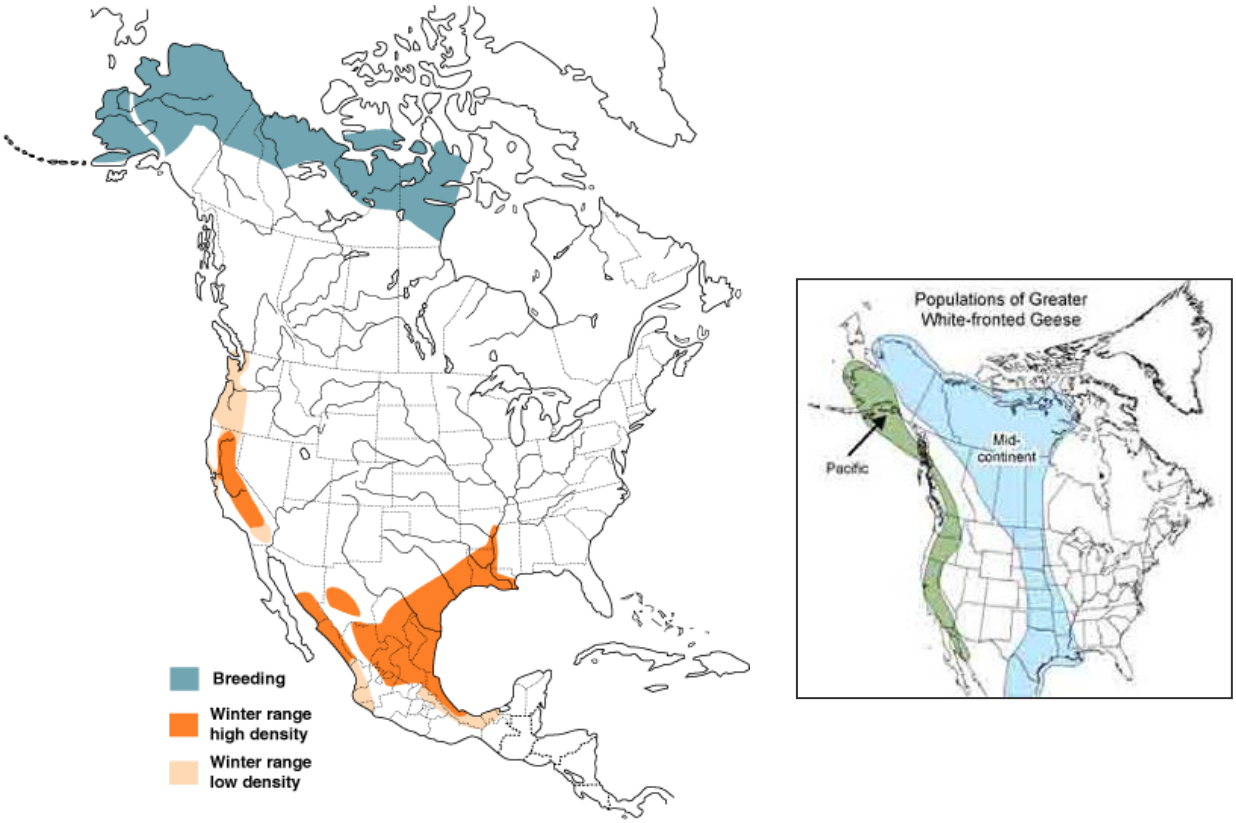


Figure 1. Range and migration map for Pacific and midcontinent populations of greater white-fronted geese, *Anser albifrons frontalis* (Birds of North America, http://bna.birds.cornell.edu/bna; Artic Goose Joint Venture). The Pacific population nests and winters south and west of the midcontinent population as indicated by white line in the breeding range.

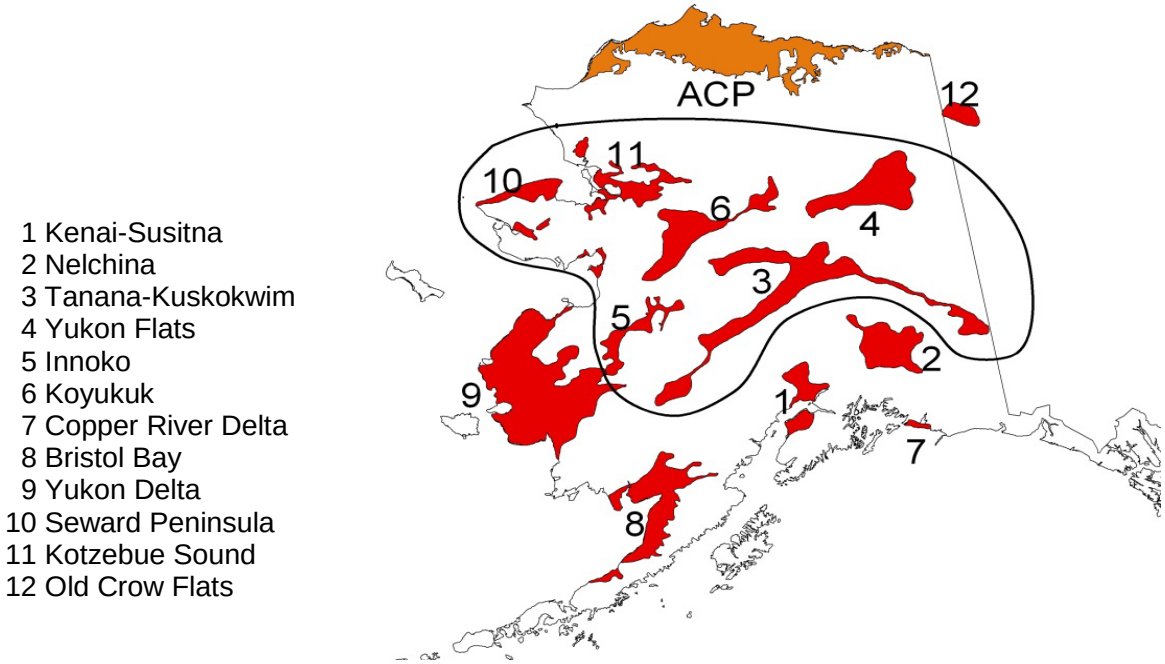


Figure 2. Location of six interior and northwest Alaska boreal habitat strata (circled polygons) relative to the Alaska-Yukon survey region (in red) sampled in the annual Waterfowl Breeding Population and Habitat Survey and the Arctic Coastal Plain (ACP) breeding pair survey.

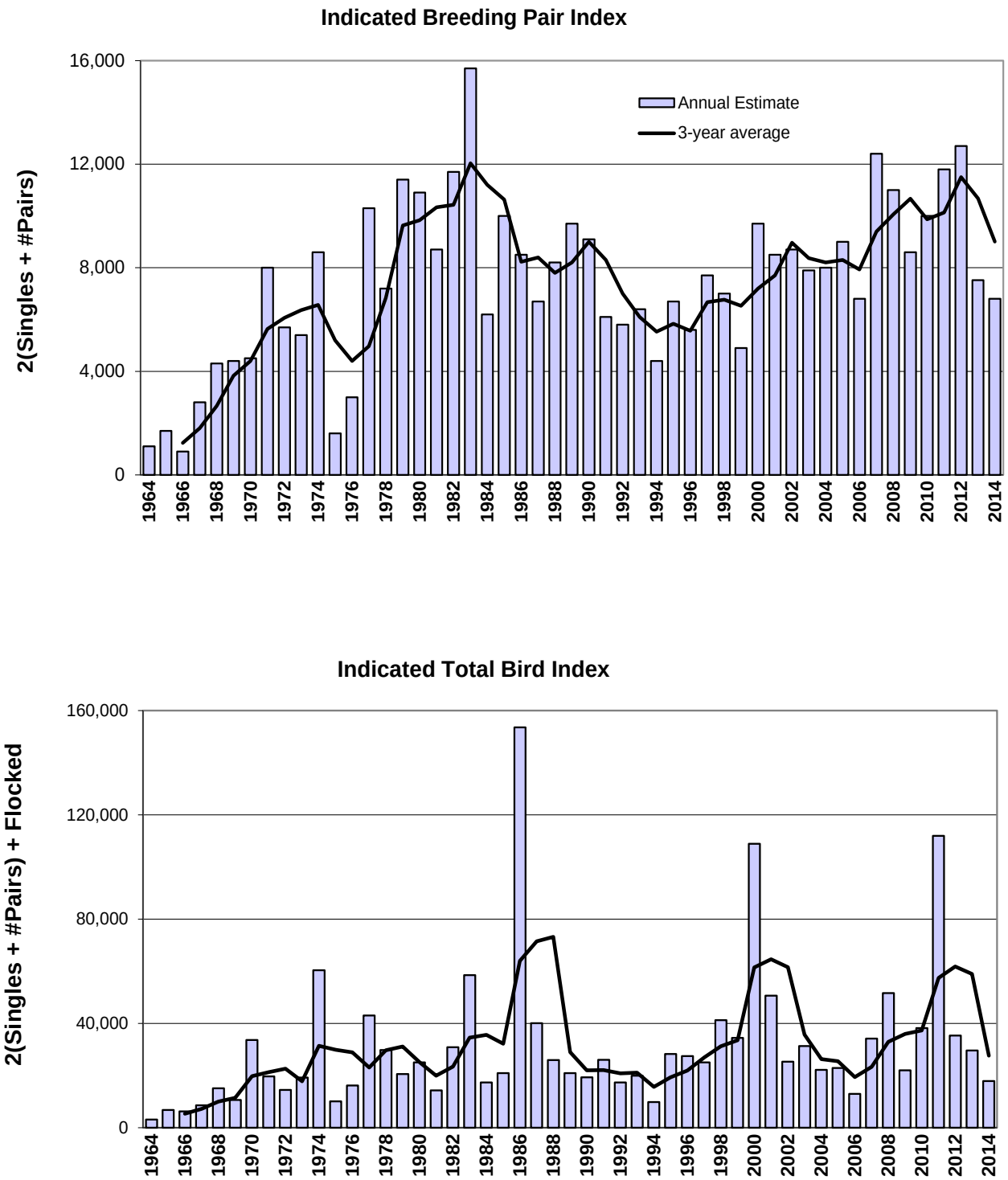


Figure 3. Indicated breeding white-front index (upper) and indicated total white-front index (lower) for the spring aerial Waterfowl Breeding Population and Habitat Survey (WBPHS) in interior and northwest Alaska, 1964-2014. Indices derived from WBPHS strata 3-6 and 10-11, Fig. 2; Groves and Shults (2014).

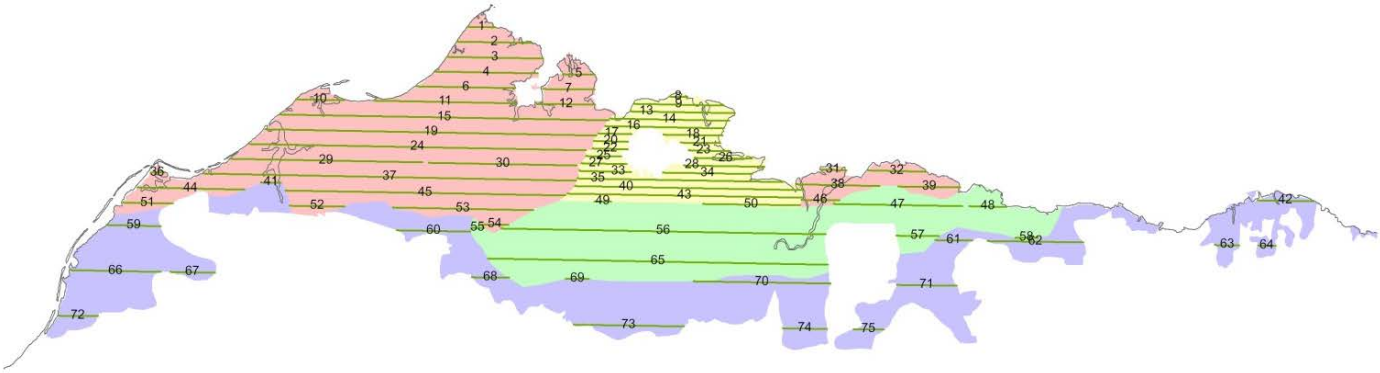


Figure 4. Spatial design of the Arctic Coastal Plain waterfowl breeding population survey. Transect lines are moved annually on a 4-year rotation within each strata; strata transect density remain the same over years. See Figure 2 for location map. From Stehn et al. 2013.

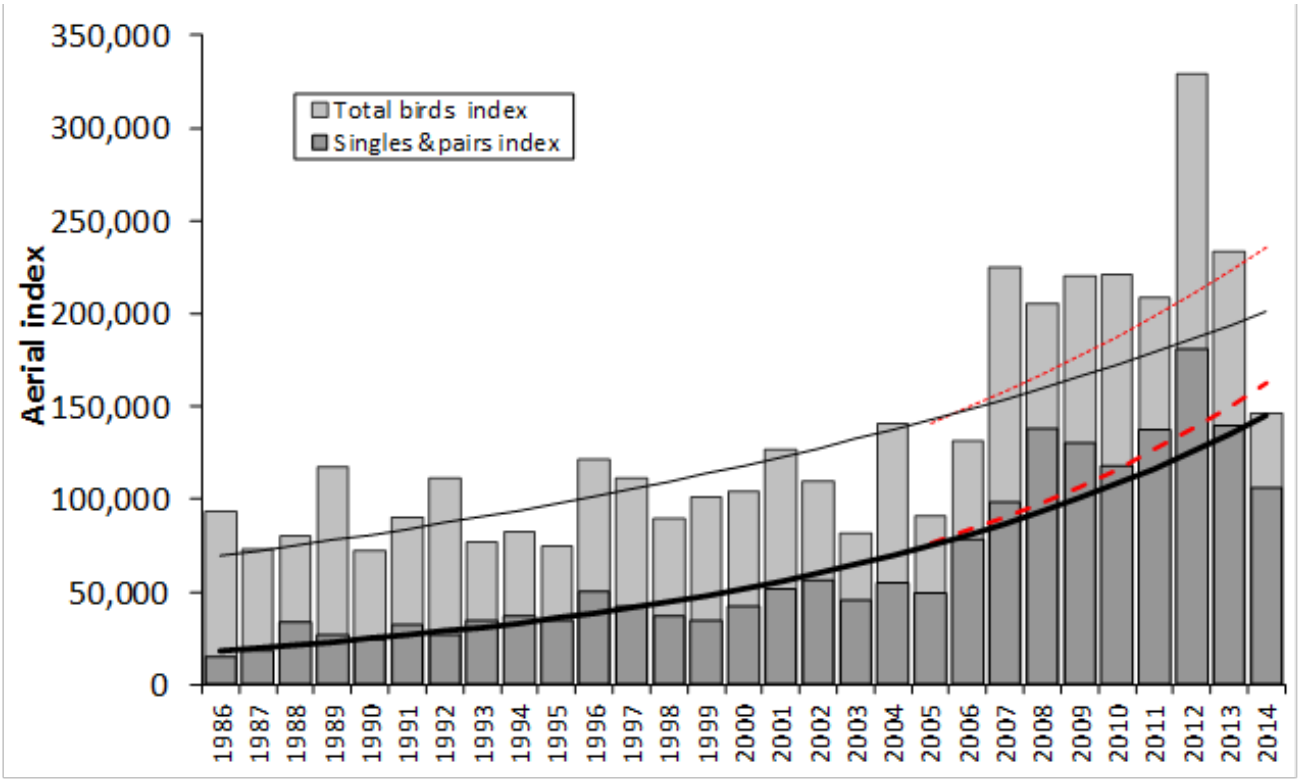


Figure 5. Indicated breeding bird (singles & pairs) and total bird for the Arctic Coastal Plain breeding pair survey 1986-2014. Long-term trends calculated by log-linear regression and 10-year trends shown with dashed lines. From Stehn et al. 2014.

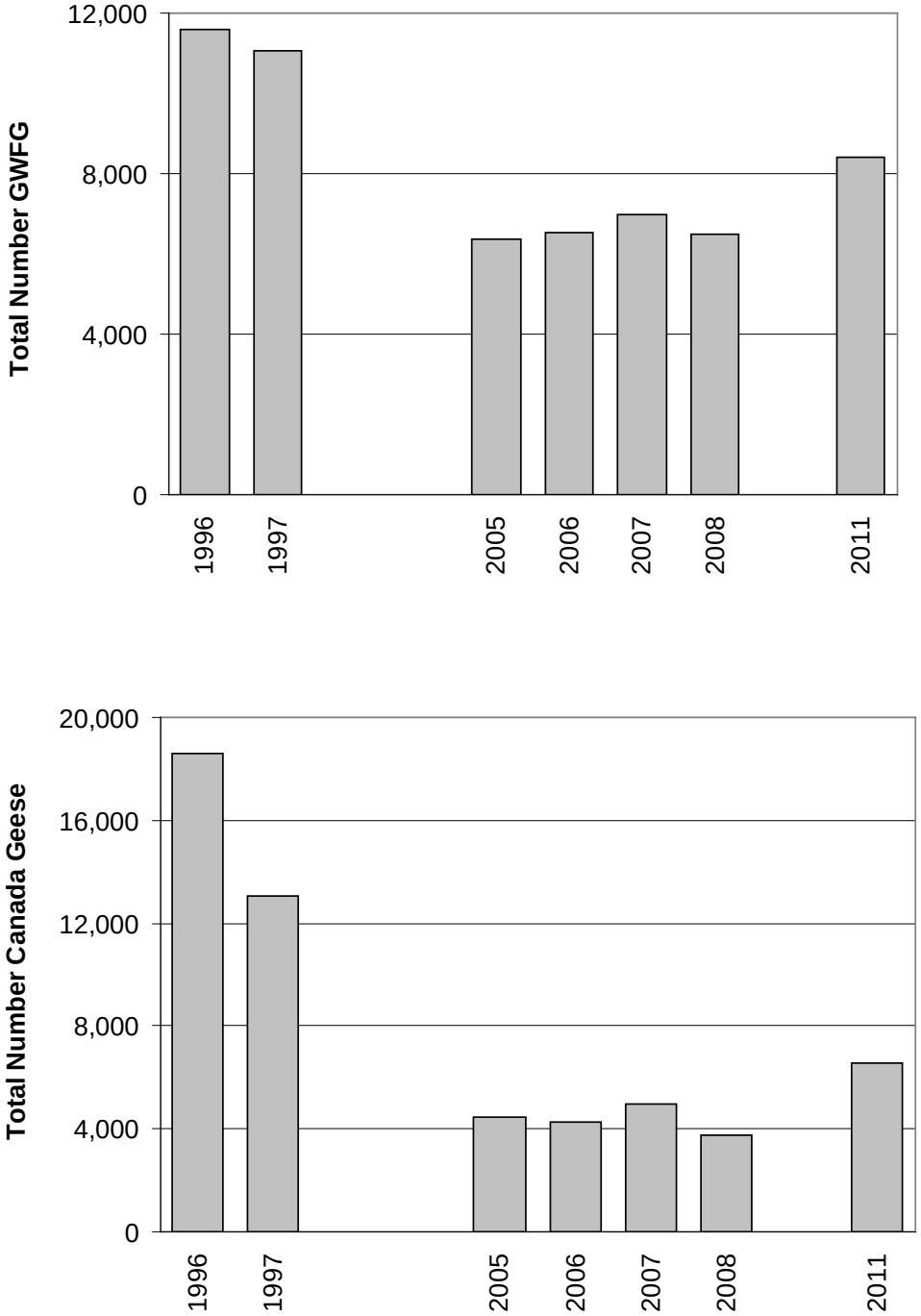


Figure 6. Total geese for white-fronts (top) and Canada geese (bottom) for aerial Selawik waterfowl breeding population surveys 1996-2011 (unpubl. Selawik NWR, USFWS data). Surveys are conducted every 3 years when possible; no survey was conducted in 2014. The total bird "index" presented here does not include multiplier for observations of single birds.

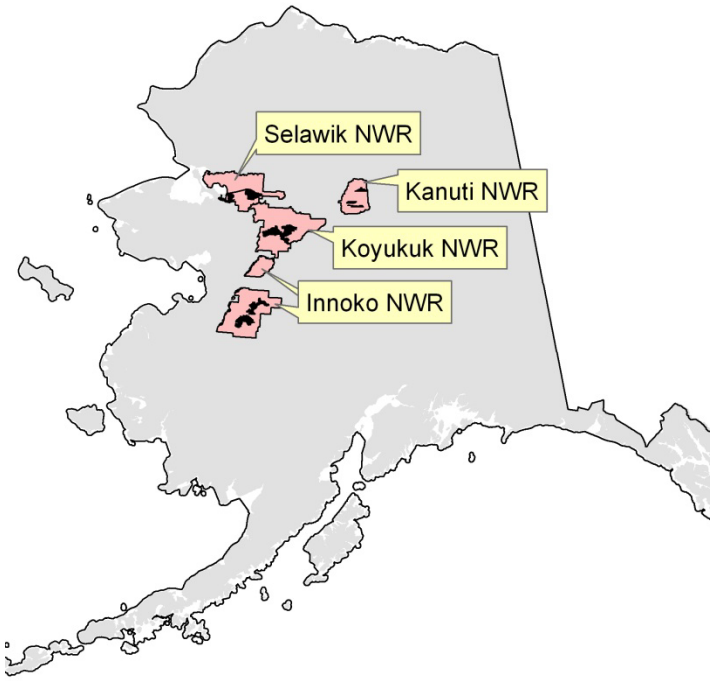


Figure 7. Molting goose survey areas, interior/northwest Alaska. National Wildlife Refuge areas in color, survey area in black.

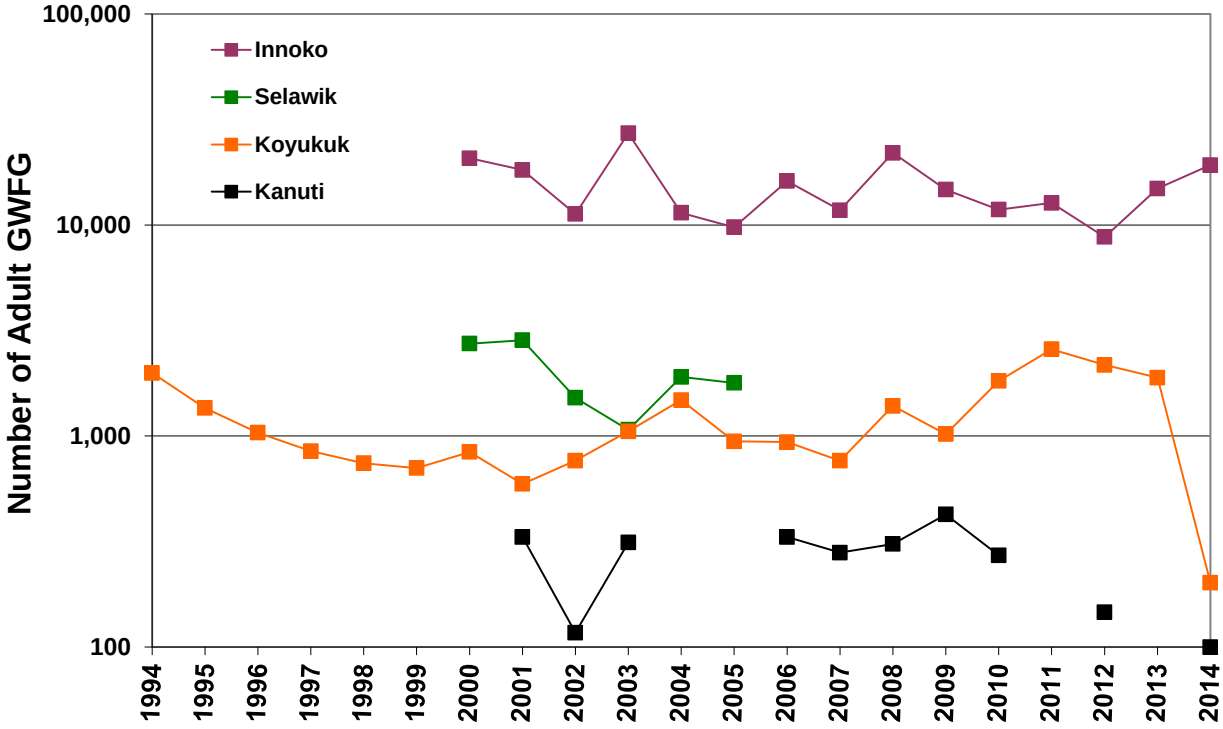


Figure 8. Numbers of adult midcontinent greater white-fronted geese at major Alaska molting areas. Numbers of geese presented on logarithmic scale to show all surveys. Selawik NWR survey was discontinued after 2005; Kanuti survey was not done in 2004-05, 2011 and 2013.

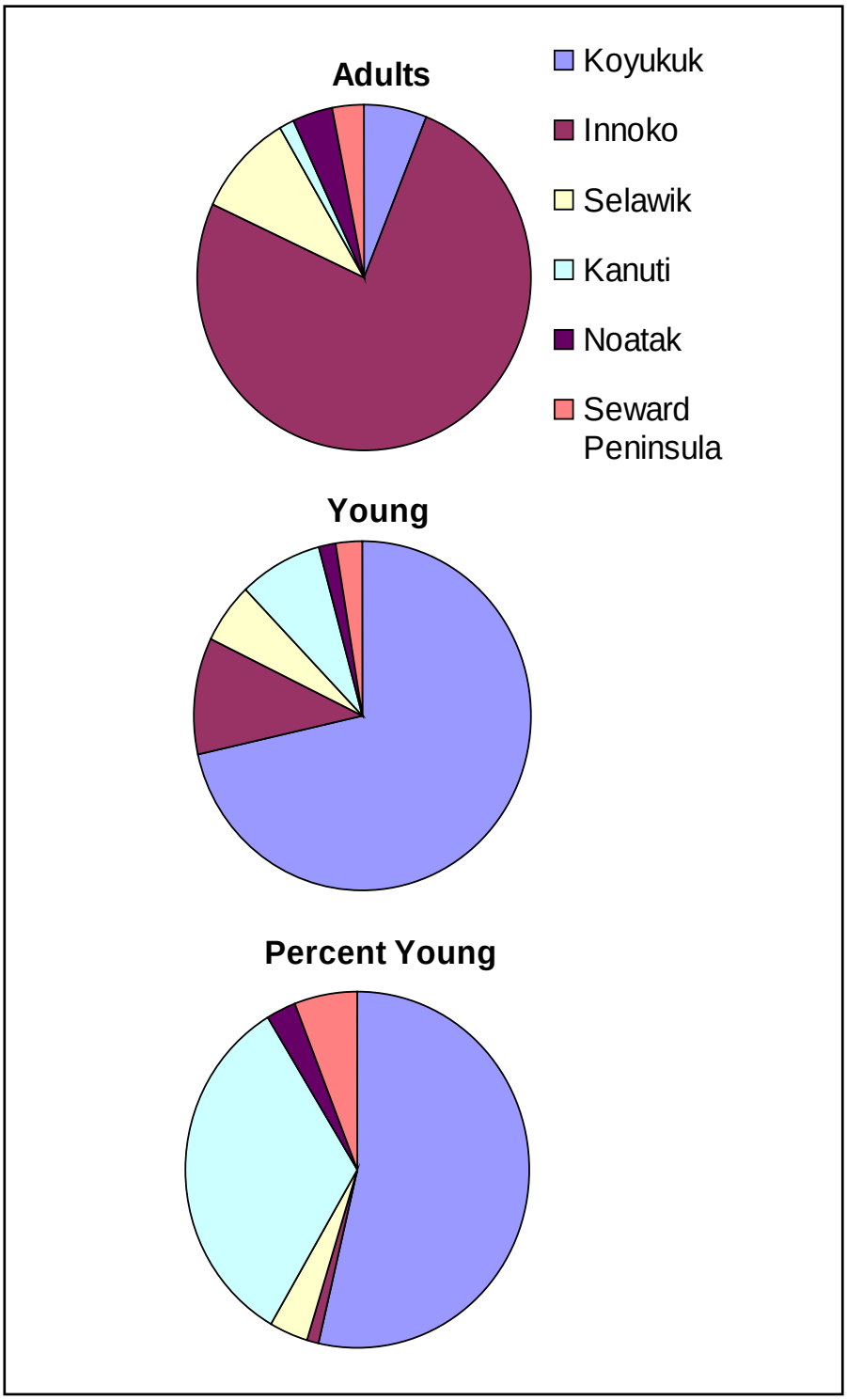


Figure 9. Distribution of midcontinent greater white-fronted geese at major Alaska molting areas. Figures based on means: 1994-2013 at Koyukuk; 2000-2013 at Innoko; 2000-2005 at Selawik; 2001-2003, 2006-2010 and 2012 at Kanuti; and 2003-2004 at Noatak and Seward Peninsula.

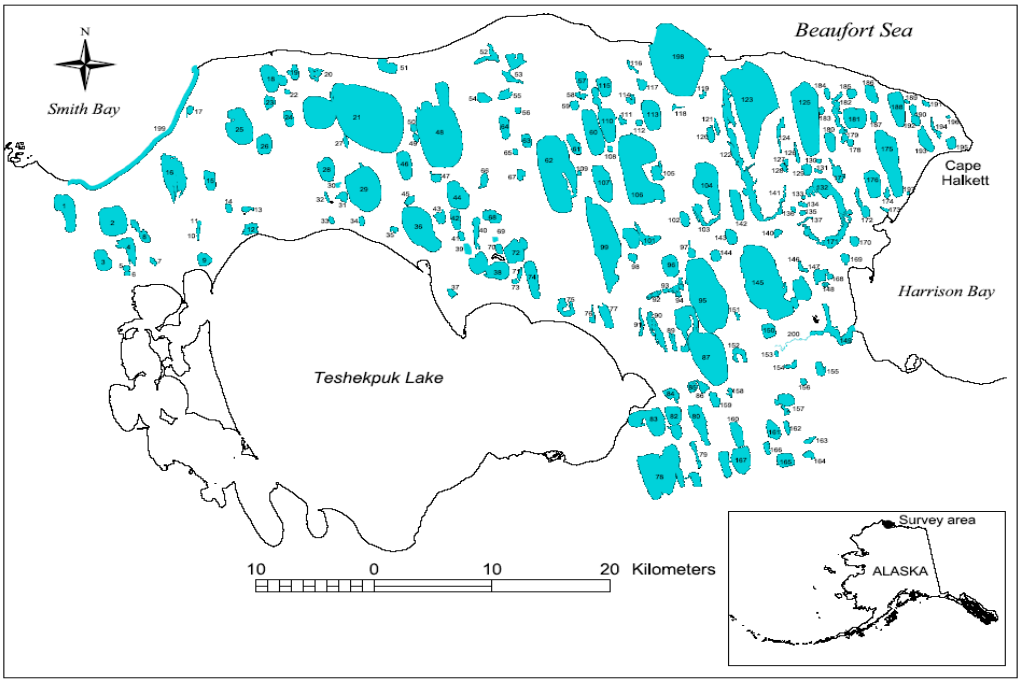


Figure 10. Lakes sampled in the Teshekpuk Lake molting area survey.

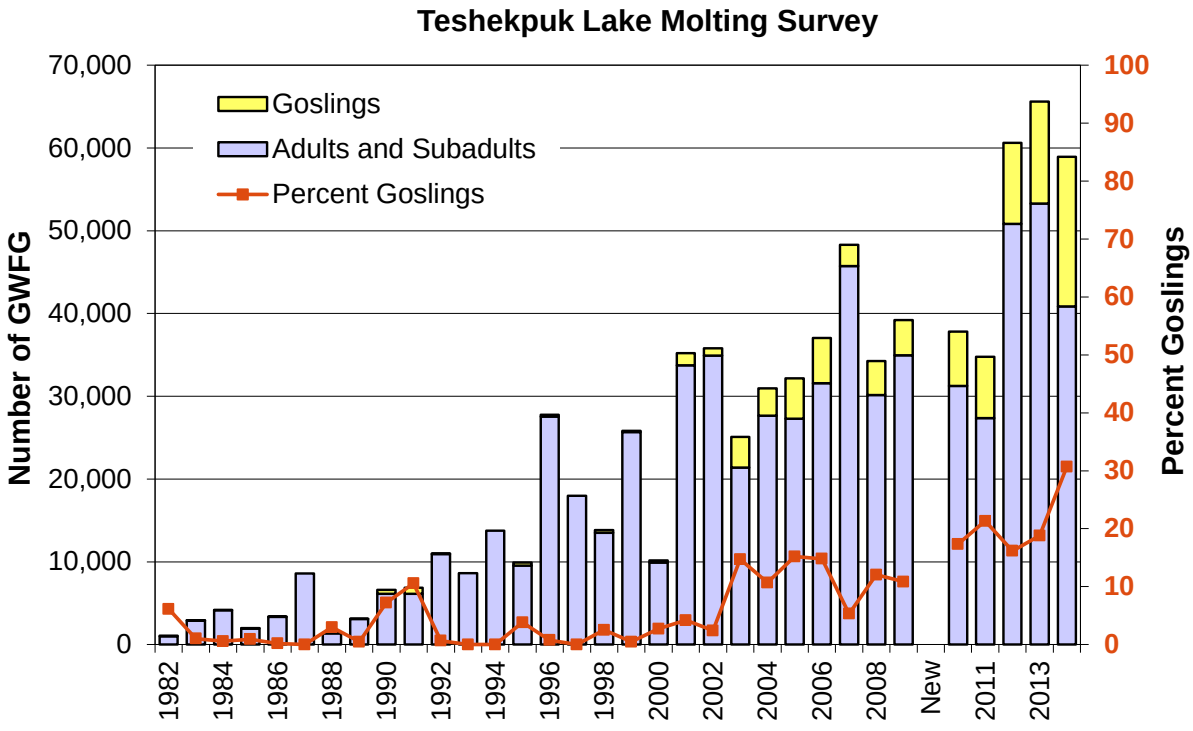


Figure 11. Numbers of greater white-fronted geese observed in the Teshekpuk Lake molting area survey, 1982-2014 (Wilson 2014, USFWS unpubl. data). In 2010, other areas in the vicinity were added to the survey (see text for details) and have added 10 and 14 percent, on average, to adult and gosling indices, respectively, over the five surveys 2010-2014 ("New" on x-axis, above).

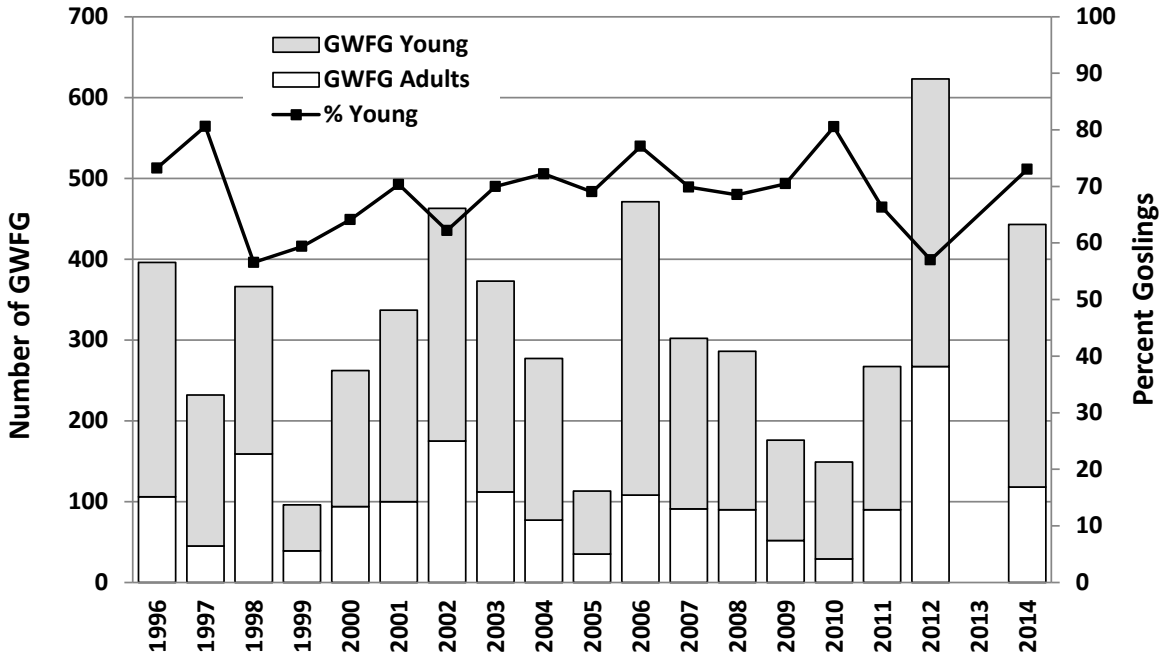


Figure 12. Production survey: numbers of adult and gosling greater white-fronted geese counted on float surveys on the Nowitna River (143 mi) in interior Alaska, late June-early July, 1996-2014. Data for all rivers in Table 4. (Bryant USFWS unpubl. data, Koyukuk/Nowitna NWR).

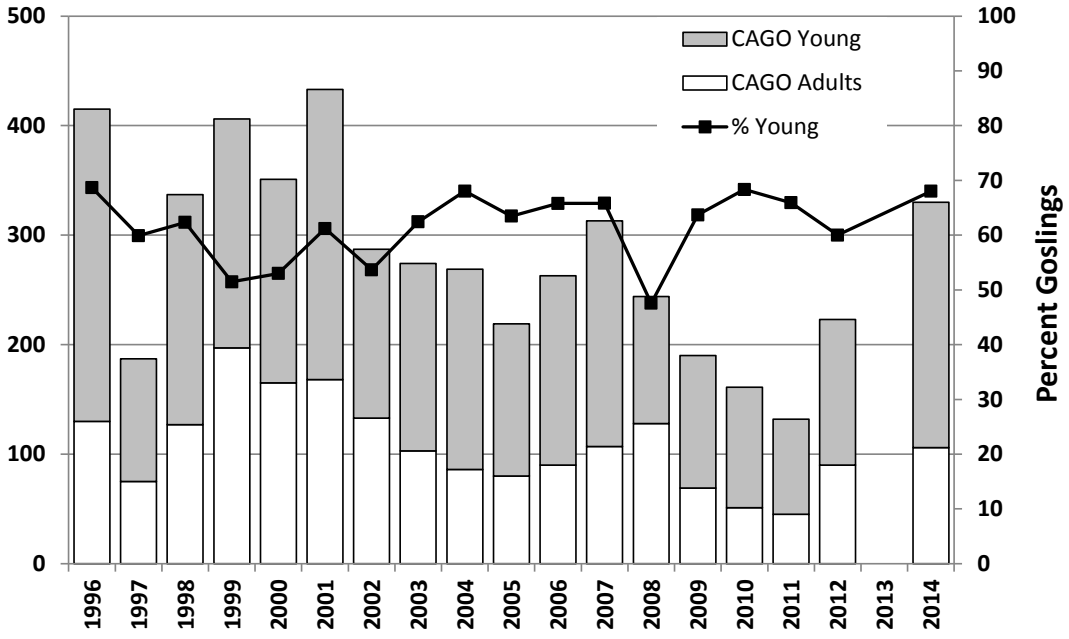


Figure. 13. Production survey: numbers of adult and gosling Canada geese counted on float surveys of 379 river miles: Dulbi (60 mi), Kaiyuh (176 mi), and Nowitna (143mi) rivers in interior Alaska, late June-early July, 1996-2014. Data in Table 5. (Bryant USFWS unpubl. data, Koyukuk/Nowitna NWR).

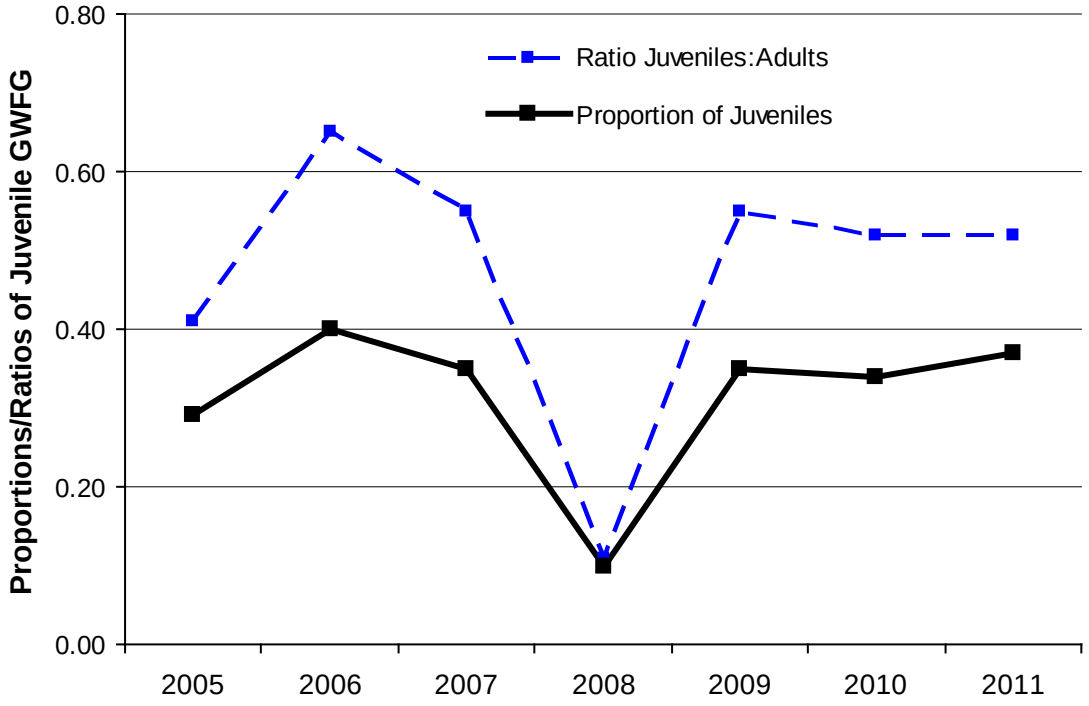


Figure 14. Age-ratio survey results for fall staging greater white-fronted geese in the vicinity of Delta Junction, Alaska, 2005-2011.

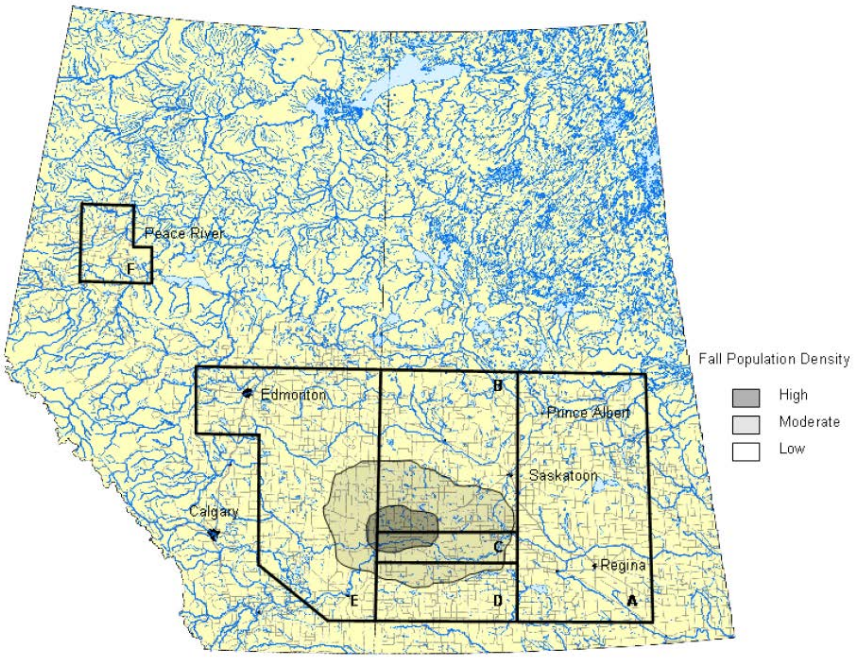


Fig 15. Map of Alberta and Saskatchewan showing survey areas for annual WHITE-FRONTS fall inventory. Peace River segment in upper left. From DeVink et al. 2013 Fall Inventory of Mid-Continent White-fronted Geese.

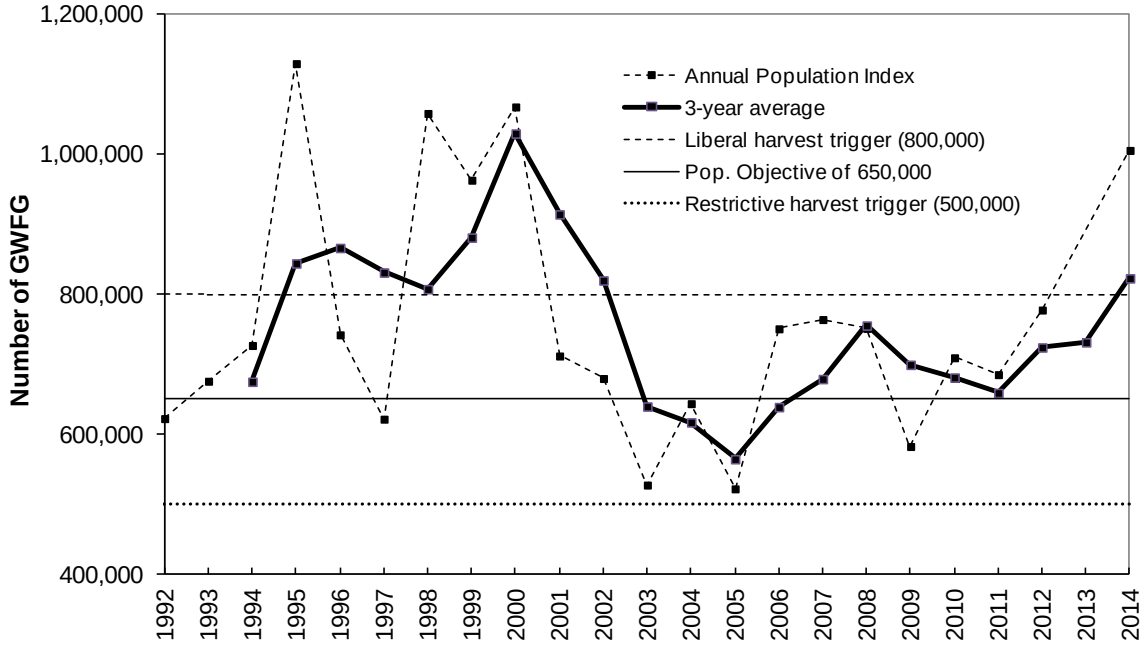


Figure 16. Fall inventory of mid-continent greater white-fronted geese, Alberta and Saskatchewan, Canada, 1992-2014 (DeVink et al. 2014). No survey was conducted in 2013; 2014 average is of years 2011, 2012 and 2014. Average for 2012 and 2014 only is 891,732. Assessment of population status in relation to objectives and triggers are to be based on the 3-year running average (Sullivan 1998).

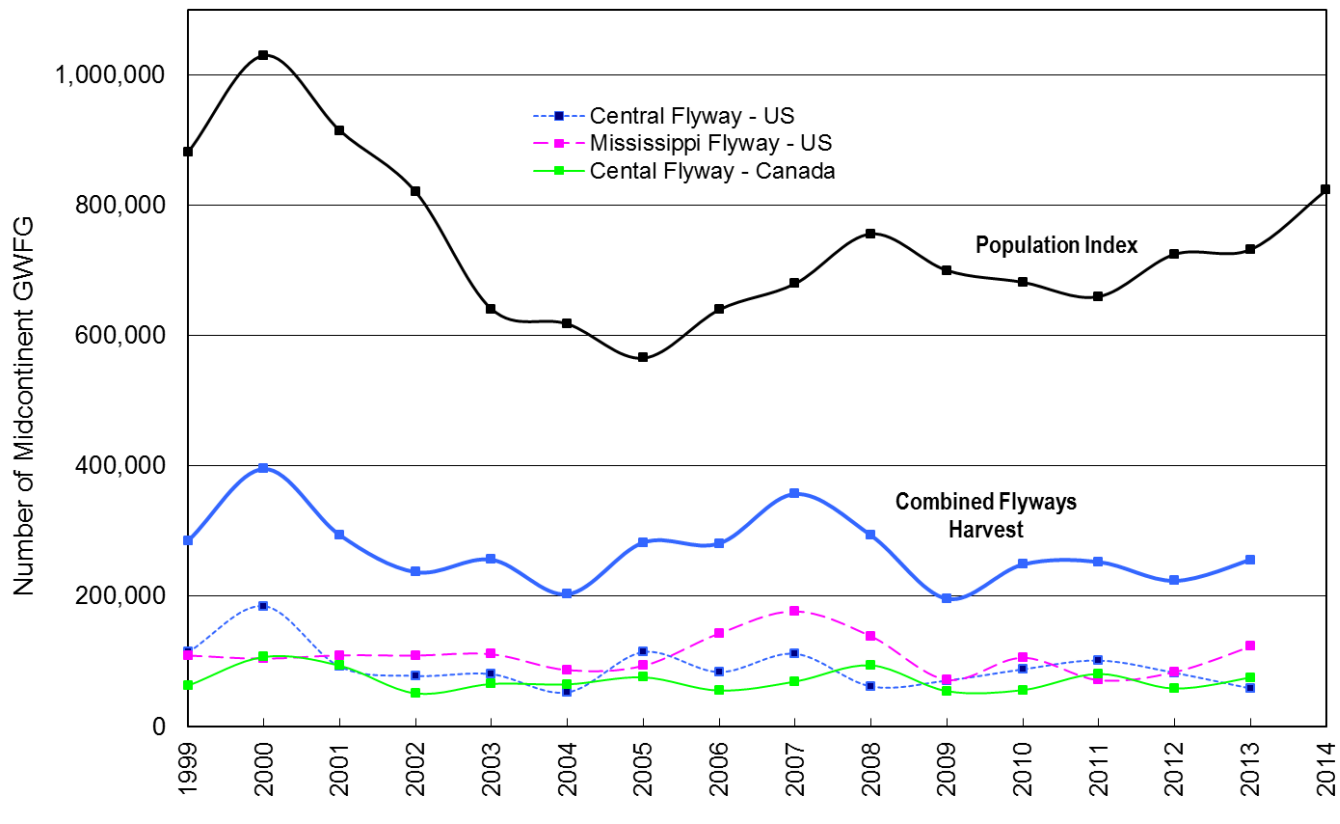
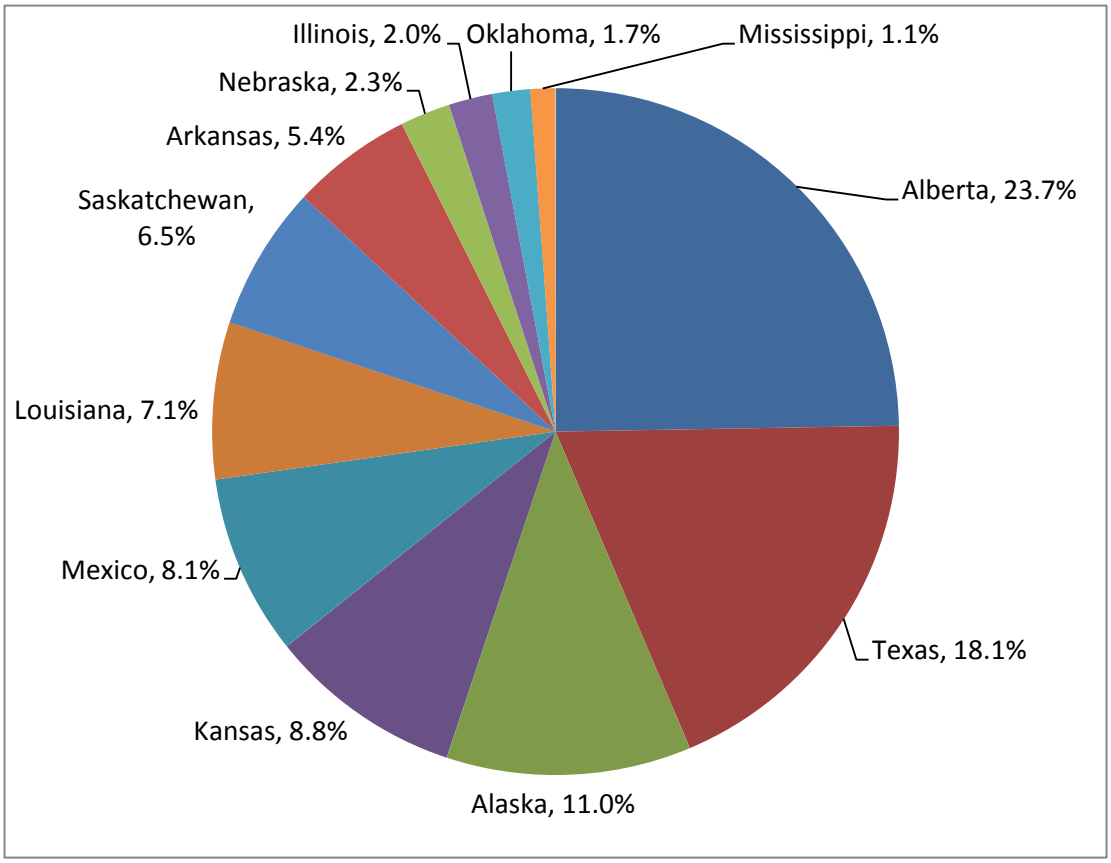


Figure 17. Estimated harvest of white-fronted geese in the U.S. and Canada portions of the Central and Mississippi Flyways, Saskatchewan and Alberta (Raftovich et al. 2013) relative to the fall population index (3-year average, DeVink et al. 2014), 1999-2014 (no survey in 2013). Year indicates start of hunting season. Harvest estimates from the Migratory Bird Harvest Information Program (HIP) surveys for the 2013 (2013-14) hunting season is preliminary, pending final counts of the number of HIP registrants in each state and complete audits of all survey response data (Raftovich et al. 2014).



Location	Percent
Mississippi	1.1%
Colorado	0.9%
Missouri	0.6%
North Dakota	0.6%
South Dakota	0.5%
Kentucky	0.3%
Yukon Territory	0.3%
Alabama	0.2%
Indiana	0.1%
Minnesota	0.1%
Montana	0.1%
Iowa	0.1%
Ontario	0.1%
Tennessee	0.1%

Figure 18. Distribution of recoveries of midcontinent greater white-fronted geese banded in interior Alaska, 2000-2014. Numbers indicate percent of harvest by state or province. Table lists those with <1% of total harvested, by percent. N=1,413 birds reported; data from GameBirds encounter database, USGS Bird Banding Laboratory, Patuxent, MD. Harvest of white-fronts in Pacific Flyway States (except Alaska) is not shown because by definition, they do not represent Midcontinent geese.

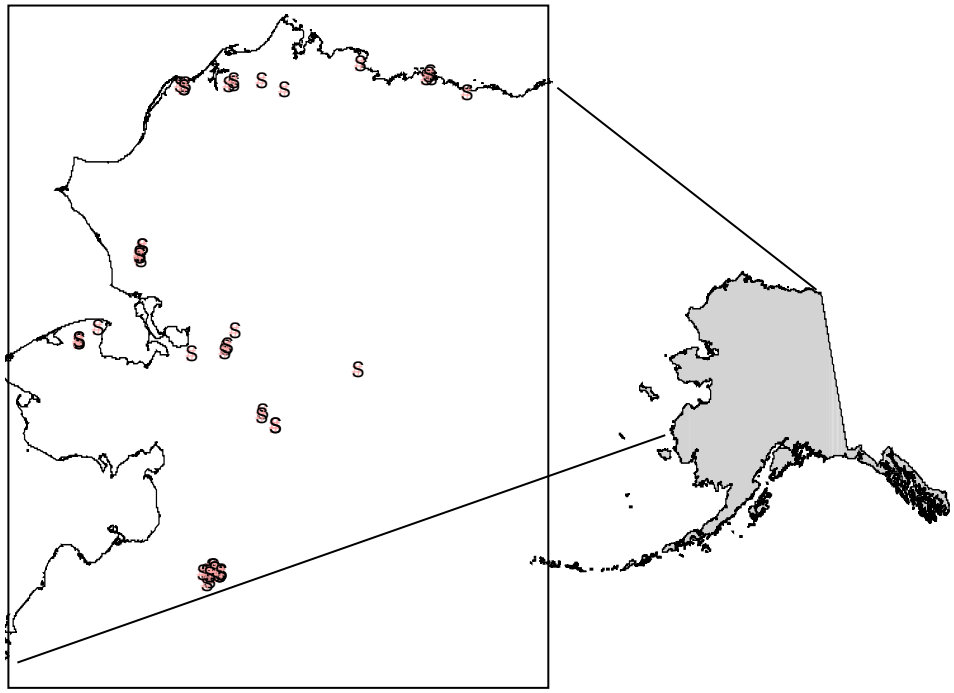


Figure 19. Midcontinent white-fronted goose banding locations in Alaska.

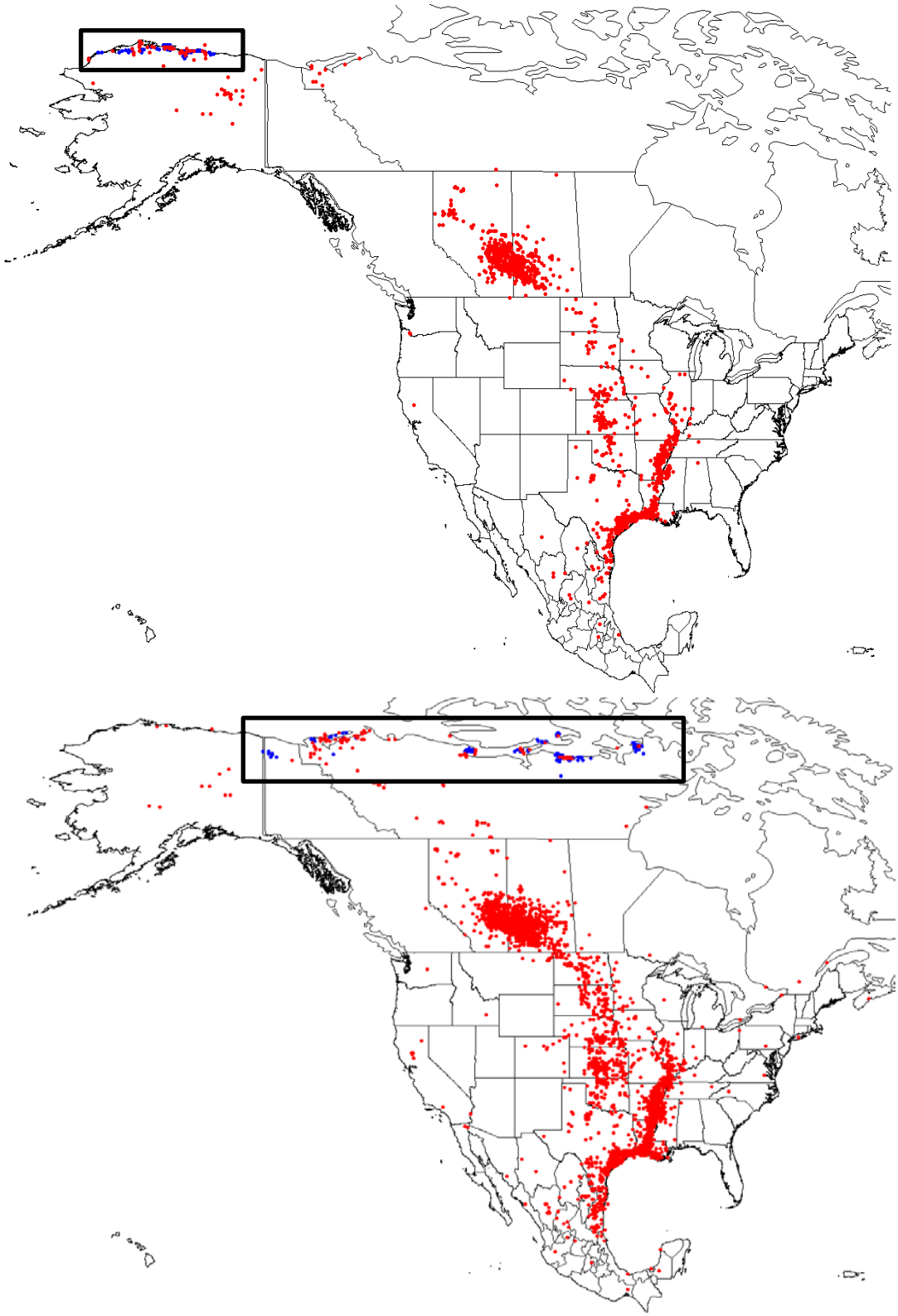


Figure 20. Banding and recovery locations of all white-fronts banded in arctic North America; Alaska Arctic Coastal Plain (top,rectangle, n=3,789 recoveries) and Canada arctic (bottom, n=11,992 recoveries) . Banding locations in blue, individual recovery locations, red. Data from Game Bird encounters database, USGS Bird Banding Laboratory, Patuxant, MD.

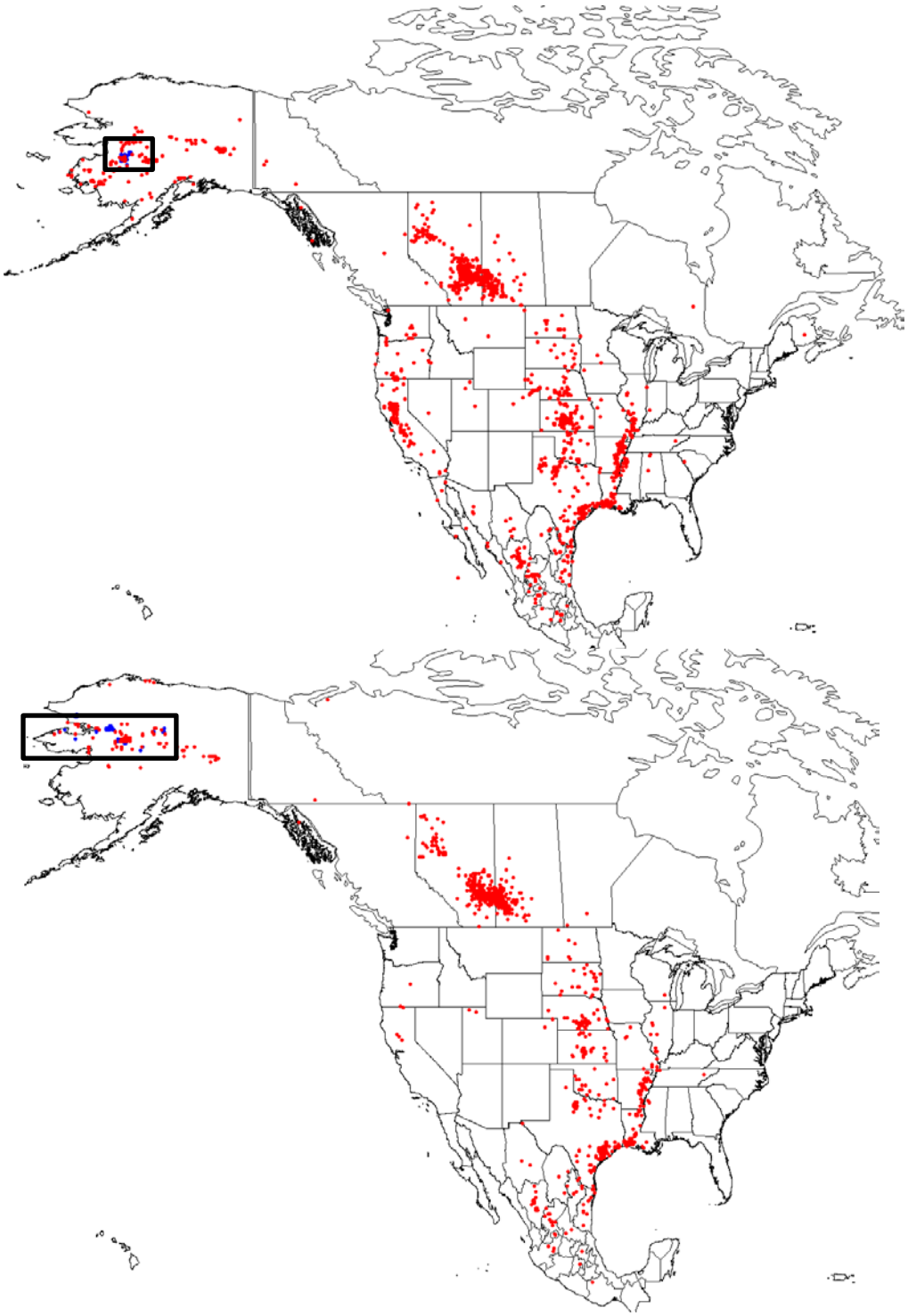


Figure 20 (continued). Banding and recovery locations of all white-fronts banded in interior Alaska; Innoko NWR (top, rectangle, n=2,484 recoveries) and other interior (Koyukuk-Nowitna,Kanuti and Selawik NWR, Seward Peninsula and Noatak River delta, bottom, n=2,166 recoveries). Banding locations in blue, individual recovery locations, red. Data from Game Bird encounters database, USGS Bird Banding Laboratory, Patuxant, MD.

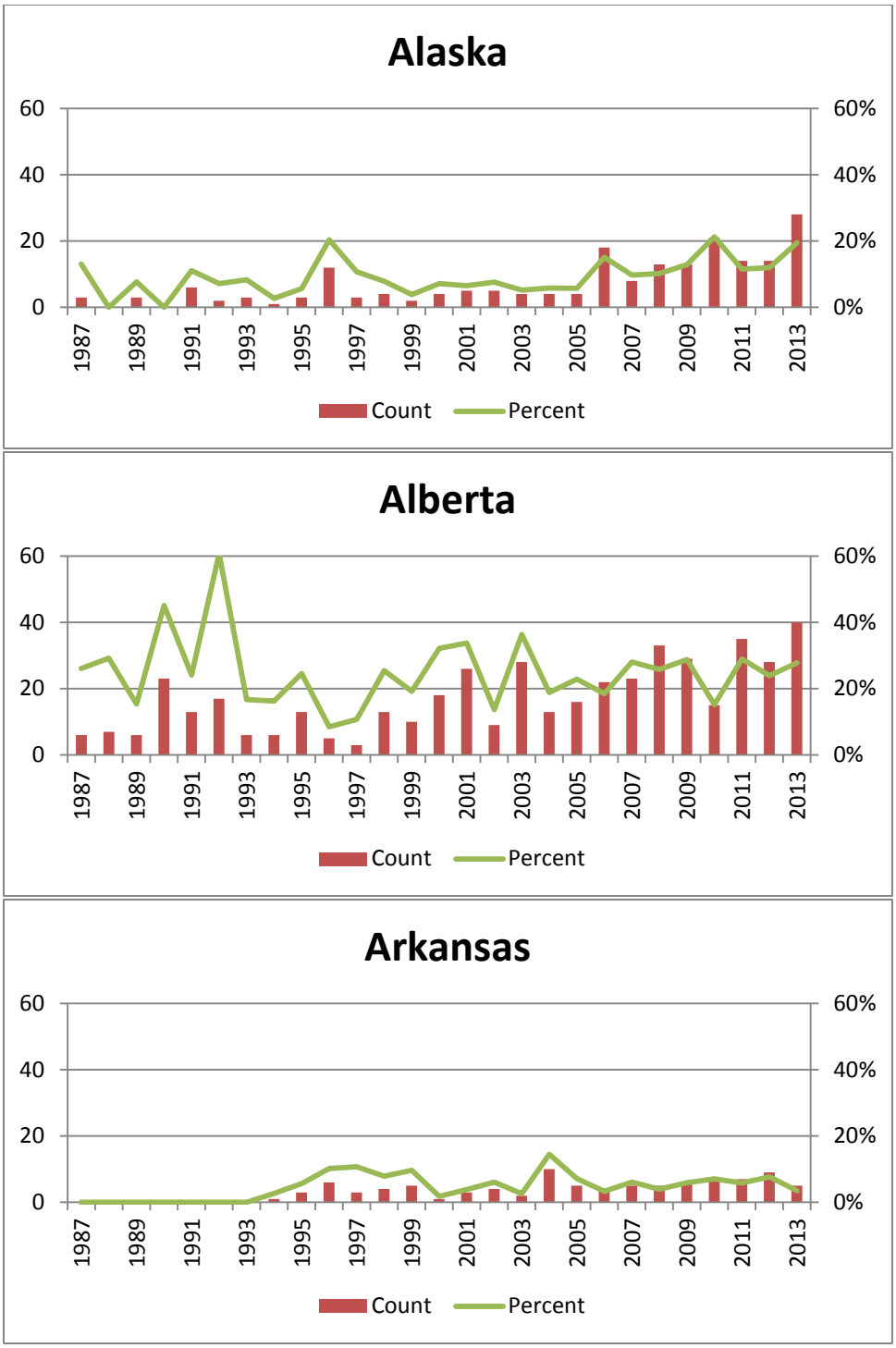
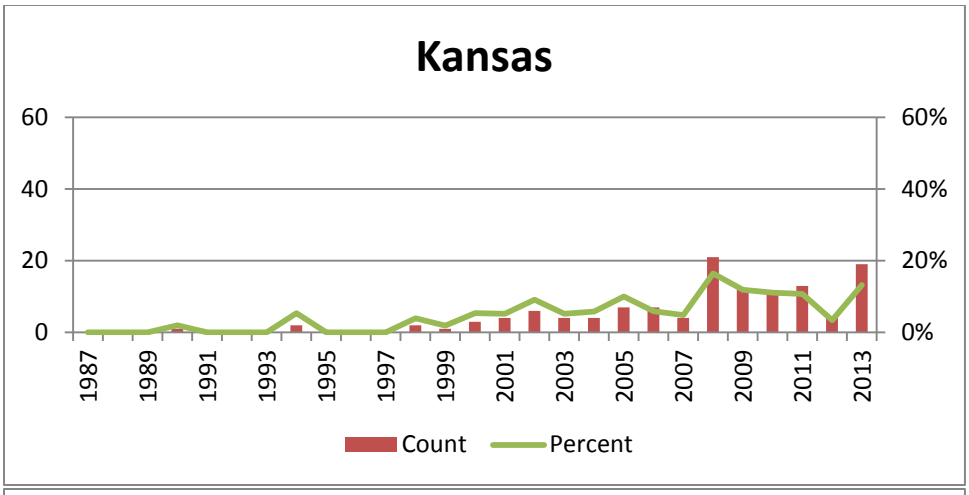
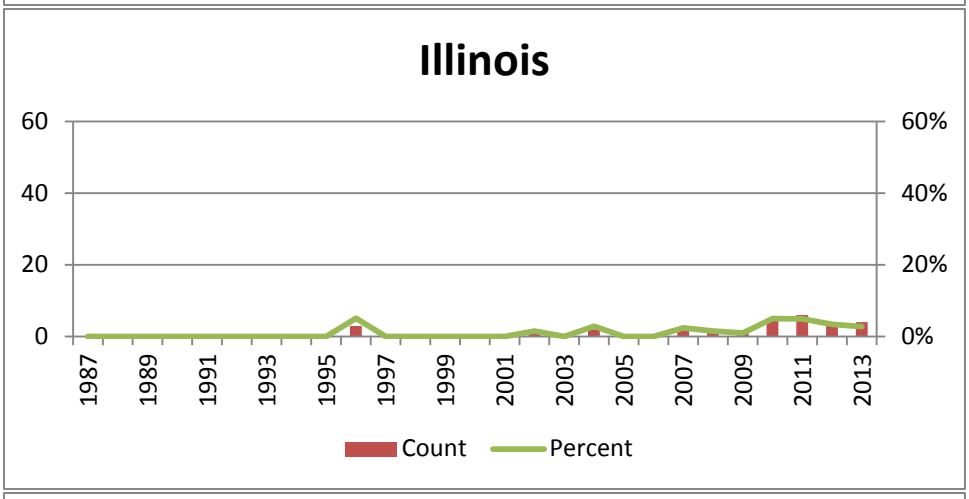


Figure 21. Percent and count of greater white-fronted geese banded at Innoko NWR that were recovered in various locales, by year, 1987-2013. Other states with recoveries listed in Figure 18. Total number of birds banded in Innoko, by year, is presented in Table 10.





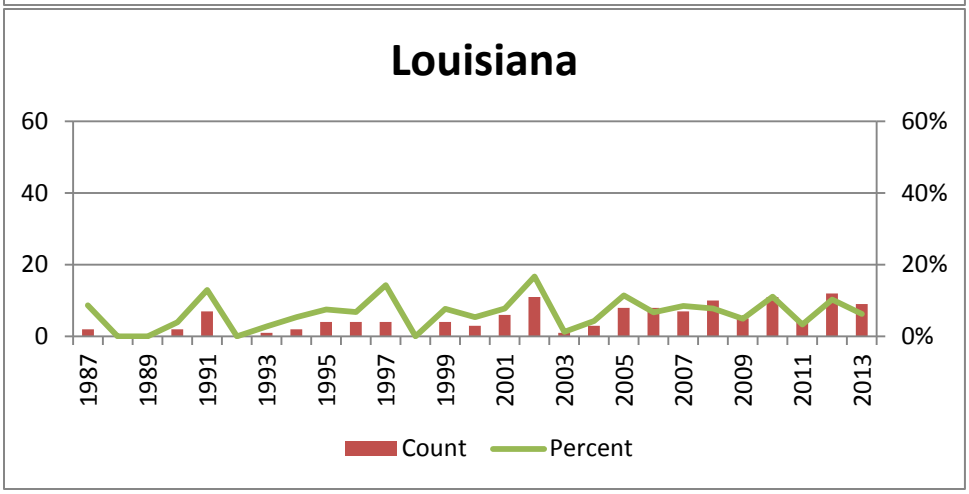
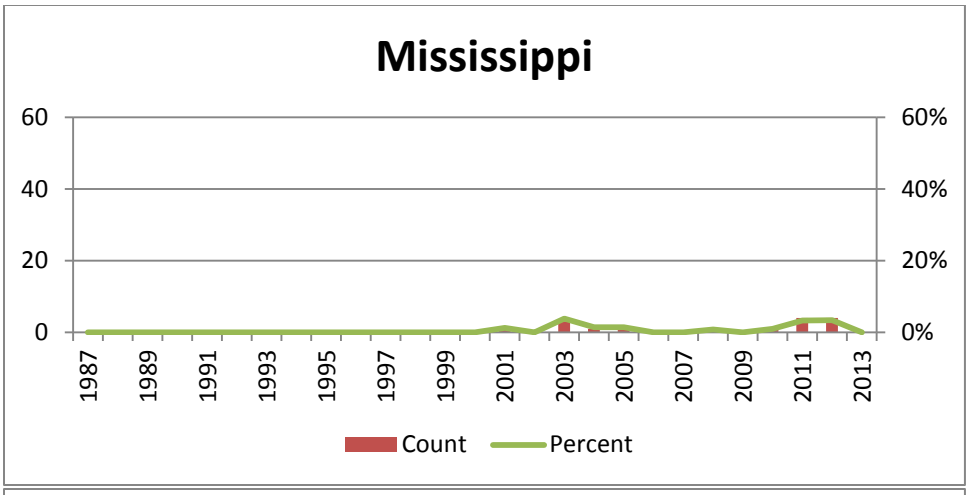


Figure 21 cont.


Mississippi
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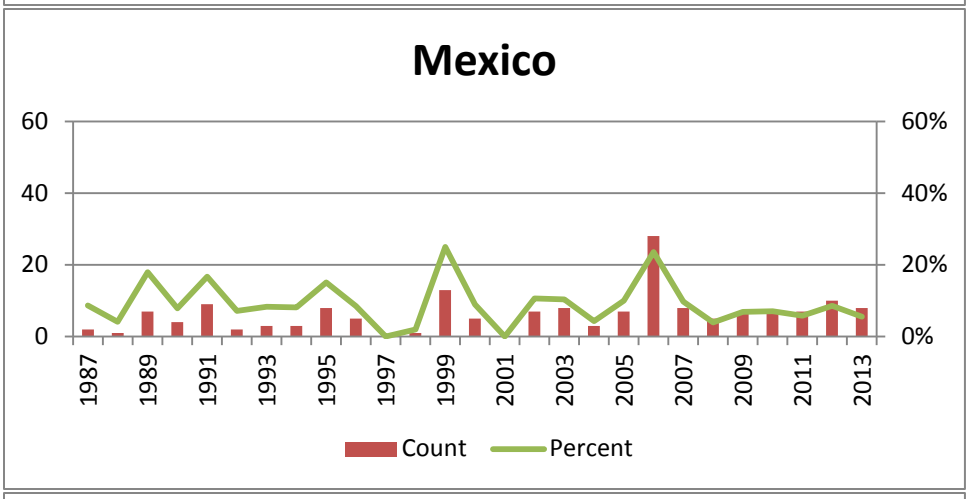
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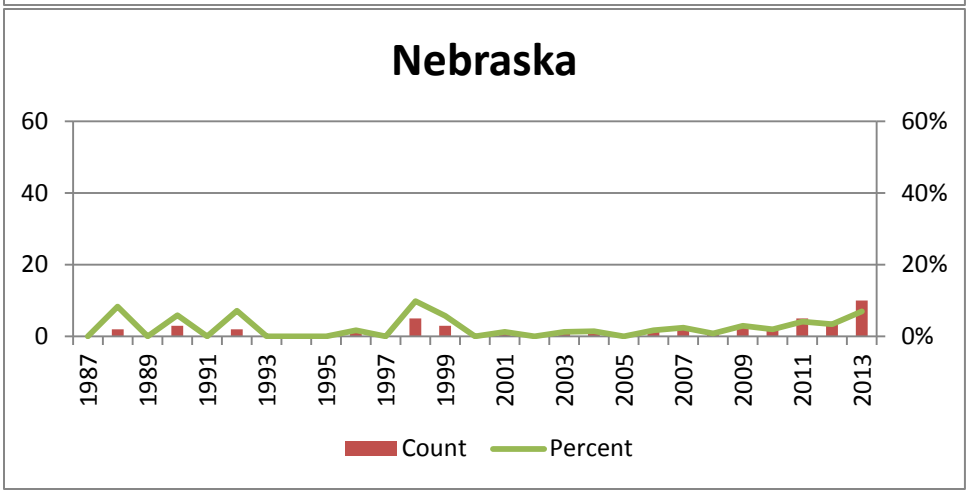
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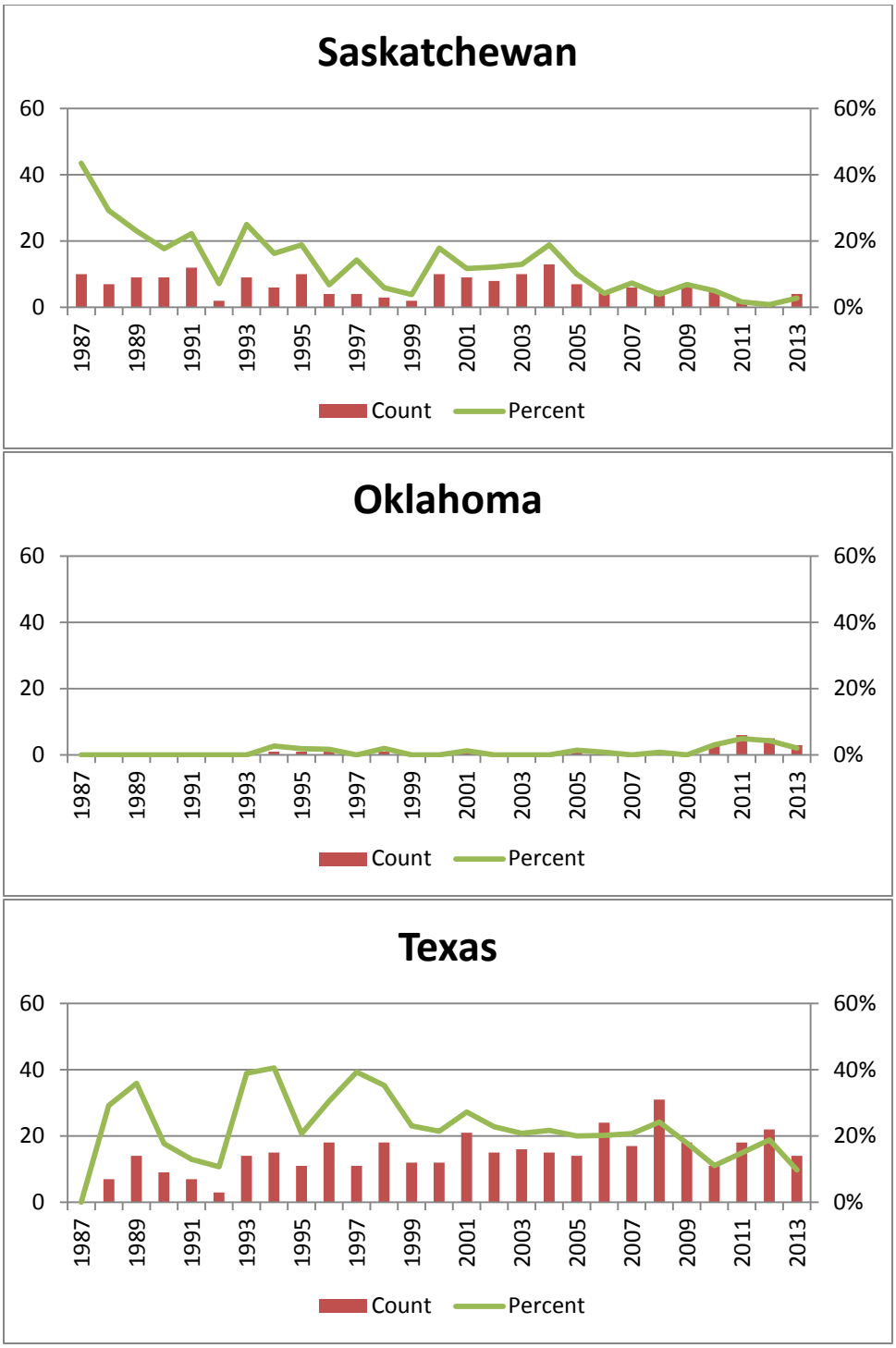
Fig. 21 cont.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Percent

Fig. 21 cont.

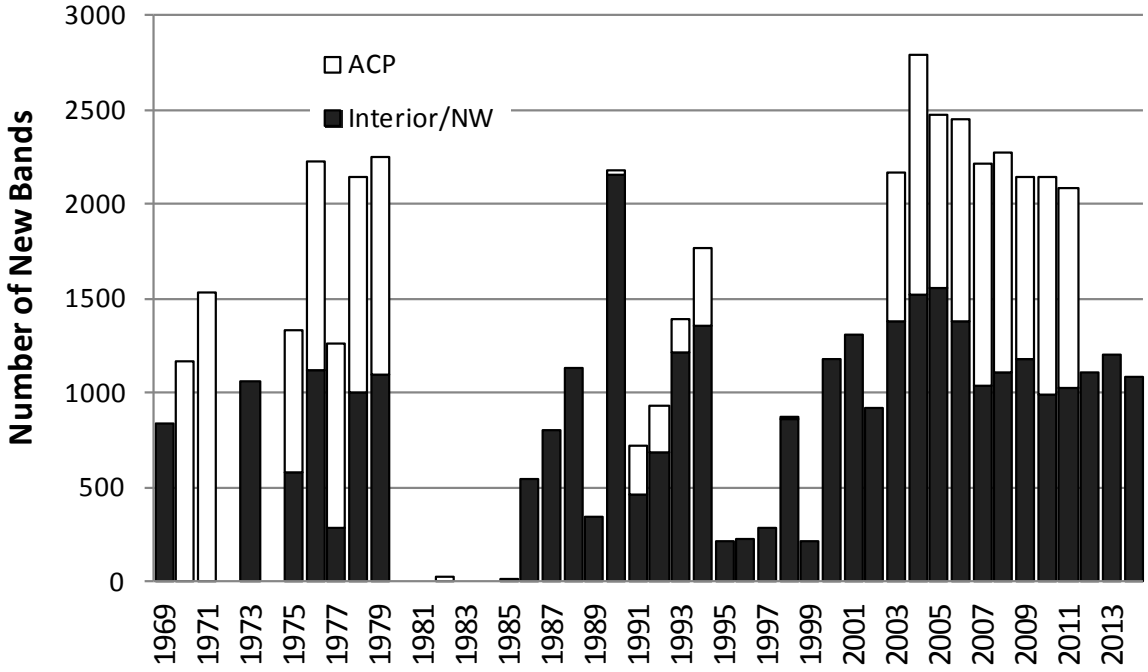

Figure 22. Numbers of midcontinent greater white-fronted geese banded each year by region, Arctic Coastal Plain, ACP, and Interior and northwest Alaska. Migratory Bird Management, USFWS Region 7, Alaska, 1969-2014.

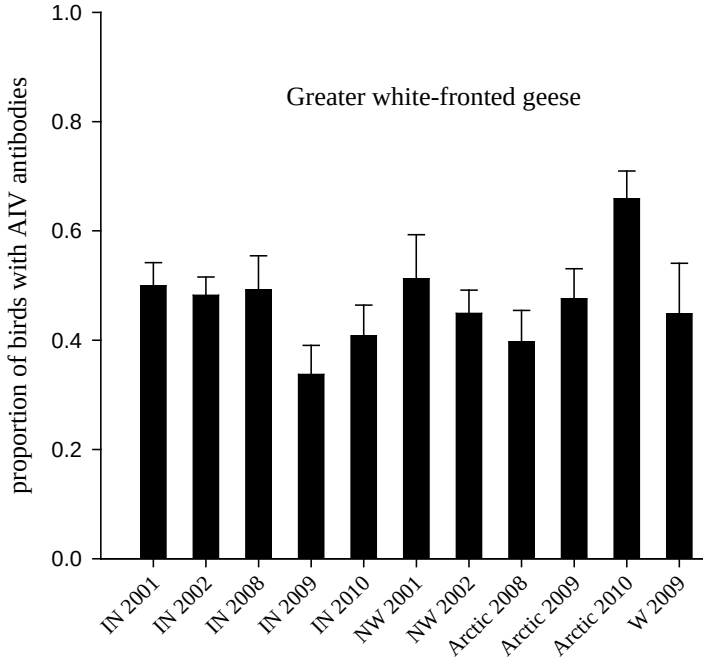

Figure 23. Spatio-temporal variation in avian influenza virus (AIV) seroprevalence rates (± s.e.) for greater white-fronted geese in Alaska. Site abbreviations are: IN= Interior Alaska, NW=Northwestern (Kotzebue region), Arctic = Arctic Coastal Plain, and W = Western (Yukon-Kuskokwim Delta)

Table 1. Abundance of midcontinent greater white-fronted geese during molting surveys in interior/northwest Alaska, 1994-2014 (Bryant 2014, Harwood 2014, Wilson 2014, USFWS unpubl. data).

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	--	--	322	64	--	--	--	--
2007	763	915	11754	177	--	--	270	80	--	--	--	--
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	--	--	--	--	--	--	--	--
2012	2172	897	8930	79	--	--	146	110	--	--	--	--
2013	1890	1280	14898	245	--	--	--	--	--	--	--	--
2014[1]	202	117	19238	130	--	--	0	0	--	--	--	--
Mean	1196	696	15392	116	1978	53	251	72	792	16	583	25

--, no survey conducted

[1]in 2014, water was exceedingly high during nesting and hatch on the Kanuti NWR (Harwood pers. comm.) and very high during the molt survey on the Koyukuk NWR (Bryant pers. comm.)

Table 2. Mean number of midcontinent greater white-fronted goose adults and young, and percent young at major Alaska molting areas, 1994-2014.

	Koyukuk	Innoko	Selawik	Kanuti	Noatak	Seward Peninsula
Mean Adults	1246	15117	1978	278	792	583
Mean Young	725	105	53	80	16	25
% Young	36.8	0.7	2.6	22.3	1.9	4.0

Table 3. Abundance of Canada geese during molting surveys in interior/northwest Alaska, 1994-2011 (Bryant 2014, Harwood 2014, Platte and Wilson 2015., USFWS unpubl. data 2014).

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	--	--	--	--	--	--	--	--
2012	45	66	5308	54	--	--	25	50	--	--	--	--
2013	48	54	2524	66	--	--	--	--	--	--	--	--
2014	8	18	6706	274	--	--	22	26	--	--	--	--
Mean	52	63	4394	165	2833	175	89	111	408	14	702	22

Table 4. Greater white-fronted geese observed during float surveys of 379 river miles on the Dulbi (60 mi), Kaiyuh (176 mi), and Nowitna (143 mi) rivers in interior Alaska, late June-early July, 1996-2014 (Bryant unpubl. data 2014, 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
2012	431	315	42	--	--	--	267	356	57	698	671	49
2013				Bad flood year - no float surveys conducted in 2013								
2014	--	--	--	--	--	--	118	325	73	118	325	73
Mean	314	260	45	108	106	53	99	214	69	486	554	54

[1] in most years, total river surveyed = 379 miles; in 2011-12 and 2014, the Kaiyuh and sometimes the Dulbi was flooded and was not surveyed (--).

Table 5. Canada geese observed during float surveys of 379 river miles on the Dulbi (60 mi), Kaiyuh (176 mi), and Nowitna (143 mi) rivers in interior Alaska, late June-early July, 1996-2014 (Bryant unpubl. data 2014, 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
2012	41	68	62	--	--	--	49	65	57	90	133	60
2013				Bad flood year - no float surveys conducted in 2013								
2014	--	--	--	--	--	--	106	224	68	106	224	68
Mean	33	46	58	19	29	62	62	104	62	108	171	62

[1] in most years, total river surveyed = 379 miles; in 2011-12 and 2014, the Kaiyuh and sometimes the Dulbi was flooded and was not surveyed (--).

Table 6. Age-ratio of fall staging greater white-fronted geese in the vicinity of Delta Junction, Alaska, 2005-2011.

Year	Observation Dates	Total Geese Observed	Juvenile GWFG Proportion[1]	Juvenile GWFG Ratio[2]
2005	21-23 Aug.	812	**0.29**	**0.41**
2006	29-30 Aug.	4271	**0.40**	**0.65**
2007	30-31 Aug.	6991	**0.35**	**0.55**
2008	21-27 Aug.	1869	**0.10**	**0.11**
2009	21 Aug.- 3 Sept	2087	**0.35**	**0.55**
2010	18 Aug.- 3 Sept	3234	**0.34**	**0.52**
2011	16 Aug.- 17 Sept	6944	**0.37**	**0.52**
Average, all years		3744	**0.31**	**0.47**

[1] Total juveniles/total geese
[2] Total juveniles/total adults

Table 7. AMBCC Regional subsistence harvest estimates for midcontinent greater white-fronted geese in Alaska, by region, 2004-2012 (Naves 2010a,b, 2012, 2014). The Bering Strait/Norton Sound region consists of 3 subregions: St. Lawrence-Diomede islands (SLI), Bering Strait mainland villages (BSV) and Nome. Estimates are presented at regional level only per request of regional partners, though SLI and BS make up the bulk of birds taken.

				Interior Alaska (5 subregions)				
Year	Bering Strait Norton Sound[1] (3 subregions)	Northwest Arctic[2] (2 subregions)	North Slope (2 subregions)	Mid-Yukon Upper Kuskokwim	Yukon Koyukuk	Upper Yukon	Tanana Villages	Tok
2004	**400**	--	--	**450**	**370**	**3,361**	**757**	--
2005	**957**	--	**6,161**	**95**	**224**	--	--	--
2006	--	**1,185**	--	**51**	**256**	**2,551**	**1,035**	**0**
2007	**897**	--	**18,355**	--	**409**	**8,491**	--	--
2008	--	--	**20,187**	--	**881**	--	--	--
2009	36	--	**7,825**	--	--	--	--	--
2010	**766**	--	--	**73**	**910**	**2,571**	**917**	**0**
2011	9	--	--	--	--	--	--	--
2012	8	**287**	--	--	--	--	--	--
Mean	**755**	**736**	**13,132**	**167**	**508**	**4,244**	**903**	**0**
Average annual harvest for all regions: 20,445								

all numbers in bold used to calculate means

[1]only SLI surveyed in 2009 and not included in mean. In 2010, Nome not surveyed but total included in average.

in 2011-12 only St. Lawrence-Diomede subregion surveyed.

[2]for Northwest Arctic Villages subregions, only villages were surveyed in 2006; in 2012, only Kotzebue was surveyed.

These two estimates were combined for a total.

Table 8. AMBCC Regional subsistence harvest estimates for midcontinent greater white-fronted goose eggs in Alaska, by region, 2004-2012 (Naves 2010a,b, 2012, 2014). The Bering Strait/Norton Sound region consists of 3 subregions: St. Lawrence-Diomede islands (SLI), Bering Strait mainland villages (BSV) and Nome. Estimates are presented at regional level only per request of regional partners, though SLI and BS make up the bulk of birds taken.

				Interior Alaska (5 subregions)				
Year	Bering Strait Norton Sound[1] (3 subregions)	Northwest Arctic[2] (2 subregions)	North Slope (2 subregions)	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**	--	--	--	--	--
2010	**21**	--	--	**0**	**0**	**0**	**0**	**0**
2011	60	--	--	--	--	--	--	--
2012	0	**0**	--	--	--	--	--	--
Mean	**18**	**68**	**315**	**0**	**0**	**0**	**0**	**0**
Average annual harvest for all regions: 401								

all numbers in bold used to calculate means

[1]only SLI surveyed in 2009 and not included in mean. In 2010, Nome not surveyed but total included in average.

in 2011-12 only St. Lawrence-Diomede subregion surveyed.

[2]for Northwest Arctic Villages subregions, only villages were surveyed in 2006; in 2012, only Kotzebue was surveyed.

These two estimates were combined for a total.

Table 9. Subsistence harvest estimates of midcontinent greater white-fronted geese in Alaska in some areas prior to 2004. Historical regional estimates from Alaska Migratory Bird Co-Management Council website (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, 1969-2014.

	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**
1974									**0**
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**
2012	1110								**1110**
2013	1198								**1198**
2014	1087								**1087**
Total	**22374**	**1808**	**7104**	**683**	**18556**	**36**	**1565**	**891**	**53017**

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**						