Nest Population Size and Potential Production of Geese and Spectacled Eiders on the Yukon-Kuskokwim Delta, Alaska, 1985-2010

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SUMMARY: We used a ground-based survey to estimate the number of nests and eggs of geese and eiders on the Yukon-Kuskokwim Delta (YKD), Alaska, 1985-2010. Geese and eider production was good in 2010 with low rates of nest depredation and nest abandonment. Recent 10-year trends in nest populations are stable or increasing for eiders and geese. We estimate that spectacled eider pairs built 6,750 nests and produced 28,957 viable eggs on the YKD coastal zone in 2010. The estimated numbers of spectacled eider nests and eggs in 2010 were the third highest since 1985, and 42% above the 1985-2009 average. Timing of spring warming was later than average with breakup of the Kuskokwim River at Bethel six days later than the previous 28-year mean. Despite the late river breakup at Bethel, hatch dates of waterfowl species in 2010 were up to 5 days earlier than the previous long-term mean (1982-2009). A long-term trend in earlier nesting is significant over the last 29 years.

INTRODUCTION:

Annual assessment of nest population size and egg production of geese and eiders on the Yukon-Kuskokwim Delta (YKD) provides information for the Spectacled and Steller's Eider Recovery Team, the Pacific Flyway Technical Committee, participants in cooperative goose management plans, and biologists interested in waterfowl status and trends in western Alaska. A ground-based sampling procedure has been used since 1985 to estimate the number of nests and eggs for spectacled eiders (*Somateria fischeri*), cackling geese (*Branta hutchinsii minima*), emperor geese (*Chen canagica*), greater white-fronted geese (*Anser albifrons frontalis*), and other nesting waterbirds on the YKD. The ground-based nest survey provides an estimate of nest population size and potential production (eggs). The ground survey is conducted concurrently with an aerial breeding pair survey (Bollinger and Hodges 2010, Platte and Stehn 2010) that provides an index to population size. Together, these surveys contribute long-term data needed to understand goose and eider population status and reproductive success.


Photo by Tim Moser

Starting in 2006 we incorporated nest detection rates in estimation of nests and eggs, restricted analyses to plots within the current survey area (716 km^2), and we refined expansion techniques that use the most recent seven years of data to generate annual expanded estimates (see Methods). As a result, nest and egg population estimates vary slightly among annual reports (e.g. Fischer et al. 2009).

METHODS:

We used a ground-based sampling procedure to monitor goose and eider nest populations and potential production on the YKD coastal zone from 1985 to 2010. Boundaries of the survey area include lands on the Yukon Delta National Wildlife Refuge (YDNWR) surrounding Hazen Bay (Fig. 1). The size of the sampled area varied among years (716-4,063 km^2) as study objectives evolved. Since 2000, the survey boundary has remained consistent at 716 km^2 (5.6% of the total coastal zone) and is comprised of medium and high density spectacled eider habitats as determined by aerial and ground observations from 1985-1997 (USFWS unpubl. data). This design excludes privately owned high density nesting habitat near Kokechik Bay, two patches on southern Nelson Island, and several tracts near Hazen Bay because annual access cannot be assured. In 1998-1999 and prior to 1994, plots were selected within a slightly larger portion of the coastal zone. Estimates of nest population size and egg production for 1985-2010 are based on plots within the core 716 km^2, whereas estimates of clutch size and hatch date use data from historical plots within and beyond the core area.


Photo by Julian Fischer

We used GIS and custom-written True BASIC computer programs to randomly select 85 plots within the ground sampled area in 2010 (Fig. 1). Plot size was 402 m by 805 m (0.32 km^2) in 1988-1994 and 1997-2010. Plot sizes were variable in 1985-1987 (0.16-1.66 km^2), 0.45 km^2 in 1995, and 0.36 km^2 in 1996. Random plot locations were restricted by excluding points that resulted in overlap with any other plot within the current year or previous five years. We then drew plot boundaries on IKONOS satellite imagery at a 1:13,000 scale for use as field maps. We included plots regardless of juxtaposition to lakes and rivers.

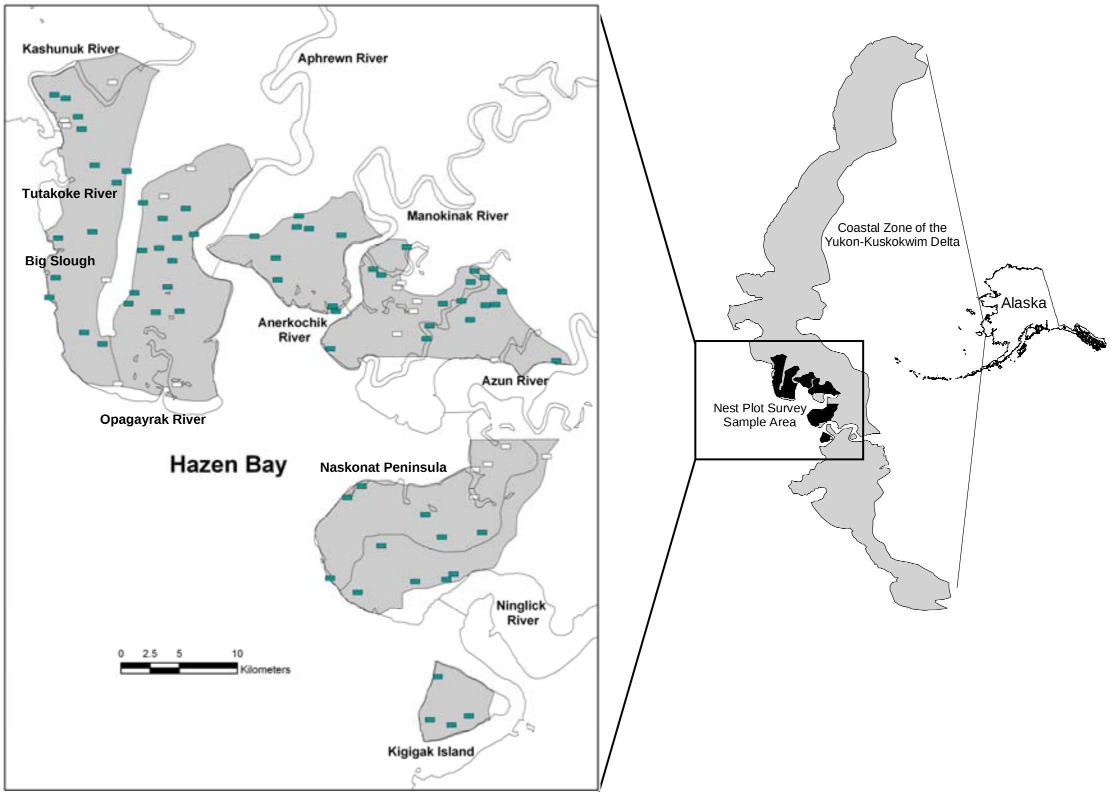

Figure 1. Location of 85 randomly selected plots within the ground sampled area (716 km^2) relative to the Yukon-Kuskokwim Delta coastal zone (12,832 km^2), Alaska, 2010. Sampled plots are represented by 66 solid rectangles. Nineteen additional plots were selected but not sampled, shown as open rectangles.

Plots were searched by 2-4 biologists who were transported either by Cessna 185 float-equipped aircraft or by motorboat. Two boat crews originated from the YDNWR Kanaryamiut Field Station and worked at plots accessible from the Aphrewn and Opagyarak rivers. A third boat crew was transported directly from Bethel to plots on the Naskonat Peninsula, and a fourth boat crew was deployed from the Tutakoke River brant colony near the mouth of the Kashunuk river and completed plots on the upper Tutakoke River and near Big Slough. Biologists at Kigigak Island (YDNWR), Manokinak River (USGS), and Tutakoke River (University of Nevada, Reno) searched plots near their camps. All sites dry enough for a nest were examined for active and destroyed waterfowl, crane, loon, and gull nests. Incidental nesting records of other species were recorded as encountered (data available upon request), but most shorebird and passerine nests were likely missed.

At each nest we recorded species, nest status, nest site habitat (shoreline, island, peninsula, grass meadow, palsa upland, ridge upland), stage of incubation, clutch size, and geographic coordinates. Species identification was determined by visual confirmation of an adult at the nest or by comparing down and contour feathers in the nest bowl with a photographic field guide (Bowman 2008). We determined stage of incubation for all species by recording float angles of eggs from active nests (Westerskov 1950). Hatch dates were estimated from incubation stage of eggs found on plots. Hatch date was estimated using float angle codes (1-9 ordinal scale), recorded for 1-3 eggs from up to 20 nests per species per plot, to determine estimated nest initiation based on published incubation duration and average clutch size. Hatch date estimates and clutch size data from 1982-1984 were derived from data collected by Butler (1983) using the same techniques described above.

Photo by Tasha DiMarzio

The mean and variance of the number of nests and eggs per plot was based on a simple random sample of plots. The estimated densities of nests and eggs were expanded to the ground sampled area (716 km^2) based on the size and number of plots for each year. Nest population estimates were corrected for detection rate using a model that considers species, nest activity status (active, destroyed), observer experience, and nest site habitat (Bowman and Stehn *manuscript in prep.*).

We expanded the detection-corrected estimates for nests and eggs in the ground-sampled area to the entire coastal zone of the YKD (12,832 km^2) based on the numbers of birds observed on aerial survey transects flown within and outside of the ground-sampled area (Butler et al. 1988, Bollinger and Hodges 2010, Platte and Stehn 2010). For example, we annually calculated the ratio of the aerial breeding population index outside the ground-sampled area ("OUT") to the aerial index within the ground-sampled area ("IN"). We then used this "Out:In ratio" as an expansion factor to determine the number of nests and eggs on the entire coastal zone. To smooth the annual variation caused by sampling error and still allow for potential trend in the Out:In ratio, we calculated a localized linear regression each year for the nearest seven years of data (current year, prior three years, and following three years, as available), and used the regression relationship to estimate the ratio for the given year. For example, the expansion factor for 2007 was based on the regression of Out:In ratios from 2004-2010. For years that did not have at least three "prior" or three "following" years of data, we based the localized regression procedure on the most proximate seven years of data. Thus, the expansion factor in 2010 was based on the localized regression of Out:In ratios from 2004-2010. Standard errors of the predicted ratio were derived from regression residuals. Variance estimates of nest populations expanded to the entire coastal zone included the variance of the Out:In ratio.

Photo by Julian Fischer

The aerial breeding population index for most species was based on twice the number of singles plus the number of birds in pairs observed, because single geese, cranes and ducks observed are assumed to be the mates of unobserved females on nests. Flocks of these species were not included in the aerial index, except brant. For swans, the number of single birds observed was not doubled because unlike other waterfowl, swans are highly visible on nests. For loons and gulls, the total number of birds observed was used as the breeding index.

Loon data were treated slightly differently as red-throated (*Gavia stellata*) and Pacific loons (*Gavia pacifica*) rarely remain near their nest sites when disturbed by plot searchers, and their nests and eggs are essentially indistinguishable from each other (Bowman 2008). Thus, we applied the ratio of observations of each loon species, as recorded during aerial surveys (Platte and Stehn 2010) to determine the relative numbers of loon nests for each species. We then used the localized linear regression technique described above to smooth the aerial-observed species proportions for loons.

Data were tabulated, edited, sorted and analyzed using Excel. Nest population, hatch date, and clutch size estimates were calculated using customized TrueBASIC programs.

The estimated total number of nests is a direct measure of the number of breeding pairs in the population. The estimated total number of eggs is a measure of the potential young that could augment the fall population if they survive through hatch and fledging. The proportion of nests that are active when the plots are searched is an index to nest success, though the actual proportion of successful nests is lower because some nests are likely lost after plots are searched. The relative production rate measures how the number of eggs per nest compares to the long-term average for each species. This measure quantifies the relative annual contribution of eggs to the population on a per nest basis. Definitions of these terms are summarized in the caption of Figure 2.

RESULTS:

In 2010 we searched 66 plots from 4 June to 15 June (Fig. 1). Crews based at the Kanaryamiut Field Station searched 19 plots, boat-based crews searched 36 plots, a Yukon Delta NWR crew at Kigigak Island searched four plots, a USGS crew at the Manokinak River searched four plots, and a University of Nevada Reno crew at Tutakoke River searched three plots. Nineteen of the 85 randomly selected plots were not sampled primarily due to a significant summer storm in mid June that prevented completion of field work prior to onset of hatch. Crews located 3,845 nests within plot boundaries in 2010 comprised of 1,548 cackling goose, 314 emperor goose, 705 greater white-fronted goose, 413 black brant, 117 spectacled eider, 69 common eider, and 679 nests of other species. Calculations of clutch size and hatch date also included an additional 22 nests located outside of plot boundaries. We present nest population, egg production, and nest success estimates in figures with accompanying tabulated data for each species (Fig. 2). Estimated hatch date for each species is presented in Table 3. The following section presents general descriptive results for each species.

<u>Cackling Geese (*Branta hutchinsii minima*)</u>


Photo by Kelly Warren

Relative production of cackling geese was good in 2010. Total numbers of nests and eggs were second and fourth highest in the 26-year span of the survey, respectively (Fig. 2). Numbers of nests and eggs were down from 2009 but remained 66% and 68%, above the previous long-term (1985-2009) means, respectively (Fig. 2, Tables 1-2). Nest success was 9% higher than the long-term average but clutch size was 5% below the long term mean. As a result, the relative production (eggs per total breeding pairs in 2010 compared to the long-term mean) was 3% above average. Prior to 2009, the cackling goose nest population had been essentially flat during the last decade; however, the relatively high estimates in 2009-2010 put the 10-year growth rate in line with the long-term significantly positive trend (Fig. 2, Tables 1-2). Average hatch date for cacklers in 2010 was four days earlier than 2009 and three days earlier than the previous long-term average (1982-2009; Table 3).

Emperor Geese (*Chen canagica*)


Photo by Declan Troy

Relative production of emperor geese was good in 2010. Total numbers of nests and eggs were down from 2009 but 10% and 11% above the long-term (1985-2009) means (Fig. 2, Tables 1-2). Nest success was above average, yet clutch size was below average. This combination resulted in a relative production rate slightly above the long-term mean. Nest and egg population size have been variable over the course of this survey and resulted in non-significant growth rates in the long-term, but growth within the recent decade has yielded a significant positive trend for both nests and eggs (Fig. 2, Tables 1-2). Similar to other waterfowl species, estimated hatch date for emperors in 2010 was three days earlier than 2009 and two days earlier than the previous long-term average (1982-2009; Table 3).

Greater White-fronted Geese (*Anser albifrons frontalis*)


Photo by Julian Fischer

Relative production of white-fronted geese was good in 2010. Total numbers of nests and eggs were the second highest estimates for the 26-year span of the survey (Fig. 2). Total numbers of nests and eggs were slightly down from 2009, but were 118%, and 114% above the long-term (1985-2009) means, respectively (Fig. 2, Tables 1-2). Clutch size was slightly above and nest success slightly below long-term averages. As a result, the relative production rate in 2010 was within 1% of average. White-fronted goose nest and egg population growth rates have been high throughout the duration of the survey, but were relatively flat during the five years prior to 2009. With high production in 2009 and 2010, growth rates of nests and eggs during the short- and long-term time spans are significantly positive. Similar to other waterfowl species, estimated hatch date for white-fronts in 2010 was four days earlier than 2009 and three days earlier than the previous long-term average (1982-2009; Table 3).

Black Brant (*Branta bernicla nigricans*)

The nest plot survey was not designed to monitor colonial nesting birds such as black brant, and we purposely excluded most primary colonies from the sample area. Five primary brant colonies are monitored annually by digital photographic surveys (see Wilson 2010). The nest plot survey produces an estimate of nest populations from non-colonial brant and small satellite colonies. In addition, the nest plot survey area includes Kigigak Island where one of the five major YKD colonies is found. In 2010, three of the four plots on Kigigak Island occurred within a primary YKD brant colony. A total of 240 brant nests were located within these three plots and accounted for 58% of all brant nests (413) found within the 66 plots sampled . Within the ground sampled area overall, brant production was good in 2010. The number of nests in 2010

Photo by Declan Troy

was up 50% from the previous year and 19% above the long-term mean (Fig. 2, Tables 1-2). Brant clutch size was average and nest success was 3% higher than the long-term mean. As a result, the relative production rate in 2010 was 1% above average. Nest and egg population sizes have been variable over the course of this survey and resulted in non-significant growth rates in both short- and long-term time spans. Similar to other waterfowl species, estimated hatch date for brant in 2010 was four days earlier than 2009 and one day earlier than the previous long-term average (1982-2009; Table 3).

Tundra Swans (*Cygnus columbianus*)

Relative production of tundra swans was poor in 2010. Total numbers of nests and eggs were up from 2009, and 29% and 10% above the long-term average (1985-2009; Fig. 2). Despite relatively high numbers of nests, clutch size was below the long-term average. Moreover, nest success was down from last year and 12% below the long-term mean. As a result, the relative production rate in 2010 was 14% below average. For tundra swans, nest and egg population sizes have been variable over the course of this survey and resulted in non-significant growth rates in the short-term. Over the long-term, however, both nest and egg population sizes have increased significantly. Estimated hatch date for tundra swans in 2010 was five days earlier than last year and unchanged from the previous long-term mean (1982-2009; Table 3).

Sandhill Cranes (*Grus canadensis*)

Relative production of sandhill cranes was excellent in 2010. Total numbers of nests and eggs were both down from 2009, but numbers of nests were similar to the long-term average, and numbers of eggs were 6% above average (Fig. 2, Tables 1-2), respectively. Estimates of clutch size and nest success in 2010 were both higher than last year and above the long-term means. Taken together, the relative production rate was 9% above average. Nest and egg population sizes have been variable over the course of this survey and have resulted in non-significant growth rates in both short- and long-term time spans. Estimated hatch date for sandhill cranes in 2010 was five days earlier than 2009 and the two days earlier than the previous long-term average (1982-2009; Table 3).

Spectacled Eiders (*Somateria fischeri*)

Relative production of spectacled eiders was excellent in 2010. Total numbers of nests and eggs were down slightly from 2009 but were 42% and 58% higher than long-term (1985-2009) means, respectively (Fig. 2, Tables 1-2). The 2010 nest population and egg production estimates were the third highest recorded in the 26 years of this study. Clutch size in 2010 was higher than the previous year and above the long-term mean. Nest success was down slightly from the previous year, but remained 8% above the long-term average. Together, these measures resulted in a relative production rate 11% above average. Estimated

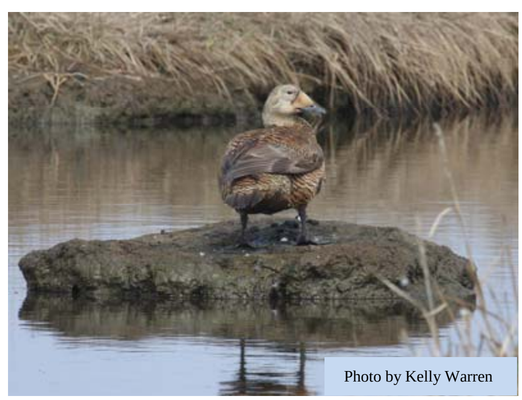

Photo by Kelly Warren

numbers of nests and eggs have grown since the early 1990s, and this change is reflected in significant positive short-term growth rates (2001-2010). In contrast, no positive growth is apparent over the long-term (1985-2009) due to the high estimates measured in the mid and late 1980s. Annual estimates of egg production are variable due to fluctuations in breeding conditions but a significant positive trend is apparent in the short-term time period. Estimated hatch date for spectacled eiders in 2010 was five days earlier than both 2009 and the long-term average (1982-2009; Table 3).

Common Eiders (*Somateria mollissima*)


Photo by Kelly Warren

Relative production of common eiders was good in 2010. Total numbers of nests and eggs were up from 2009 and were 228% and 203% above long-term (1985-2009) means, respectively (Fig. 2, Tables 1-2). The 2010 nest population and egg production estimates were the highest and second highest recorded in the 26 years of this study, respectively. Clutch size was the same as 2009 and the long-term average, whereas nest success was down 9% and 4% from last year and the long-term mean. Together, these measures resulted in a relative production rate 4% below average. Nest numbers and egg production have grown substantially throughout the course of this survey, most notably starting in 2005. This change is reflected in significant positive short- (2001-2010) and long-term (1985-2009) growth rates. Similar to other waterfowl species, estimated hatch date for common eiders in 2010 was two days earlier than 2009 and three days earlier than the previous long-term average (1982-2009; Table 3).

Gulls and Terns

Colonial nesting seabird such as gulls (glaucous gulls [*Larus hyperboreus*], Sabine's gulls [*Xema sabini*], mew gulls [*Larus canus*], and arctic terns [*Sterna paradisaea*]) are not monitored with precision by the nest plot survey. Nonetheless, the survey does provide a measure of potential production for these species. In 2010, relative production varied from poor to excellent among the four species (Fig. 2). Numbers of glaucous gull nests and eggs in 2010 were up from the previous year and 5% and 13% above the long-term means (Fig. 2, Tables 1-2). Additionally, both clutch size and nest success were high for the species in 2010, resulting in a relative production rate 7% higher than average. The glaucous gull nest population has remained relatively stable within the most recent ten-year period and long-term average, whereas the estimate of eggs has increased significantly during the most recent decade. Unlike glaucous gulls, mew gulls exhibited a relatively low rate of nest success in 2010. However, the numbers of mew gull nests and eggs have increased significantly since 2001. Unlike the other gulls, the estimate of Sabine's gull nests and eggs, and clutch size and nest success increased substantially over the previous year and the long term mean. This resulted in relative production 7% above the long-term mean.


Photo by Declan Troy

The high estimate observed among Sabine's gull in 2010 was due to an unprecedented large colony with 102 nests located in one plot. The resulting spike in the annual estimate of Sabine's gull is indicative of how colonial nesting species are not monitored with precision on an annual basis, but instead may require larger, combined-year samples to better estimate mean population size. Nonetheless, the nest population data show significant positive growth over the long-term (1985-2009), but insignificant growth within the last decade. Finally, in 2010 the number of arctic tern nests and eggs declined dramatically from 2009 but remained 57% and 8% above the long-term means, respectively. Poor nest success and low clutch size among arctic terns resulted in a relative production rate 31% below average. Growth rates of arctic tern nests and eggs are significantly positive over the long-term, but too variable in the short term to indicate positive or negative growth. Estimated hatch date of gulls and terns in 2010 was up to seven days earlier than 2009 and up to four days earlier than the long-term average (1982-2009; Table 3).


Photo by Declan Troy

Loons

Relative production of Pacific loons (*Gavia pacifica*) and red-throated loons (*Gavia stellata*) was excellent in 2010. Estimates of numbers of nests for both species was slightly lower than 2009, but remained well above long-term averages (Fig. 2, Tables 1-2). Clutch size and nest success, however, were up from the previous year and above long-term means. These factors led to a relative production rate 9% above average. Nest and egg population sizes have been variable over the course of this survey and have generally resulted in non-significant growth rates in the long-term time span. However, a slight, but significant positive trend in the short-term is apparent for both species. Similar to waterfowl, estimated hatch date for both loon species in 2010 was three days earlier than 2009 and one day earlier than the long-term average (1982-2009; Table 3).

DISCUSSION:

The nest plot survey was specifically designed to provide annual estimates of nest population size and trend, and predict potential production (active eggs) and hatching dates for non-colonial nesting geese (cackling geese, emperor geese, greater white-fronted geese) and eiders (spectacled and common) on the Yukon-Kuskokwim Delta coastal zone. Data from other waterfowl encountered incidentally (black brant, tundra swans) and other waterbirds (sandhill cranes, loons, and gulls and terns) were also collected and reported.

In 2010, numbers of nests and eggs of these species were among some of the highest recorded since the survey began 26 years ago. Numbers of nests and eggs increased significantly for spectacled eiders and emperor geese in the short-term (2001-2010); and cackling geese, white-fronted geese, and common eiders in the long-term (1985-2010) and short-term (2001-2010) periods. No species sampled in this study indicate a significant negative trend in nest populations or egg production over short- or long-term periods.

Relative production rates (contribution of eggs per nest relative to the long-term mean) were excellent for spectacled eiders, loons, cranes, and glaucous gulls; good for all geese, common eiders, mew gulls, and Sabine's gulls; and poor for tundra swans and arctic terns. Nest success in 2010 was down slightly for some species compared to 2009, but was higher than long-term means for all goose species, spectacled eiders, cranes, loons and several gull species. Nest success in 2010 was lower than long-term means for tundra swans, common eiders, mew gulls, and arctic terns. Clutch size in 2010 was lower than long-term means for geese and arctic terns, but higher for eiders, loons, and gulls.


Photo by Kelly Warren

Incidence of nest desertion and depredation was variable among plots and not isolated to one region within the ground sampled area. Avian and mammalian predators are known to destroy nests on the YKD during incubation. Arctic fox (*Alopex lagopus*), specifically have been shown to be a significant source of nest depredation in some years, particularly in brant colonies (Anthony et al. 1991). Presence of recent fox activity was noted within 42% of sampled plots in 2010 (Table 4), similar to the long-term mean. Fox were likely contributors to egg loss in some study plots in 2010, but there is no indication that fox presence on plots necessarily resulted in higher levels of depredation. For example, mean plot nest success, measured by the total number of active nests/total number of nests, was the same (0.90) in plots with fox sign (fur, tracks, active dens, fox observed) and without fox sign. Similarly, in 2009 nest success did not appear to be related to presence of fox, and this apparent minimal predation was assumed to be related to extremely abundant vole populations (presumably tundra vole, *Microtus oeconomus*) that may have served as alternative food for foxes and other nest predators. Presence of voles and vole burrowing activity were recorded on 72% of plots in 2009, a level unprecedented in recent years (Table 4). Similar to 2009, presence of voles in 2010 was very high, with evidence of voles on 58% of plots (Table 4). This level of frequency was the third highest since these data were collected in 1988 and was well above the long-term mean. Concern that high abundance of voles in 2009 would result in high production and survival of foxes with negative repercussions for avian nest success in 2010 was not realized. This was welcome news for waterfowl in 2010, but high abundance of voles in recent years may have consequences for waterfowl production in the future. The relationship between voles, foxes and individual species of birds is poorly understood on the YKD and deserves investigation.


Photo by Julian Fischer

Spring 2010 was relatively cool compared to recent years. Timing of spring warming was later than average with breakup of the Kuskokwim River at Bethel occurring on May 17, eight days later than 2009 and six days later than the previous 28-year mean (NOAA 2010). Timing of waterfowl nest initiation is typically correlated with timing of spring breakup (Raveling 1978, Dau and Mickelson 1979). However, despite the relatively late river breakup at Bethel (~175 km from Hazen Bay), conditions on the coast were different. For example, May temperatures at weather stations on the coast where most waterfowl nest were a few degrees above average in 2010, and the long-term trend (1960-2010) indicates an average annual increase of 0.063 degrees Fahrenheit. This change equates to an average increase of 3.21 degrees F in May mean temperature since 1960 (METAR weather data – Mekoryuk, Hooper Bay, Cape Romanzof, Emmonak, Nome). Corresponding to warmer May temperatures, initiation and hatch dates of waterfowl species in 2010 was up to 5 days earlier than the previous long-term mean (1982-2009), and a long-term trend in earlier nesting is significant over the last 29 years. Based on data since 1982, we estimate that on average, hatch for cackling geese, for which the most data are available, occurs 0.32 days earlier each year (Fig. 3). This change translates to an advance of nine days since data collection began in 1982.

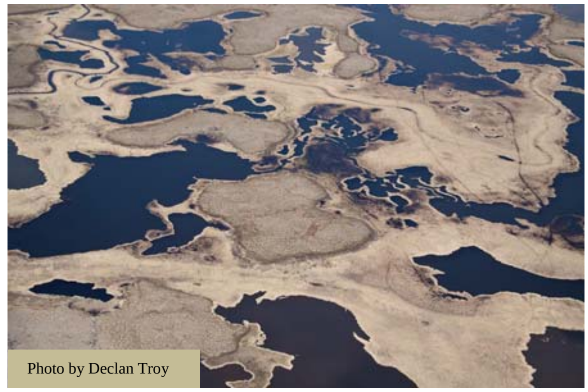

Photo by Declan Troy

Long-term increases in spring temperatures and earlier occurrence of spring events such as river breakup and nest initiation are predicted in many climate change models (Root et. al. 2003, IPCC 2007). Effects of climate change on YKD nesting habitat are not understood, but may prove to be a significant factor in long-term sustainability of waterfowl populations. For example, preliminary analyses indicate that boundaries of the Yukon Delta National Wildlife Refuge have lost an average of 30 ha/yr over a recent fifty year period (B. Jones, USGS unpubl. data). Further, alteration of habitats through sea level rise (erosion, inundation, salinization), melting permafrost, and increased river discharge (accelerated sedimentation rates) could change the value of current nesting areas. Point location data taken at each nest sampled in this study (2009-2010) will be incorporated into ongoing cooperative habitat change studies involving USFWS, USGS, and University of Alaska. Further, standardized pond salinity monitoring (Wilson, MBM, unpubl. data) initiated in 2006 will provide baseline and trend information needed to assess changes to the waterfowl nesting habitats of the YKD.

Photo by Declan Troy

In general, goose nest population trends derived from the ground-based nest plot survey parallel trends derived from aerial breeding pair surveys. For example, estimates of cackling goose and greater white-fronted goose nests were at record lows in the mid-1980s prior to adoption of the cooperative Yukon-Kuskokwim Delta Goose Management Plan that provided much needed protection for nesting and wintering populations of geese (Pamplin 1986). Data from this ground-based plot survey and from aerial breeding pair surveys (Bollinger and Hodges 2010, Platte and Stehn 2010) show that by the late-1980s, the cackling goose population of nests and pairs increased rapidly, peaking in the late-1990s. Since 1999, trends for cackling geese have been relatively stable (this study, Bollinger and Hodges 2010). Similarly, both ground and air based surveys have measured growth in breeding pair indices of approximately 10% per year since the mid-1980s. Unlike the other goose species, populations of emperor geese did not increase markedly after adoption of the Yukon Delta Goose Management Plan, although a slow annual increase in the long-term trends from ground and air surveys is apparent (this study, Bollinger and Hodges 2010).

The number of spectacled eider nests has varied widely since the beginning of the survey in the mid-1980s. The average long-term growth rate (1985-2010) is minimally negative, but the rate is not significantly different from 1.00. Following a long-term decline of spectacled eiders on the YKD from the 1950s through the early 1990s (Stehn et al. 1993), the population stabilized and began to increase. The current 10-year positive growth rates of nests and eggs are 1.098 and 1.137, respectively, and are significant at the 0.10 alpha level (Fig. 2, Table 1). Data from aerial surveys on the YKD show a similarly positive ten-year growth rate for spectacled eider pairs (1.073, 2001-2010; Platte and Stehn 2010). The relatively higher growth rate measured from the ground-based plot survey is influenced by a markedly low nest population estimate in 2001. In that year, a significant regional nesting failure resulted in a low spectacled eider nest population estimate thereby creating positive leverage on the subsequent 10-year trend estimate. When 2001 is excluded the 9-year growth rates of the nest population and the aerial index growth rates are even more closely in agreement (1.092 and 1.080, respectively).

Spectacled eider nest success is variable among years and generally reflects current levels of nest predation. Plots are visited one time, so the measure of nest success is an overestimation of actual success because some nests undoubtedly fail after the plot is searched. In addition, nests destroyed during laying (before down is added to the nest bowl) are seldom detected and thus underestimated. Nonetheless, the pattern in nest success measured from the nest plot survey (number of active nests divided by total nests times 100%, corrected for detection rate) generally matches nest success at Kigigak Island (successful hatched nests/total nests) where nests are visited every seven days until hatch (Gabrielson et al. 2010; Fig. 4). The largest difference between estimates from these surveys was noted in 2001 and 2003, years of very poor production, where perhaps many nest failures occurred late in nesting. Alternatively, a localized factor may have caused low success on Kigigak Island during those years. Large annual fluctuations in production estimates are reduced when sampling occurs over a large portion of the nesting range, such as in the nest plot survey described here.

Photographic methods were initiated in the 1990s to monitor the nest population of brant in major colonies with greater precision than ground surveys or standard straight line aerial waterfowl surveys (Wilson 2010). Brant nest estimates derived from photographic colony survey data indicate a significant decline in nest populations over the last 18 years within five primary colonies (Wilson 2010), whereas results of the ground-based nest plot survey (this study; Fig. 5) and a range-wide winter survey (Collins and Trost 2010) indicate relative stability. One explanation for this dichotomy is that brant are nesting in increasing proportions in small dispersed colonies or satellite colonies outside primary colonies. This hypothesis is being examined through analysis of historical and contemporary aerial, photographic, and ground based surveys (Stehn et al. in prep.).


Photo by Kelly Warren

The population sizes of goose and eider nests should not be interpreted as direct estimates of population size. For example, a year of poor nesting conditions may result in fewer nesting attempts (and thus nests), but does not represent a loss of adults from the population.

This was particularly apparent in 2001 and 2003 when nesting failures resulted in relatively low estimates of spectacled eider nests and eggs whereas aerial surveys documented numbers of pairs close to long-term means. Isolated events of low nesting effort in a given year will not affect population status immediately, but will ultimately be manifest in reduced numbers of potential breeders several years later.

A primary advantage of the random nest plot sampling procedure over intensive local studies is that it assures applicability of estimates to the entire coastal zone, not just the immediate areas around intensive biological study camps. Moreover, the single brief visit to scattered plots ensures that the monitoring of populations occurs with minimum disturbance. The expansion of estimated nests and eggs from the ground sampled area to the entire coastal zone is based the assumption that observed breeding bird indices obtained from aerial surveys provide an accurate linear relationship with the number of nests within versus outside of the ground sampled area. By using a 7-year localized average of the Out:In ratio, the annual variability due to sampling error is moderated.


Photo by Kelly Warren

Annual changes in nest population size are less informative than long-term trends because of sampling error, changes in observers, distribution of plots, and small sample size for less common species. Only several years of consistent declines or increases will indicate a true change in the number of nests and eggs produced on the Yukon-Kuskokwim coastal zone. We believe that a graphical presentation (Fig. 2) enables better interpretation of data than analysis of year-to-year changes in population size. Large inter-annual changes in nest population size probably reflect sampling error or result from extremes in nesting effort and success, rather than real population change.

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Photo by Tasha DiMarzio


Photo by Julian Fischer

LITERATURE CITED

Anthony, R. M., P. L. Flint, and J. S. Sedinger. 1991. Arctic fox removal improves nest success of black brant. Wildl. Soc. Bull. 19: 176-184.

Bollinger, K. S. and J. I. Hodges. 2010. Report to the Pacific Flyway Committee on the 1985-2010 Coastal Zone Yukon-Kuskokwim Delta Goose Survey of geese, swans, and sandhill cranes. Memorandum. USFWS, Fairbanks, AK.

Bowman, T. D. 2008. Field guide to bird nests and eggs of Alaska's coastal tundra, 2nd Edition. Alaska Sea Grant College Program, University of Alaska, Fairbanks.

Bowman, T. D. and R. A. Stehn. *Manuscript in prep*. Nest detection rate on plots searched to monitor Yukon-Kuskokwim Delta waterbird populations.

Butler, W. I. Jr. 1983. U.S. Fish and Wildlife Service Memorandum, July 19, 1983. Cackling Canada goose nesting population. Yukon Delta NWR.

Butler, W. I., Jr., R. A. Stehn, and W. D. Eldridge. 1988. Development of an aerial breeding pair survey for geese nesting in the coastal zone of the Yukon Delta. Annual progress report, U.S. Fish and Wildlife Service, Anchorage.

Collins, D. P. and R. E. Trost. 2010. 2010 Pacific Flyway data book. Unpubl. Rep., U.S. Fish and Wildlife Service, Portland, OR.

Dau, C. P. and P. G. Mickelson. 1979. Relation of weather to spring migration and nesting of Cackling Geese on the Yukon-Kuskokwim Delta, pgs. 94-104, *In* R. L. Jarvis and J. C. Bartonek [eds], Management and biology of Pacific Flyway geese. Oregon State University Book Stores. Corvallis, Oregon.

Fischer, J. B., R. A. Stehn, and G. Walters. 2009. Nest population size and potential production of geese and spectacled eiders on the Yukon-Kuskokwim Delta, Alaska, 2009. Unpubl. Rep., U.S. Fish and Wildlife Service, Anchorage, AK.

Gabrielson, M., M. Wege, and N. Graff. 2010. Monitoring and avian influenza sampling of waterfowl on Kigigak Island, 2010. Unpubl. Rep. Yukon Delta NWR, Bethel, AK.

IPCC. 2007. Climate Change 2007: the physical science basis, summary for policymakers. Contribution of Working Group I to the Fouth Assessment Report of the IPCC. IPCC Secretariat. Geneva Switzerland.

NOAA. 2010. National Weather Service, Alaska-Pacific, River Forecast Center Home Page. <http://aprfc.arh.noaa.gov/data/breakup.html>.

Pamplin, W. L. Jr. 1986. Cooperative efforts to halt population declines of geese nesting on Alaska's Yukon-Kuskokwim Delta. Trans. N. Am. Wildl. Nat. Resour. Conf. 51:487-506.

Platte, R. M. and R. A. Stehn. 2010. Abundance and trend of waterbirds on Alaska's Yukon-Kuskokwim Delta coast based on 1988 to 2010 aerial surveys. Unpubl. Rep., U.S. Fish and Wildlife Service, Anchorage, AK.

Raveling, D. G. 1978. Timing of egg laying by northern geese. Auk 95: 294-303.

Root, T. L., J. T. Price, K. R. Hall, S. H. Schneider, C. Rosenzweig, and J. A. Pounds. 2003. Fingerprints of global warming on wild animals and plants. Nature 42: 57-60.

Stehn, R. A., C. P. Dau, B. Conant, and W. I. Butler. 1993. Decline of spectacled eiders nesting in western Alaska. Arctic 46: 264-277.

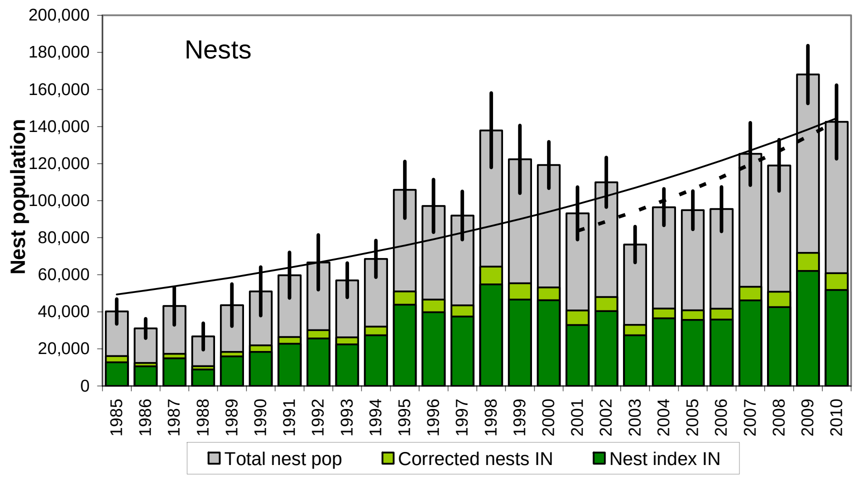
Westerkov, K. 1950. Methods for determining the age of game bird eggs. J. Wildl. Manage. 14:56-67.

Wilson, H. M. 2010. Aerial photographic surveys of brant colonies on the Yukon-Kuskokwim Delta, Alaska, 2010. Unpubl. Rep., U.S. Fish and Wildlife Service, Anchorage, AK.

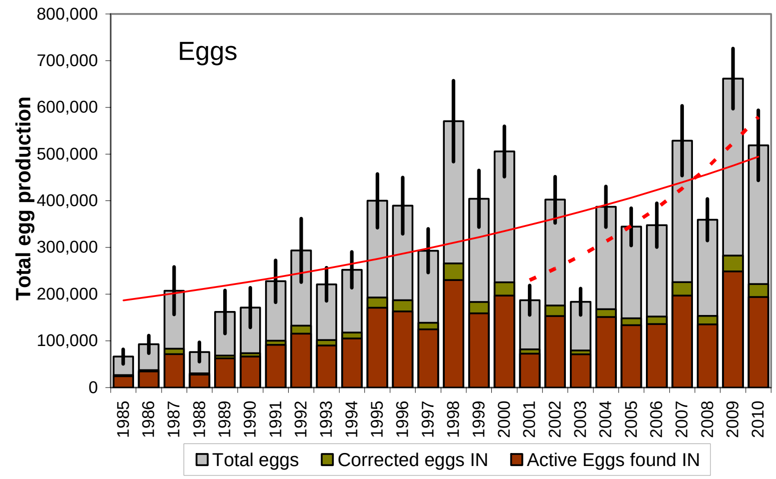
Figure 2 (Subsequent pages). Population size with ± 90% confidence intervals and trends of waterbird nests and egg production on the Yukon-Kuskokwim Delta Alaska, 1985-2010, with accompanying tabulated data. Column heading definitions follow:

Year = survey year;
N plots = number of ground sampled plots used in the analysis;
Sampled km^2 = total area searched (N plots*plot size);
Nest index IN = number of nests within the core 716 km^2 ground sampled area uncorrected for nest detection;
SE nest index IN= standard error for nest index;
Avg nest detection rates = annual proportion of nests detected based on predictive model that includes the covariates of species, nest status, habitat, and observer experience;
Corrected nest IN = Nest index in ground sampled area corrected for nest detection;
7 yr avg aerial Out:In ratio = the seven-year localized average ratio of aerial observations seen out of the ground sampled area vs. in the ground sampled area (seven years are based on from the current year, 3 prior years, and 3 following years data as available – see Methods);
Corrected nests OUT = number of nests extrapolated beyond the ground sampled area based on the 7-yr localized average Out:In ratio, corrected for nest detection rate;
Total nests In+Out = total number of nests in the YKD coastal zone, corrected for nest detection rate;
SE total nests = standard error for total nest estimate;
Total eggs In+Out = total number of viable eggs at time of plot search in the YKD coastal zone, corrected for detection rate;
SE total eggs = standard error for total egg estimate;
Total eggs/active nests = total viable eggs In+Out divided by the nests with eggs In+Out, corrected for detection rate;
Total eggs/total nests = total viable eggs In+Out divided by the total nests In+Out, corrected for detection rate;
Corrected % nest success = number of active nests divided by total nests times 100%, corrected for detection rate;
Relative production rate = Total eggs/total nests divided by the long-term average of total eggs/total nests. This measure reflects how the production of eggs per nests compares to the long-term average and illustrates the relative potential contribution of young to the population on a per breeding pair basis.

CCGO Cackling Goose



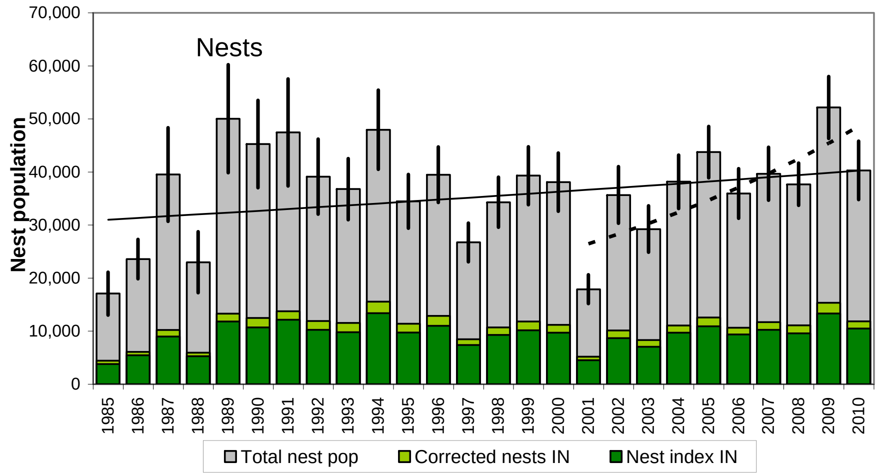
1985-2010 avg annual growth rate= 1.044 (90%c.i.= 1.031-1.057)
2001-2010 last 10 yrs annual growth rate= 1.061 (90%c.i.= 1.031-1.092)



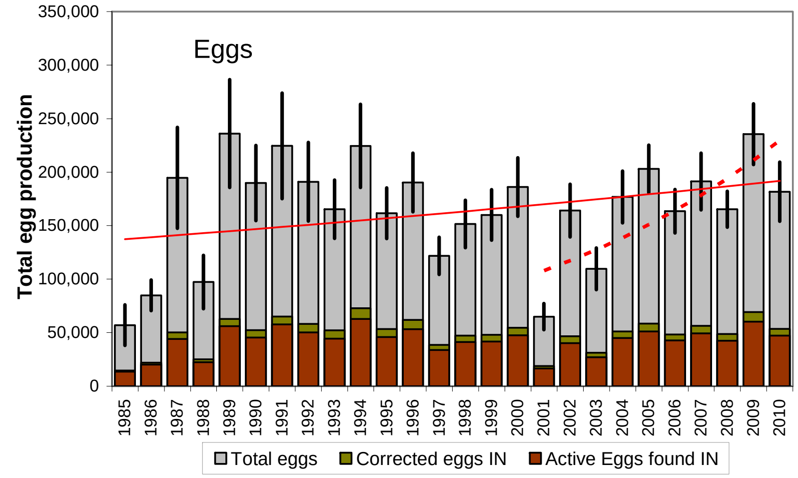
1985-2010 avg annual growth rate= 1.040 (90%c.i.= 1.020-1.059)
2001-2010 last 10 yrs annual growth rate= 1.108 (90%c.i.= 1.050-1.167)

Year	N plots	Sampled km2	Nest index IN	SE nest index IN	Avg nest detection rate	Corrected nests IN	7yr avg Aerial OUT:IN ratio	Corrected nests OUT	**Total nests IN+OUT**	SE total nests	**Total eggs IN+OUT**	SE total eggs	Total eggs / active nests	Total eggs / total nests	Corrected % nest success	Relative production rate
1985	49	24.57	12,788	1,625	79.2%	16,149	1.49	24,064	**40,213**	4,044	**66,326**	9,364	3.91	1.65	42%	47%
1986	46	22.16	10,594	1,406	85.0%	12,467	1.49	18,578	**31,045**	3,153	**92,779**	11,490	4.89	2.99	61%	84%
1987	37	12.67	14,909	2,693	86.1%	17,319	1.49	25,808	**43,127**	6,102	**207,220**	30,979	5.12	4.80	94%	136%
1988	32	10.48	8,947	1,912	83.2%	10,749	1.49	16,018	**26,768**	4,357	**76,227**	12,732	4.52	2.85	63%	81%
1989	23	7.45	16,053	3,536	87.3%	18,390	1.37	25,244	**43,634**	6,883	**162,046**	28,156	4.85	3.71	77%	105%
1990	33	10.70	18,465	3,890	83.9%	21,997	1.32	29,040	**51,037**	7,928	**171,285**	25,876	4.55	3.36	74%	95%
1991	36	11.66	22,840	3,763	86.5%	26,414	1.26	33,387	**59,801**	7,483	**227,526**	27,305	4.64	3.80	82%	108%
1992	42	13.39	25,662	4,554	85.3%	30,098	1.22	36,583	**66,680**	8,983	**293,956**	41,285	4.82	4.41	91%	125%
1993	47	15.23	22,469	2,877	85.4%	26,323	1.17	30,753	**57,076**	5,622	**221,063**	21,490	4.51	3.87	86%	110%
1994	41	13.27	27,391	3,099	85.5%	32,051	1.14	36,555	**68,606**	6,025	**252,233**	23,308	4.58	3.68	80%	104%
1995	50	22.56	43,839	5,413	85.9%	51,015	1.07	54,795	**105,810**	9,303	**399,910**	35,053	4.46	3.78	85%	107%
1996	54	19.44	39,761	4,827	85.3%	46,617	1.08	50,546	**97,162**	8,674	**389,565**	36,565	4.49	4.01	89%	113%
1997	72	23.31	37,516	4,527	86.1%	43,550	1.11	48,431	**91,982**	7,947	**292,993**	28,269	4.03	3.19	79%	90%
1998	64	20.71	54,802	6,330	85.1%	64,403	1.14	73,549	**137,952**	12,199	**570,263**	52,640	4.47	4.13	92%	117%
1999	53	16.97	46,698	5,561	84.1%	55,508	1.20	66,830	**122,339**	11,093	**404,090**	36,943	3.89	3.30	85%	93%
2000	80	25.86	46,279	3,884	87.0%	53,165	1.24	66,059	**119,224**	7,594	**505,617**	32,676	4.50	4.24	94%	120%
2001	81	26.23	32,937	3,999	80.7%	40,799	1.28	52,358	**93,157**	8,606	**187,188**	19,151	3.64	2.01	55%	57%
2002	84	27.15	40,438	3,989	84.3%	47,948	1.29	61,973	**109,921**	8,121	**402,247**	30,175	4.42	3.66	83%	103%
2003	83	26.87	27,323	2,905	82.6%	33,071	1.31	43,232	**76,303**	5,831	**183,773**	17,127	3.96	2.41	61%	68%
2004	81	26.22	36,574	3,024	87.5%	41,818	1.31	54,683	**96,501**	5,939	**387,103**	26,534	4.72	4.01	85%	113%
2005	83	26.87	35,666	3,192	87.2%	40,898	1.32	53,920	**94,818**	6,283	**344,377**	24,329	4.27	3.63	85%	103%
2006	75	24.28	35,842	3,708	85.9%	41,706	1.29	53,736	**95,441**	7,285	**347,652**	28,478	4.43	3.64	82%	103%
2007	79	25.58	46,112	4,684	86.2%	53,492	1.34	71,739	**125,231**	10,238	**528,756**	45,287	4.60	4.22	92%	119%
2008	82	26.55	42,566	3,963	83.7%	50,846	1.34	68,190	**119,036**	8,382	**359,395**	27,005	4.06	3.02	74%	85%
2009	81	26.24	62,090	4,476	86.5%	71,807	1.34	96,300	**168,107**	9,458	**661,549**	39,091	4.34	3.94	91%	111%
2010	66	21.37	51,850	5,637	85.2%	60,861	1.34	81,620	**142,481**	12,048	**518,537**	45,641	4.21	3.64	86%	103%

EMGO Emperor Goose



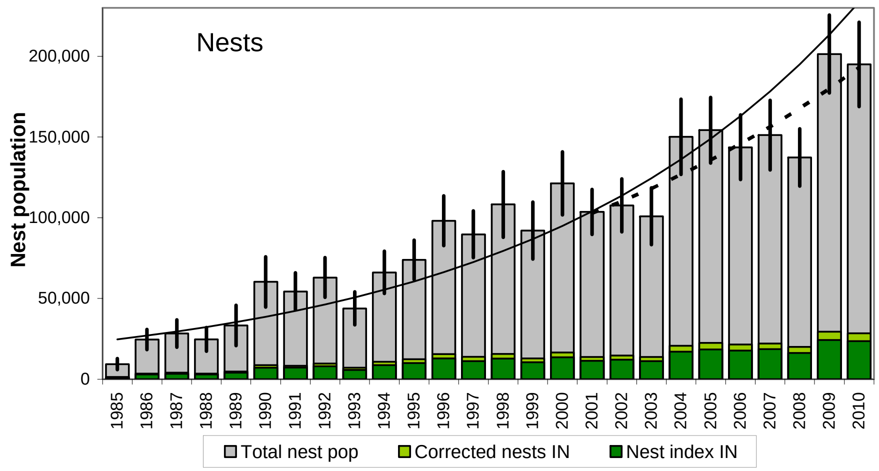
1985-2010 avg annual growth rate= 1.010 (90%c.i.= 0.998-1.023)
2001-2010 last 10 yrs annual growth rate= 1.070 (90%c.i.= 1.029-1.111)



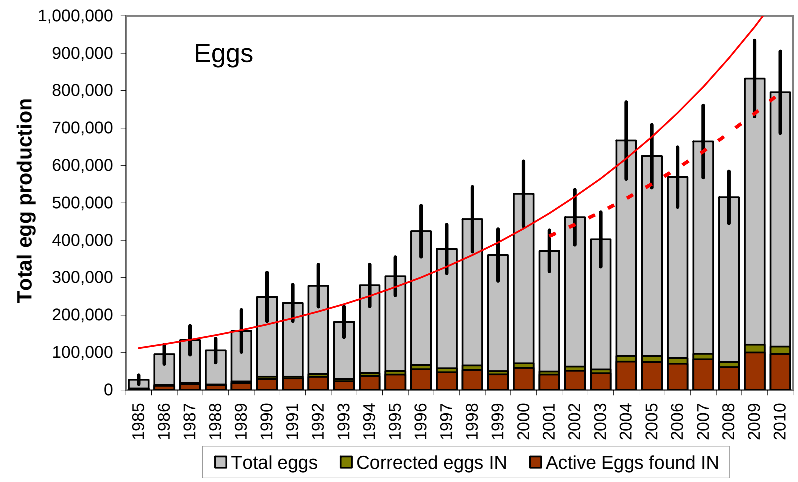
1985-2010 avg annual growth rate= 1.013 (90%c.i.= 0.997-1.030)
2001-2010 last 10 yrs annual growth rate= 1.088 (90%c.i.= 1.032-1.143)

Year	N plots	Sampled km2	Nest index IN	SE nest index IN	Avg nest detection rate	Corrected nests IN	7yr avg Aerial OUT:IN ratio	Corrected nests OUT	**Total nests IN+OUT**	SE total nests	**Total eggs IN+OUT**	SE total eggs	Total eggs / active nests	Total eggs / total nests	Corrected % nest success	Relative production rate
1985	49	24.57	3,816	685	86.5%	4,411	2.87	12,660	**17,071**	2,459	**57,029**	11,470	5.67	3.34	59%	75%
1986	46	22.16	5,426	620	89.0%	6,096	2.87	17,495	**23,590**	2,267	**84,857**	8,751	4.93	3.60	73%	81%
1987	37	12.67	8,979	1,477	87.9%	10,218	2.87	29,326	**39,544**	5,355	**194,650**	28,633	5.12	4.92	96%	111%
1988	32	10.48	5,259	981	88.5%	5,942	2.87	17,055	**22,998**	3,485	**97,407**	15,123	4.70	4.24	90%	96%
1989	23	7.45	11,824	1,769	88.9%	13,306	2.76	36,738	**50,044**	6,194	**235,985**	30,641	5.12	4.72	92%	106%
1990	33	10.70	10,704	1,299	85.7%	12,490	2.62	32,779	**45,269**	5,000	**189,853**	21,316	4.91	4.19	85%	95%
1991	36	11.66	12,157	1,812	88.4%	13,758	2.45	33,711	**47,469**	6,131	**224,513**	29,936	4.89	4.73	97%	107%
1992	42	13.39	10,265	1,372	86.2%	11,906	2.29	27,216	**39,122**	4,301	**191,003**	22,297	5.07	4.88	96%	110%
1993	47	15.23	9,777	1,116	84.5%	11,571	2.18	25,203	**36,775**	3,490	**165,442**	16,560	4.78	4.50	94%	101%
1994	41	13.27	13,372	1,647	85.9%	15,561	2.08	32,403	**47,964**	4,544	**224,440**	23,628	4.99	4.68	94%	106%
1995	50	22.56	9,738	1,127	85.5%	11,389	2.03	23,082	**34,471**	3,069	**161,656**	14,375	4.86	4.69	96%	106%
1996	54	19.44	11,008	1,105	85.6%	12,866	2.07	26,635	**39,501**	3,182	**190,198**	16,670	5.14	4.81	94%	109%
1997	72	23.31	7,368	736	87.1%	8,461	2.16	18,282	**26,743**	2,219	**121,774**	10,551	4.78	4.55	95%	103%
1998	64	20.71	9,295	964	86.7%	10,719	2.20	23,595	**34,314**	2,875	**151,635**	13,475	4.64	4.42	95%	100%
1999	53	16.97	10,166	875	86.2%	11,794	2.33	27,515	**39,309**	3,319	**160,030**	14,259	4.44	4.07	92%	92%
2000	80	25.86	9,715	929	86.9%	11,185	2.41	26,908	**38,093**	3,335	**186,005**	16,620	4.98	4.88	98%	110%
2001	81	26.23	4,503	478	86.4%	5,209	2.44	12,694	**17,903**	1,651	**64,939**	7,457	4.81	3.63	75%	82%
2002	84	27.15	8,699	942	85.8%	10,142	2.52	25,532	**35,674**	3,256	**164,016**	15,009	4.98	4.60	92%	104%
2003	83	26.87	7,057	768	84.9%	8,311	2.52	20,950	**29,261**	2,644	**109,668**	11,862	4.79	3.75	78%	85%
2004	81	26.22	9,690	909	87.7%	11,051	2.45	27,127	**38,178**	3,065	**176,789**	14,696	4.88	4.63	95%	104%
2005	83	26.87	10,948	812	87.0%	12,588	2.48	31,160	**43,748**	2,945	**203,005**	13,514	4.97	4.64	93%	105%
2006	75	24.28	9,373	957	88.0%	10,648	2.38	25,305	**35,953**	2,837	**163,476**	12,357	4.78	4.55	95%	103%
2007	79	25.58	10,241	976	87.6%	11,688	2.40	27,994	**39,681**	3,032	**191,271**	16,117	4.98	4.82	97%	109%
2008	82	26.55	9,570	782	86.2%	11,103	2.40	26,595	**37,698**	2,424	**165,411**	10,217	4.81	4.39	91%	99%
2009	81	26.24	13,340	1,137	86.8%	15,369	2.40	36,812	**52,181**	3,548	**235,414**	17,245	4.71	4.51	96%	102%
2010	66	21.37	10,517	1,118	88.6%	11,873	2.40	28,438	**40,311**	3,340	**181,726**	16,834	4.62	4.51	98%	102%

WFGO White-fronted Goose



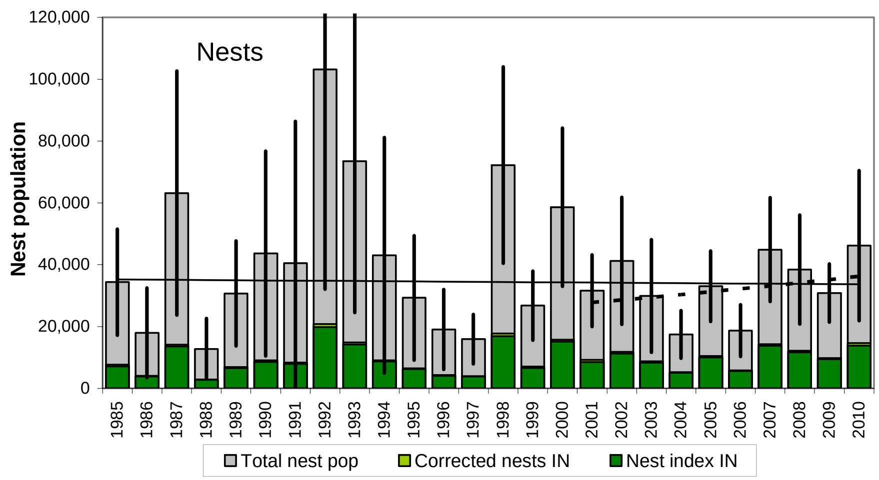
1985-2010 avg annual growth rate= 1.094 (90%c.i.= 1.080-1.108)
2001-2010 last 10 yrs annual growth rate= 1.073 (90%c.i.= 1.048-1.097)



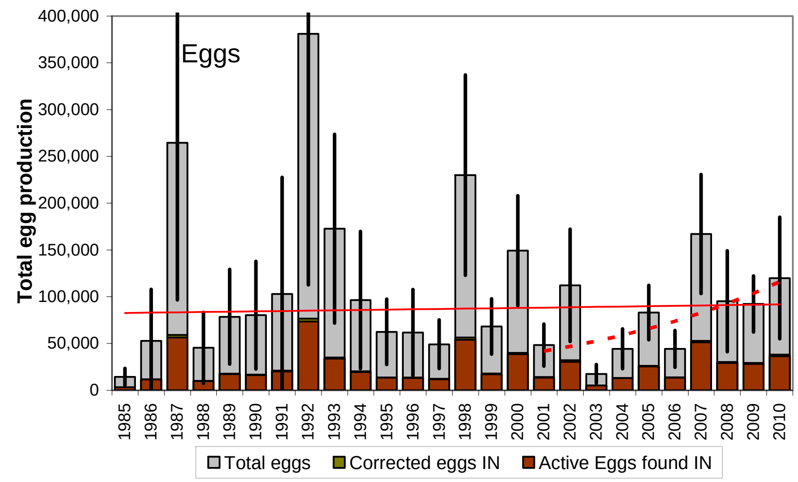
1985-2010 avg annual growth rate= 1.094 (90%c.i.= 1.077-1.111)
2001-2010 last 10 yrs annual growth rate= 1.076 (90%c.i.= 1.043-1.109)

Year	N plots	Sampled km2	Nest index IN	SE nest index IN	Avg nest detection rate	Corrected nests IN	7yr avg Aerial OUT:IN ratio	Corrected nests OUT	**Total nests IN+OUT**	SE total nests	**Total eggs IN+OUT**	SE total eggs	Total eggs / active nests	Total eggs / total nests	Corrected % nest success	Relative production rate
1985	49	24.57	1,078	257	81.0%	1,331	6.02	8,017	**9,348**	2,049	**27,617**	7,235	4.20	2.95	70%	71%
1986	46	22.16	2,907	463	83.2%	3,493	6.02	21,035	**24,528**	3,773	**95,472**	15,918	4.37	3.89	89%	94%
1987	37	12.67	3,275	629	81.4%	4,026	6.02	24,246	**28,272**	5,112	**133,082**	23,580	4.90	4.71	96%	114%
1988	32	10.48	2,937	576	83.7%	3,509	6.02	21,134	**24,643**	4,466	**105,646**	19,344	4.40	4.29	98%	104%
1989	23	7.45	4,037	1,004	84.9%	4,753	6.00	28,516	**33,269**	7,624	**157,870**	34,264	5.01	4.75	95%	115%
1990	33	10.70	7,025	1,108	81.0%	8,674	5.95	51,573	**60,247**	9,448	**248,679**	39,565	4.45	4.13	93%	100%
1991	36	11.66	7,184	1,009	86.1%	8,345	5.52	46,042	**54,388**	6,969	**232,734**	29,649	4.53	4.28	94%	103%
1992	42	13.39	8,019	1,001	82.6%	9,710	5.49	53,286	**62,996**	7,469	**278,756**	34,249	4.52	4.42	98%	107%
1993	47	15.23	5,641	853	80.4%	7,015	5.25	36,816	**43,830**	6,198	**181,874**	24,937	4.27	4.15	97%	100%
1994	41	13.27	8,789	1,097	81.3%	10,813	5.12	55,348	**66,161**	7,956	**279,779**	34,062	4.34	4.23	97%	102%
1995	50	22.56	9,992	1,093	81.0%	12,340	4.99	61,563	**73,903**	7,411	**303,858**	31,087	4.26	4.11	97%	99%
1996	54	19.44	12,849	1,303	82.6%	15,558	5.31	82,587	**98,145**	9,389	**424,347**	41,487	4.49	4.32	96%	105%
1997	72	23.31	11,298	1,145	81.7%	13,823	5.49	75,917	**89,740**	8,785	**377,093**	39,272	4.28	4.20	98%	102%
1998	64	20.71	12,785	1,320	81.7%	15,657	5.91	92,579	**108,236**	12,325	**456,545**	52,664	4.33	4.22	97%	102%
1999	53	16.97	10,588	1,157	82.4%	12,853	6.16	79,213	**92,065**	10,685	**360,806**	42,205	4.17	3.92	94%	95%
2000	80	25.86	13,646	1,258	82.9%	16,461	6.37	104,876	**121,337**	11,868	**524,331**	52,672	4.45	4.32	97%	104%
2001	81	26.23	11,407	935	82.8%	13,775	6.52	89,869	**103,645**	8,496	**371,884**	33,434	3.86	3.59	93%	87%
2002	84	27.15	11,994	1,001	81.6%	14,694	6.33	92,956	**107,650**	9,961	**461,687**	44,778	4.39	4.29	98%	104%
2003	83	26.87	11,265	1,151	81.8%	13,773	6.32	87,106	**100,878**	10,708	**402,433**	44,274	4.25	3.99	94%	96%
2004	81	26.22	17,059	1,465	82.7%	20,638	6.28	129,507	**150,145**	14,194	**666,798**	62,581	4.59	4.44	97%	107%
2005	83	26.87	18,432	1,472	82.2%	22,421	5.88	131,866	**154,287**	12,342	**624,702**	51,201	4.24	4.05	96%	98%
2006	75	24.28	17,685	1,571	82.1%	21,537	5.67	122,130	**143,666**	12,188	**569,269**	48,513	4.15	3.96	96%	96%
2007	79	25.58	18,579	1,518	84.4%	22,017	5.87	129,171	**151,188**	13,111	**664,264**	58,641	4.47	4.39	98%	106%
2008	82	26.55	16,175	1,124	80.8%	20,010	5.87	117,400	**137,410**	10,798	**514,659**	42,173	4.05	3.75	92%	91%
2009	81	26.24	24,252	1,481	82.7%	29,327	5.87	172,063	**201,390**	14,659	**832,537**	61,669	4.30	4.13	96%	100%
2010	66	21.37	23,614	1,738	83.2%	28,397	5.87	166,604	**195,000**	15,904	**795,700**	66,310	4.19	4.08	97%	99%

BRAN Black Brant



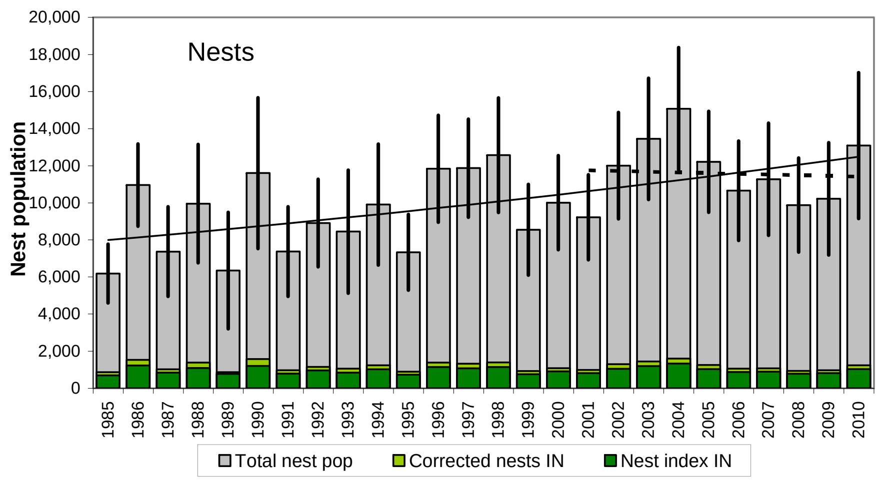
1985-2010 avg annual growth rate= 0.998 (90%c.i.= 0.976-1.021)
2001-2010 last 10 yrs annual growth rate= 1.030 (90%c.i.= 0.966-1.094)



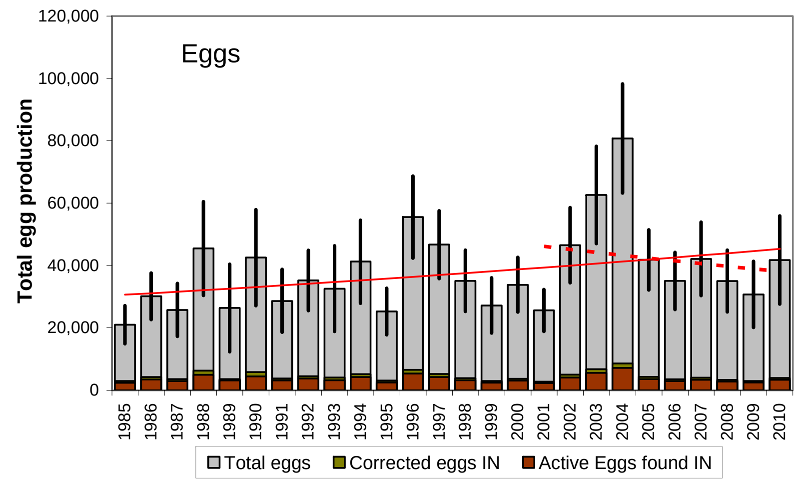
1985-2010 avg annual growth rate= 1.004 (90%c.i.= 0.971-1.037)
2001-2010 last 10 yrs annual growth rate= 1.120 (90%c.i.= 0.997-1.242)

Year	N plots	Sampled km2	Nest index IN	SE nest index IN	Avg nest detection rate	Corrected nests IN	7yr avg Aerial OUT:IN ratio	Corrected nests OUT	**Total nests IN+OUT**	SE total nests	**Total eggs IN+OUT**	SE total eggs	Total eggs / active nests	Total eggs / total nests	Corrected % nest success	Relative production rate
1985	49	24.57	7,107	2,569	92.6%	7,675	3.47	26,664	**34,339**	10,439	**14,350**	5,601	3.09	0.42	14%	16%
1986	46	22.16	3,844	2,304	95.7%	4,017	3.47	13,957	**17,975**	8,816	**52,866**	33,404	3.99	2.94	74%	114%
1987	37	12.67	13,497	6,158	95.6%	14,117	3.47	49,047	**63,164**	24,006	**264,695**	102,181	4.26	4.19	98%	162%
1988	32	10.48	2,732	1,554	95.9%	2,848	3.47	9,893	**12,741**	5,957	**45,362**	23,092	3.98	3.56	89%	138%
1989	23	7.45	6,537	2,701	94.8%	6,893	3.45	23,755	**30,648**	10,338	**78,581**	30,707	3.49	2.56	73%	99%
1990	33	10.70	8,563	4,710	94.7%	9,047	3.82	34,557	**43,604**	20,163	**80,288**	35,026	3.15	1.84	58%	71%
1991	36	11.66	7,859	6,513	94.3%	8,335	3.86	32,201	**40,536**	27,870	**102,937**	75,723	3.66	2.54	69%	98%
1992	42	13.39	19,835	9,859	95.6%	20,742	3.97	82,434	**103,176**	43,232	**381,036**	163,092	3.87	3.69	95%	143%
1993	47	15.23	14,196	6,832	95.7%	14,838	3.95	58,667	**73,505**	29,796	**172,715**	61,309	3.23	2.35	73%	91%
1994	41	13.27	8,681	5,693	96.0%	9,047	3.76	34,004	**43,051**	23,186	**96,524**	44,514	2.42	2.24	93%	87%
1995	50	22.56	6,186	3,119	96.5%	6,410	3.56	22,850	**29,260**	12,241	**62,530**	21,223	2.98	2.14	72%	83%
1996	54	19.44	4,050	2,022	95.6%	4,235	3.49	14,794	**19,029**	7,882	**61,664**	28,011	3.75	3.24	87%	125%
1997	72	23.31	3,807	1,423	96.7%	3,938	3.03	11,947	**15,885**	4,857	**49,158**	15,777	3.32	3.09	93%	120%
1998	64	20.71	16,862	5,452	95.3%	17,702	3.08	54,517	**72,219**	19,316	**229,935**	65,075	3.67	3.18	87%	123%
1999	53	16.97	6,581	2,064	94.1%	6,991	2.82	19,738	**26,729**	6,794	**68,162**	18,018	3.16	2.55	81%	99%
2000	80	25.86	15,140	5,069	96.6%	15,679	2.74	42,891	**58,570**	15,558	**149,228**	35,681	2.87	2.55	89%	99%
2001	81	26.23	8,487	2,391	92.7%	9,156	2.45	22,437	**31,593**	7,060	**48,314**	13,621	2.95	1.53	52%	59%
2002	84	27.15	11,177	4,344	94.8%	11,792	2.50	29,444	**41,235**	12,502	**112,171**	36,456	3.12	2.72	87%	105%
2003	83	26.87	8,229	4,048	94.1%	8,741	2.42	21,146	**29,887**	11,069	**17,457**	6,087	1.25	0.58	47%	23%
2004	81	26.22	4,968	1,710	95.7%	5,192	2.36	12,229	**17,421**	4,682	**44,262**	12,960	3.28	2.54	77%	98%
2005	83	26.87	10,015	2,732	96.4%	10,385	2.18	22,660	**33,045**	6,920	**83,131**	17,624	3.02	2.52	83%	97%
2006	75	24.28	5,541	1,993	95.4%	5,810	2.21	12,844	**18,655**	5,112	**44,195**	11,932	3.44	2.37	69%	92%
2007	79	25.58	13,711	4,083	96.5%	14,214	2.16	30,647	**44,860**	10,226	**167,010**	38,660	3.94	3.72	95%	144%
2008	82	26.55	11,619	4,337	95.5%	12,169	2.16	26,237	**38,406**	10,722	**95,102**	32,785	3.20	2.48	77%	96%
2009	81	26.24	9,384	2,276	96.1%	9,769	2.16	21,063	**30,832**	5,712	**92,275**	18,258	3.56	2.99	84%	116%
2010	66	21.37	13,833	5,850	94.6%	14,618	2.16	31,518	**46,136**	14,771	**119,920**	39,473	3.29	2.60	79%	101%

TUSW Tundra Swan



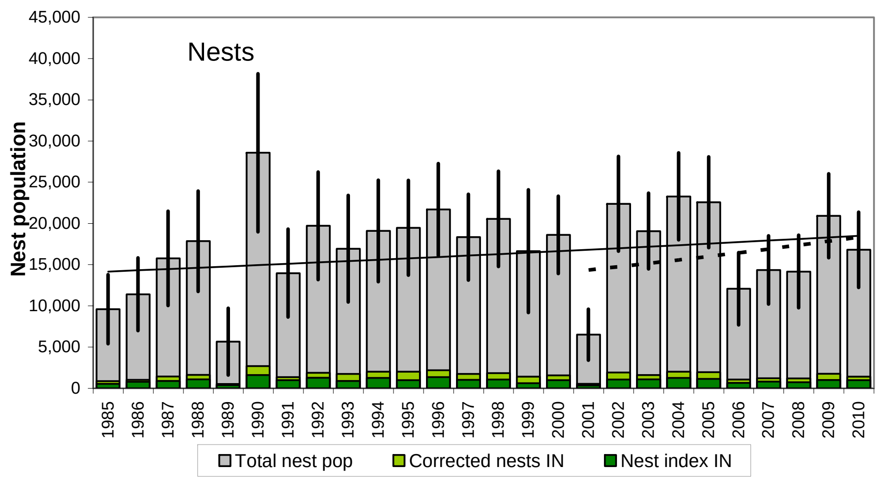
1985-2010 avg annual growth rate= 1.018 (90%c.i.= 1.010-1.026)
2001-2010 last 10 yrs annual growth rate= 0.997 (90%c.i.= 0.968-1.026)

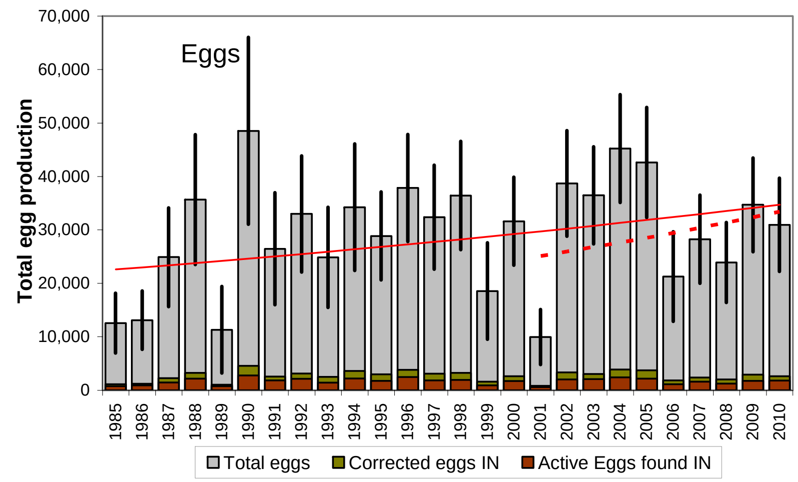


1985-2010 avg annual growth rate= 1.016 (90%c.i.= 1.003-1.029)
2001-2010 last 10 yrs annual growth rate= 0.979 (90%c.i.= 0.917-1.040)

Year	N plots	Sampled km2	Nest index IN	SE nest index IN	Avg nest detection rate	Corrected nests IN	7yr avg Aerial OUT:IN ratio	Corrected nests OUT	**Total nests IN+OUT**	SE total nests	**Total eggs IN+OUT**	SE total eggs	Total eggs / active nests	Total eggs / total nests	Corrected % nest success	Relative production rate
1985	49	24.57	699	119	81.0%	863	6.18	5,327	**6,190**	961	**21,002**	3,709	3.93	3.39	86%	92%
1986	46	22.16	1,227	166	80.4%	1,527	6.18	9,430	**10,957**	1,347	**30,149**	4,524	3.21	2.75	86%	74%
1987	37	12.67	847	189	82.5%	1,027	6.18	6,343	**7,370**	1,467	**25,773**	5,165	3.50	3.50	100%	95%
1988	32	10.48	1,093	237	78.7%	1,388	6.18	8,570	**9,958**	1,939	**45,480**	9,135	4.57	4.57	100%	123%
1989	23	7.45	769	263	88.5%	869	6.31	5,481	**6,351**	1,909	**26,383**	8,532	4.15	4.15	100%	112%
1990	33	10.70	1,204	288	76.3%	1,579	6.35	10,028	**11,607**	2,472	**42,542**	9,358	3.92	3.67	93%	99%
1991	36	11.66	798	178	81.8%	976	6.55	6,398	**7,374**	1,469	**28,668**	6,131	4.25	3.89	92%	105%
1992	42	13.39	962	174	83.5%	1,152	6.73	7,759	**8,912**	1,437	**35,204**	5,876	3.95	3.95	100%	107%
1993	47	15.23	846	226	79.6%	1,063	6.95	7,384	**8,446**	2,019	**32,587**	8,316	4.07	3.86	95%	104%
1994	41	13.27	1,024	231	82.8%	1,237	7.01	8,670	**9,907**	1,982	**41,254**	8,093	4.16	4.16	100%	113%
1995	50	22.56	730	135	82.1%	889	7.25	6,446	**7,335**	1,244	**25,261**	4,525	3.79	3.44	91%	93%
1996	54	19.44	1,141	177	82.2%	1,389	7.52	10,449	**11,837**	1,751	**55,533**	8,002	4.89	4.69	96%	127%
1997	72	23.31	1,074	155	81.0%	1,326	7.95	10,544	**11,870**	1,607	**46,701**	6,620	4.20	3.93	94%	106%
1998	64	20.71	1,140	182	81.7%	1,396	8.00	11,175	**12,571**	1,878	**35,119**	5,980	3.10	2.79	90%	76%
1999	53	16.97	759	145	82.2%	924	8.25	7,621	**8,545**	1,488	**27,203**	5,349	3.63	3.18	88%	86%
2000	80	25.86	913	153	84.2%	1,085	8.23	8,923	**10,008**	1,541	**33,826**	5,337	3.62	3.38	93%	91%
2001	81	26.23	819	134	83.1%	986	8.36	8,239	**9,225**	1,395	**25,615**	4,083	3.38	2.78	82%	75%
2002	84	27.15	1,054	166	80.9%	1,303	8.21	10,705	**12,008**	1,747	**46,528**	7,332	4.35	3.87	89%	105%
2003	83	26.87	1,198	187	82.7%	1,449	8.29	12,002	**13,451**	1,990	**62,625**	9,480	4.79	4.66	97%	126%
2004	81	26.22	1,337	189	83.2%	1,608	8.37	13,456	**15,064**	2,009	**80,724**	10,641	5.48	5.36	98%	145%
2005	83	26.87	1,039	150	82.5%	1,259	8.70	10,952	**12,210**	1,657	**41,814**	5,857	3.63	3.42	94%	93%
2006	75	24.28	884	143	83.3%	1,062	9.03	9,591	**10,653**	1,632	**35,064**	5,573	3.54	3.29	93%	89%
2007	79	25.58	895	154	83.6%	1,071	9.52	10,200	**11,271**	1,841	**42,151**	7,155	3.87	3.74	97%	101%
2008	82	26.55	782	127	83.3%	939	9.52	8,938	**9,877**	1,542	**35,053**	6,025	3.85	3.55	92%	96%
2009	81	26.24	818	155	84.3%	971	9.52	9,246	**10,218**	1,846	**30,751**	6,418	3.40	3.01	88%	81%
2010	66	21.37	1,038	201	83.5%	1,244	9.52	11,843	**13,087**	2,392	**41,768**	8,591	3.87	3.19	83%	86%

SACR Sandhill Crane



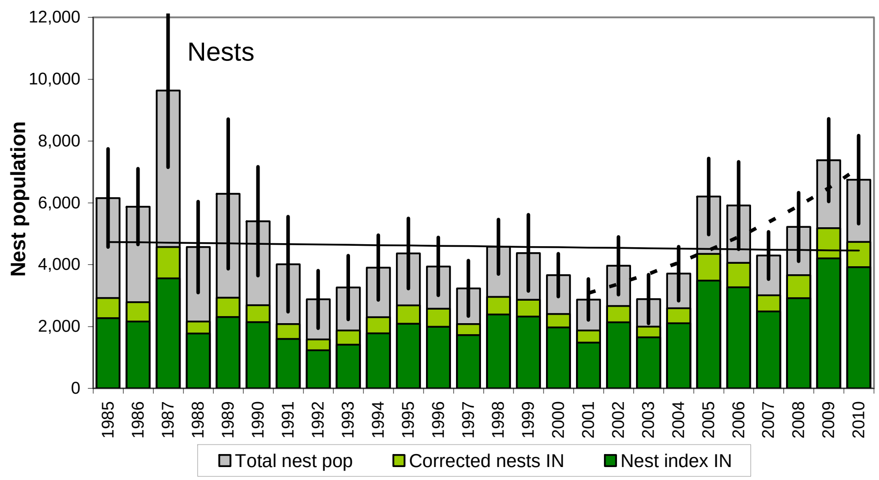


1985-2010 avg annual growth rate= 1.011 (90%c.i.= 0.995-1.027)
2001-2010 last 10 yrs annual growth rate= 1.028 (90%c.i.= 0.952-1.104)

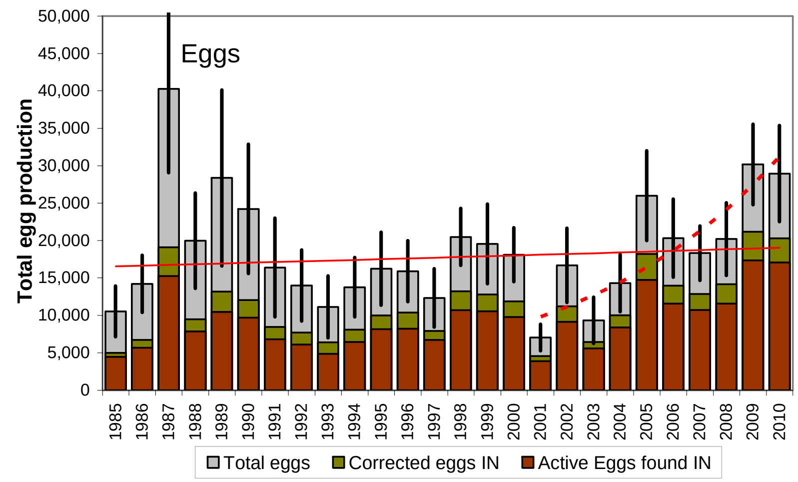
1985-2010 avg annual growth rate= 1.017 (90%c.i.= 0.999-1.036)
2001-2010 last 10 yrs annual growth rate= 1.032 (90%c.i.= 0.946-1.119)

Year	N plots	Sampled km2	Nest index IN	SE nest index IN	Avg nest detection rate	Corrected nests IN	7yr avg Aerial OUT:IN ratio	Corrected nests OUT	**Total nests IN+OUT**	SE total nests	**Total eggs IN+OUT**	SE total eggs	Total eggs / active nests	Total eggs / total nests	Corrected % nest success	Relative production rate
1985	49	24.57	553	145	63.3%	875	9.96	8,715	**9,589**	2,546	**12,571**	3,405	1.63	1.31	80%	77%
1986	46	22.16	775	188	74.5%	1,040	9.96	10,362	**11,402**	2,680	**13,115**	3,321	1.48	1.15	78%	68%
1987	37	12.67	904	192	62.8%	1,439	9.96	14,332	**15,771**	3,480	**24,892**	5,622	1.58	1.58	100%	93%
1988	32	10.48	1,093	220	67.2%	1,627	9.96	16,209	**17,836**	3,695	**35,672**	7,390	2.14	2.00	94%	118%
1989	23	7.45	385	178	73.2%	526	9.77	5,135	**5,661**	2,465	**11,322**	4,931	2.00	2.00	100%	118%
1990	33	10.70	1,606	305	59.5%	2,696	9.60	25,883	**28,580**	5,829	**48,540**	10,616	1.79	1.70	95%	100%
1991	36	11.66	982	222	72.8%	1,350	9.35	12,627	**13,978**	3,238	**26,476**	6,376	1.89	1.89	100%	112%
1992	42	13.39	1,283	267	68.2%	1,881	9.48	17,825	**19,706**	3,959	**32,976**	6,610	1.75	1.67	96%	99%
1993	47	15.23	893	227	51.8%	1,723	8.83	15,212	**16,935**	3,930	**24,875**	5,701	1.67	1.47	88%	87%
1994	41	13.27	1,240	254	62.0%	2,001	8.54	17,096	**19,097**	3,744	**34,262**	7,202	1.79	1.79	100%	106%
1995	50	22.56	983	154	49.1%	2,003	8.72	17,467	**19,469**	3,498	**28,855**	5,003	1.92	1.48	77%	87%
1996	54	19.44	1,362	213	62.2%	2,191	8.90	19,501	**21,692**	3,392	**37,840**	6,087	1.88	1.74	93%	103%
1997	72	23.31	1,044	187	59.8%	1,746	9.50	16,593	**18,340**	3,161	**32,379**	5,916	1.77	1.77	100%	104%
1998	64	20.71	1,071	175	58.2%	1,839	10.18	18,725	**20,564**	3,518	**36,414**	6,158	1.77	1.77	100%	104%
1999	53	16.97	633	162	44.7%	1,416	10.75	15,222	**16,638**	4,521	**18,562**	5,486	1.69	1.12	66%	66%
2000	80	25.86	969	139	62.0%	1,563	10.90	17,039	**18,602**	2,857	**31,621**	4,994	1.84	1.70	92%	100%
2001	81	26.23	355	111	65.4%	542	11.01	5,968	**6,510**	1,884	**9,970**	3,125	1.70	1.53	90%	90%
2002	84	27.15	1,054	149	54.6%	1,933	10.58	20,453	**22,386**	3,497	**38,666**	6,007	2.00	1.73	86%	102%
2003	83	26.87	1,092	155	67.9%	1,608	10.86	17,465	**19,073**	2,796	**36,465**	5,531	1.96	1.91	97%	113%
2004	81	26.22	1,256	161	62.7%	2,003	10.62	21,278	**23,280**	3,211	**45,210**	6,126	1.94	1.94	100%	115%
2005	83	26.87	1,145	164	58.4%	1,962	10.50	20,601	**22,564**	3,348	**42,619**	6,270	1.89	1.89	100%	111%
2006	75	24.28	648	141	61.6%	1,052	10.48	11,026	**12,078**	2,663	**21,267**	5,081	1.76	1.76	100%	104%
2007	79	25.58	811	147	66.8%	1,215	10.82	13,146	**14,361**	2,521	**28,267**	5,010	1.97	1.97	100%	116%
2008	82	26.55	728	136	60.7%	1,199	10.82	12,972	**14,171**	2,674	**23,897**	4,556	1.76	1.69	96%	100%
2009	81	26.24	1,009	143	57.0%	1,771	10.82	19,155	**20,925**	3,092	**34,698**	5,337	1.85	1.66	89%	98%
2010	66	21.37	971	157	68.3%	1,423	10.82	15,393	**16,816**	2,779	**30,958**	5,311	1.93	1.84	95%	109%

SPEI **Spectacled Eider**



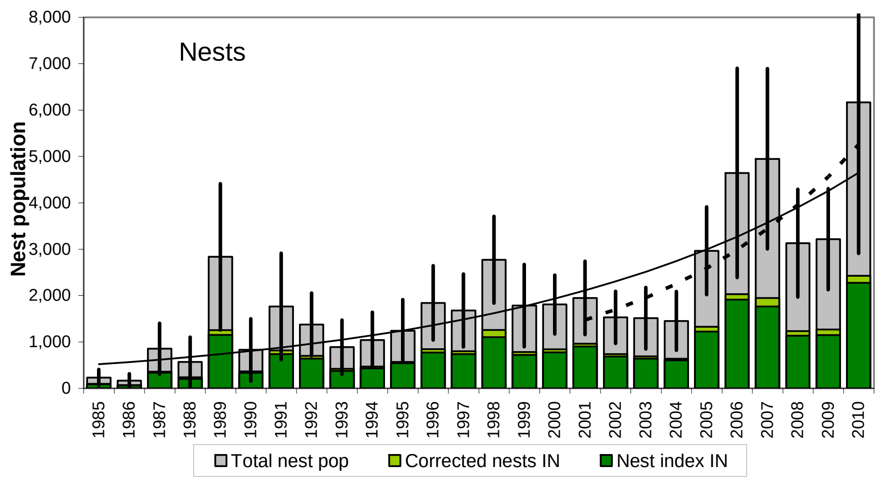
1985-2010 avg annual growth rate= 0.998 (90%c.i.= 0.984-1.011)
2001-2010 last 10 yrs annual growth rate= 1.098 (90%c.i.= 1.057-1.138)



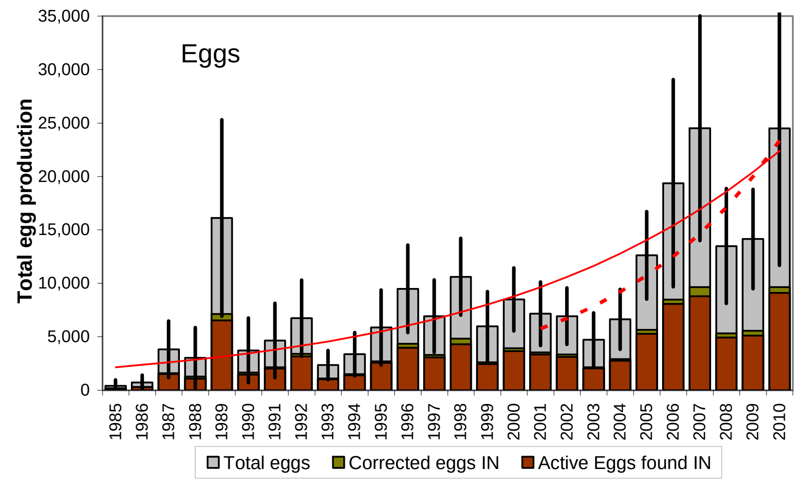
1985-2010 avg annual growth rate= 1.006 (90%c.i.= 0.988-1.023)
2001-2010 last 10 yrs annual growth rate= 1.137 (90%c.i.= 1.078-1.196)

Year	N plots	Sampled km2	Nest index IN	SE nest index IN	Avg nest detection rate	Corrected nests IN	7yr avg Aerial OUT:IN ratio	Corrected nests OUT	**Total nests IN+OUT**	SE total nests	**Total eggs IN+OUT**	SE total eggs	Total eggs / active nests	Total eggs / total nests	Corrected % nest success	Relative production rate
1985	49	24.57	2,272	489	77.8%	2,919	1.11	3,238	**6,157**	966	**10,535**	2,061	3.84	1.71	45%	44%
1986	46	22.16	2,164	366	77.7%	2,786	1.11	3,090	**5,876**	747	**14,217**	2,325	4.40	2.42	55%	62%
1987	37	12.67	3,558	758	77.9%	4,568	1.11	5,067	**9,635**	1,508	**40,284**	6,821	5.06	4.18	83%	108%
1988	32	10.48	1,776	484	82.0%	2,166	1.11	2,402	**4,568**	896	**19,977**	3,874	4.81	4.37	91%	113%
1989	23	7.45	2,307	751	78.8%	2,927	1.15	3,362	**6,289**	1,469	**28,366**	7,148	4.99	4.51	90%	116%
1990	33	10.70	2,141	552	79.6%	2,689	1.01	2,716	**5,404**	1,071	**24,236**	5,251	5.03	4.48	89%	116%
1991	36	11.66	1,596	491	76.9%	2,075	0.93	1,940	**4,015**	938	**16,402**	4,011	5.27	4.09	77%	105%
1992	42	13.39	1,230	308	77.5%	1,587	0.81	1,289	**2,876**	565	**13,997**	2,886	5.43	4.87	90%	125%
1993	47	15.23	1,410	348	75.3%	1,874	0.74	1,385	**3,259**	628	**11,135**	2,524	4.27	3.42	80%	88%
1994	41	13.27	1,779	344	77.4%	2,300	0.70	1,607	**3,907**	638	**13,769**	2,403	4.65	3.52	76%	91%
1995	50	22.56	2,094	417	78.0%	2,684	0.63	1,679	**4,363**	690	**16,236**	2,955	4.88	3.72	76%	96%
1996	54	19.44	1,988	377	77.3%	2,573	0.53	1,373	**3,946**	571	**15,913**	2,474	5.06	4.03	80%	104%
1997	72	23.31	1,719	404	82.7%	2,079	0.55	1,154	**3,233**	546	**12,335**	2,376	4.38	3.82	87%	98%
1998	64	20.71	2,384	374	80.6%	2,956	0.55	1,623	**4,579**	537	**20,493**	2,313	4.87	4.48	92%	115%
1999	53	16.97	2,320	532	81.0%	2,864	0.53	1,513	**4,377**	749	**19,556**	3,234	4.96	4.47	90%	115%
2000	80	25.86	1,965	295	82.0%	2,398	0.53	1,260	**3,657**	422	**18,103**	2,186	5.34	4.95	93%	127%
2001	81	26.23	1,474	275	78.7%	1,873	0.53	1,002	**2,875**	402	**7,044**	1,087	4.18	2.45	59%	63%
2002	84	27.15	2,135	407	80.1%	2,664	0.49	1,300	**3,964**	568	**16,690**	3,015	5.26	4.21	80%	108%
2003	83	26.87	1,651	350	82.7%	1,998	0.45	889	**2,887**	478	**9,341**	1,883	4.41	3.24	73%	83%
2004	81	26.22	2,102	387	81.1%	2,590	0.43	1,119	**3,710**	530	**14,328**	2,325	4.97	3.86	78%	99%
2005	83	26.87	3,489	538	80.3%	4,346	0.43	1,860	**6,206**	750	**25,994**	3,645	4.69	4.19	89%	108%
2006	75	24.28	3,272	641	80.6%	4,061	0.46	1,853	**5,913**	861	**20,324**	3,174	4.50	3.44	76%	89%
2007	79	25.58	2,490	340	82.7%	3,013	0.43	1,282	**4,295**	466	**18,318**	2,209	5.06	4.26	84%	110%
2008	82	26.55	2,911	482	79.5%	3,662	0.43	1,559	**5,221**	675	**20,212**	2,952	5.04	3.87	77%	100%
2009	81	26.24	4,201	576	81.2%	5,176	0.43	2,204	**7,380**	811	**30,168**	3,271	4.50	4.09	91%	105%
2010	66	21.37	3,919	646	82.8%	4,735	0.43	2,016	**6,750**	866	**28,957**	3,906	4.98	4.29	86%	111%

COEI Common Eider



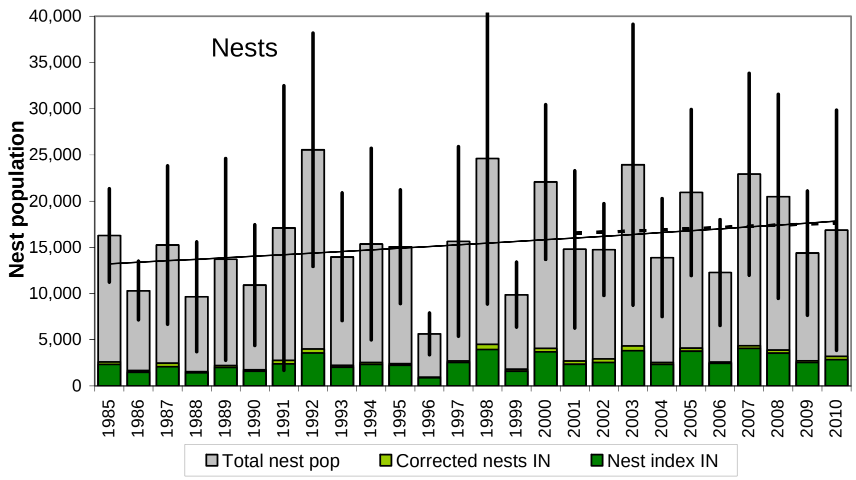
1985-2010 avg annual growth rate= 1.092 (90%c.i.= 1.067-1.116)
2001-2010 last 10 yrs annual growth rate= 1.152 (90%c.i.= 1.082-1.222)



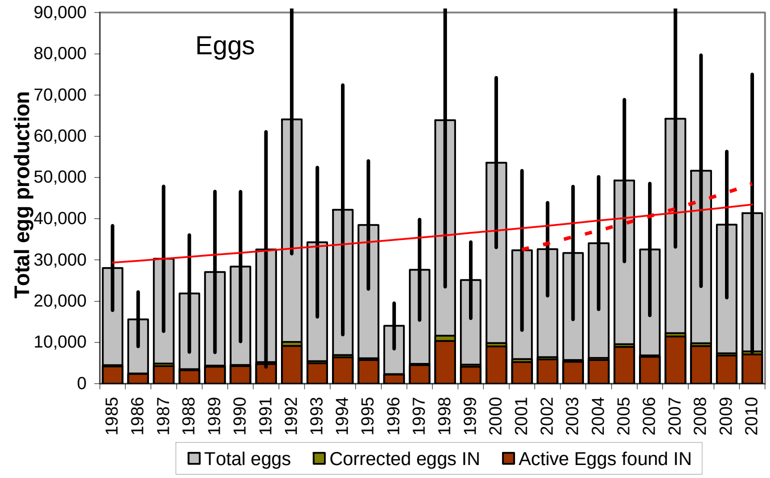
1985-2010 avg annual growth rate= 1.098 (90%c.i.= 1.068-1.128)
2001-2010 last 10 yrs annual growth rate= 1.168 (90%c.i.= 1.091-1.246)

Year	N plots	Sampled km2	Nest index IN	SE nest index IN	Avg nest detection rate	Corrected nests IN	7yr avg Aerial OUT:IN ratio	Corrected nests OUT	**Total nests IN+OUT**	SE total nests	**Total eggs IN+OUT**	SE total eggs	Total eggs / active nests	Total eggs / total nests	Corrected % nest success	Relative production rate
1985	49	24.57	87	47	90.2%	97	1.39	134	**231**	105	**425**	322	6.00	1.84	31%	44%
1986	46	22.16	65	45	94.2%	69	1.39	95	**164**	91	**740**	416	4.52	4.52	100%	109%
1987	37	12.67	339	152	94.7%	358	1.39	496	**854**	334	**3,822**	1,606	5.41	4.47	83%	108%
1988	32	10.48	205	150	86.3%	237	1.39	329	**567**	327	**3,033**	1,716	5.35	5.35	100%	129%
1989	23	7.45	1,154	456	91.9%	1,256	1.26	1,580	**2,836**	959	**16,117**	5,590	5.68	5.68	100%	137%
1990	33	10.70	335	216	91.2%	367	1.26	462	**829**	409	**3,732**	1,841	4.50	4.50	100%	109%
1991	36	11.66	737	381	90.6%	814	1.17	952	**1,765**	697	**4,656**	2,118	4.76	2.64	55%	64%
1992	42	13.39	642	254	91.9%	698	0.97	678	**1,376**	412	**6,739**	2,159	5.38	4.90	91%	118%
1993	47	15.23	376	203	89.5%	420	1.11	466	**886**	354	**2,359**	835	4.43	2.66	60%	64%
1994	41	13.27	431	205	92.7%	465	1.24	578	**1,043**	361	**3,362**	1,235	3.73	3.22	86%	78%
1995	50	22.56	539	247	95.1%	567	1.18	671	**1,238**	411	**5,876**	2,135	5.08	4.75	93%	115%
1996	54	19.44	773	271	91.4%	846	1.18	996	**1,842**	487	**9,488**	2,489	5.44	5.15	95%	124%
1997	72	23.31	737	285	92.1%	800	1.10	878	**1,678**	477	**6,926**	2,061	4.53	4.13	91%	100%
1998	64	20.71	1,106	299	87.7%	1,261	1.20	1,513	**2,774**	568	**10,622**	2,184	5.01	3.83	76%	92%
1999	53	16.97	717	296	91.7%	782	1.28	1,003	**1,785**	539	**5,987**	1,969	4.47	3.35	75%	81%
2000	80	25.86	775	212	92.6%	837	1.16	970	**1,807**	386	**8,501**	1,790	4.90	4.70	96%	114%
2001	81	26.23	900	292	93.6%	962	1.02	986	**1,947**	480	**7,160**	1,807	4.10	3.68	90%	89%
2002	84	27.15	685	191	92.6%	740	1.07	791	**1,531**	341	**6,933**	1,602	4.72	4.53	96%	109%
2003	83	26.87	639	225	92.9%	688	1.20	825	**1,513**	403	**4,736**	1,521	4.28	3.13	73%	76%
2004	81	26.22	600	212	94.3%	637	1.28	816	**1,453**	386	**6,635**	1,700	4.80	4.57	95%	110%
2005	83	26.87	1,225	298	92.4%	1,325	1.24	1,638	**2,964**	575	**12,621**	2,487	4.93	4.26	86%	103%
2006	75	24.28	1,916	751	94.4%	2,030	1.29	2,612	**4,642**	1,372	**19,369**	5,894	4.81	4.17	87%	101%
2007	79	25.58	1,763	540	90.5%	1,948	1.54	3,002	**4,950**	1,184	**24,521**	6,387	5.22	4.95	95%	120%
2008	82	26.55	1,132	329	91.9%	1,232	1.54	1,899	**3,131**	706	**13,490**	3,269	4.82	4.31	89%	104%
2009	81	26.24	1,146	295	90.5%	1,266	1.54	1,951	**3,217**	662	**14,156**	2,828	4.91	4.40	90%	106%
2010	66	21.37	2,278	976	93.8%	2,428	1.54	3,740	**6,168**	1,982	**24,501**	7,799	4.86	3.97	82%	96%

GLGU Glaucous Gull



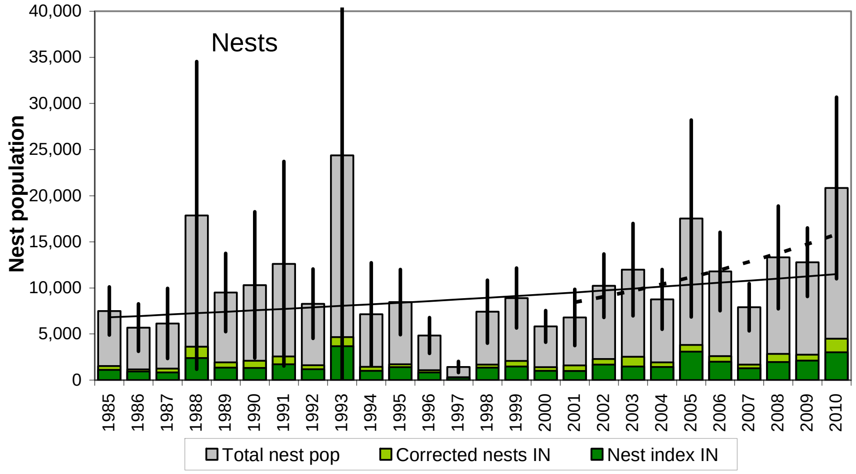
1985-2010 avg annual growth rate= 1.012 (90%c.i.= 0.992-1.032)
2001-2010 last 10 yrs annual growth rate= 1.007 (90%c.i.= 0.962-1.053)



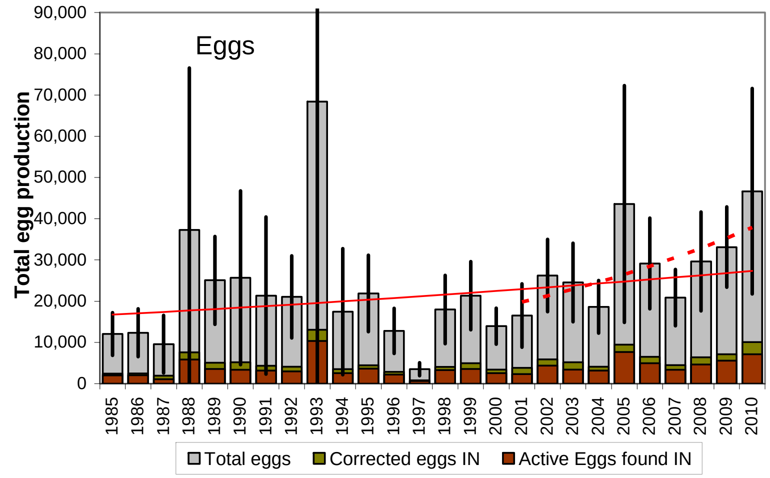
1985-2010 avg annual growth rate= 1.016 (90%c.i.= 0.996-1.036)
2001-2010 last 10 yrs annual growth rate= 1.045 (90%c.i.= 1.004-1.087)

Year	N plots	Sampled km2	Nest index IN	SE nest index IN	Avg nest detection rate	Corrected nests IN	7yr avg Aerial OUT:IN ratio	Corrected nests OUT	**Total nests IN+OUT**	SE total nests	**Total eggs IN+OUT**	SE total eggs	Total eggs / active nests	Total eggs / total nests	Corrected % nest success	Relative production rate
1985	49	24.57	2,330	487	88.8%	2,625	5.20	13,661	**16,287**	3,071	**28,069**	6,226	2.08	1.72	83%	75%
1986	46	22.16	1,486	316	89.3%	1,663	5.20	8,657	**10,320**	1,927	**15,630**	3,994	2.15	1.51	70%	66%
1987	37	12.67	2,089	766	85.0%	2,457	5.20	12,788	**15,245**	5,212	**30,300**	10,662	2.15	1.99	93%	87%
1988	32	10.48	1,434	622	92.2%	1,556	5.20	8,097	**9,653**	3,612	**21,869**	8,603	2.53	2.27	89%	99%
1989	23	7.45	2,019	1,106	91.4%	2,208	5.20	11,490	**13,697**	6,637	**27,102**	11,852	2.27	1.98	87%	86%
1990	33	10.70	1,606	689	91.3%	1,758	5.20	9,149	**10,907**	3,971	**28,392**	11,030	2.91	2.60	90%	113%
1991	36	11.66	2,395	1,501	86.9%	2,754	5.20	14,333	**17,088**	9,359	**32,559**	17,321	2.99	1.91	64%	83%
1992	42	13.39	3,582	1,211	88.9%	4,027	5.34	21,524	**25,551**	7,673	**64,122**	19,803	2.71	2.51	92%	109%
1993	47	15.23	2,021	703	90.7%	2,228	5.27	11,741	**13,969**	4,201	**34,292**	11,007	2.53	2.45	97%	107%
1994	41	13.27	2,319	1,103	91.6%	2,532	5.06	12,816	**15,348**	6,301	**42,132**	18,381	2.83	2.75	97%	120%
1995	50	22.56	2,252	643	92.8%	2,428	5.20	12,634	**15,062**	3,744	**38,489**	9,426	2.56	2.56	100%	111%
1996	54	19.44	884	241	94.0%	940	4.99	4,689	**5,629**	1,373	**14,029**	3,345	2.49	2.49	100%	109%
1997	72	23.31	2,548	1,188	93.8%	2,716	4.76	12,916	**15,632**	6,235	**27,649**	7,407	1.79	1.77	99%	77%
1998	64	20.71	3,939	1,749	87.6%	4,495	4.47	20,107	**24,601**	9,578	**63,904**	24,556	2.67	2.60	97%	113%
1999	53	16.97	1,603	387	88.9%	1,804	4.48	8,079	**9,883**	2,143	**25,124**	5,607	2.72	2.54	94%	111%
2000	80	25.86	3,709	974	91.5%	4,054	4.44	18,005	**22,059**	5,092	**53,612**	12,512	2.50	2.43	97%	106%
2001	81	26.23	2,347	955	86.3%	2,718	4.44	12,056	**14,774**	5,165	**32,333**	11,743	2.36	2.19	93%	95%
2002	84	27.15	2,531	580	86.7%	2,917	4.06	11,833	**14,750**	3,025	**32,641**	6,852	2.59	2.21	85%	96%
2003	83	26.87	3,835	1,748	88.4%	4,338	4.52	19,596	**23,934**	9,241	**31,702**	9,774	1.64	1.32	81%	58%
2004	81	26.22	2,320	717	91.5%	2,534	4.48	11,361	**13,896**	3,886	**34,087**	9,763	2.49	2.45	99%	107%
2005	83	26.87	3,782	1,049	92.6%	4,084	4.12	16,836	**20,920**	5,459	**49,252**	11,938	2.41	2.35	98%	102%
2006	75	24.28	2,446	742	94.1%	2,600	3.72	9,664	**12,264**	3,483	**32,550**	9,721	2.69	2.65	99%	116%
2007	79	25.58	4,057	1,101	93.0%	4,360	4.26	18,554	**22,915**	6,642	**64,275**	18,916	2.83	2.80	99%	122%
2008	82	26.55	3,558	1,156	91.2%	3,901	4.26	16,602	**20,503**	6,716	**51,626**	17,036	2.67	2.52	94%	110%
2009	81	26.24	2,537	688	92.8%	2,735	4.26	11,639	**14,375**	4,086	**38,588**	10,780	2.72	2.68	99%	117%
2010	66	21.37	2,847	1,429	88.8%	3,206	4.26	13,643	**16,849**	7,899	**41,349**	20,445	2.54	2.45	96%	107%

MEGU Mew Gull



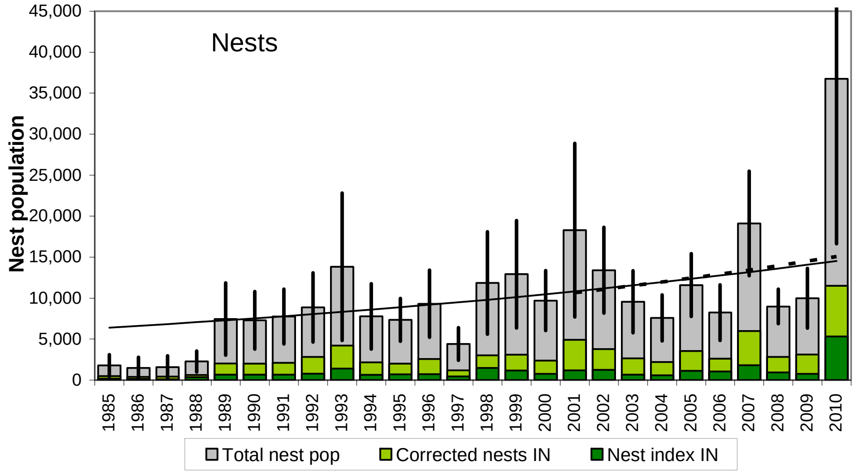
1985-2010 avg annual growth rate= 1.021 (90%c.i.= 0.989-1.053)
2001-2010 last 10 yrs annual growth rate= 1.072 (90%c.i.= 1.016-1.128)



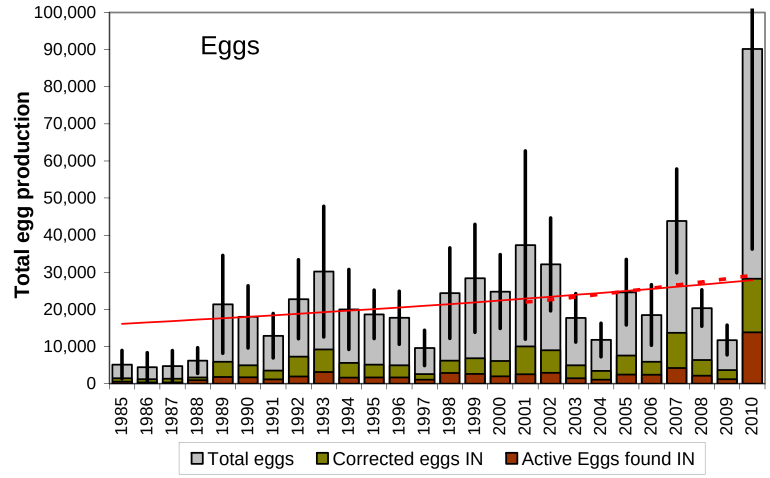
1985-2010 avg annual growth rate= 1.020 (90%c.i.= 0.988-1.052)
2001-2010 last 10 yrs annual growth rate= 1.075 (90%c.i.= 1.021-1.128)

Year	N plots	Sampled km2	Nest index IN	SE nest index IN	Avg nest detection rate	Corrected nests IN	7yr avg Aerial OUT:IN ratio	Corrected nests OUT	**Total nests IN+OUT**	SE total nests	**Total eggs IN+OUT**	SE total eggs	Total eggs / active nests	Total eggs / total nests	Corrected % nest success	Relative production rate
1985	49	24.57	1,107	270	72.6%	1,525	3.92	5,981	**7,506**	1,589	**12,071**	3,143	1.95	1.61	82%	69%
1986	46	22.16	937	286	80.9%	1,157	3.92	4,540	**5,698**	1,565	**12,348**	3,530	2.29	2.17	95%	93%
1987	37	12.67	847	385	67.8%	1,249	3.92	4,899	**6,148**	2,306	**9,599**	4,242	1.56	1.56	100%	67%
1988	32	10.48	2,390	1,793	65.9%	3,629	3.92	14,236	**17,866**	10,134	**37,301**	23,875	2.47	2.09	85%	89%
1989	23	7.45	1,346	385	69.7%	1,930	3.92	7,569	**9,499**	2,589	**25,064**	6,473	2.64	2.64	100%	113%
1990	33	10.70	1,338	814	63.9%	2,095	3.92	8,217	**10,311**	4,819	**25,668**	12,817	2.68	2.49	93%	107%
1991	36	11.66	1,719	1,037	67.1%	2,562	3.92	10,052	**12,615**	6,742	**21,369**	11,568	2.37	1.69	72%	72%
1992	42	13.39	1,176	323	72.9%	1,612	4.14	6,672	**8,285**	2,292	**21,061**	6,052	2.69	2.54	95%	109%
1993	47	15.23	3,667	2,931	78.7%	4,661	4.23	19,716	**24,377**	15,547	**68,382**	44,008	2.81	2.81	100%	120%
1994	41	13.27	1,024	547	70.7%	1,450	3.93	5,694	**7,143**	3,395	**17,436**	9,286	2.65	2.44	92%	104%
1995	50	22.56	1,396	403	81.2%	1,719	3.92	6,745	**8,465**	2,151	**21,904**	5,625	2.59	2.59	100%	111%
1996	54	19.44	847	241	78.2%	1,083	3.47	3,763	**4,846**	1,177	**12,787**	3,331	2.64	2.64	100%	113%
1997	72	23.31	276	85	85.6%	323	3.42	1,104	**1,426**	372	**3,501**	955	2.45	2.45	100%	105%
1998	64	20.71	1,348	446	80.0%	1,685	3.41	5,738	**7,423**	2,071	**18,009**	5,040	2.43	2.43	100%	104%
1999	53	16.97	1,476	399	70.7%	2,089	3.26	6,813	**8,903**	1,970	**21,335**	5,018	2.48	2.40	97%	103%
2000	80	25.86	1,024	189	72.4%	1,414	3.12	4,411	**5,825**	1,043	**13,966**	2,656	2.59	2.40	93%	103%
2001	81	26.23	982	300	61.8%	1,588	3.27	5,201	**6,790**	1,854	**16,523**	4,683	2.43	2.43	100%	104%
2002	84	27.15	1,687	378	73.2%	2,305	3.44	7,924	**10,229**	2,086	**26,211**	5,332	2.68	2.56	96%	110%
2003	83	26.87	1,465	387	57.8%	2,535	3.72	9,443	**11,978**	3,048	**24,543**	5,785	2.58	2.05	79%	88%
2004	81	26.22	1,419	326	73.4%	1,934	3.53	6,829	**8,763**	1,968	**18,640**	3,891	2.45	2.13	87%	91%
2005	83	26.87	3,090	1,366	81.0%	3,813	3.59	13,698	**17,511**	6,486	**43,559**	17,470	2.49	2.49	100%	106%
2006	75	24.28	2,004	507	76.4%	2,623	3.49	9,162	**11,786**	2,593	**29,132**	6,686	2.47	2.47	100%	106%
2007	79	25.58	1,287	252	75.5%	1,705	3.64	6,210	**7,916**	1,557	**20,854**	4,148	2.63	2.63	100%	113%
2008	82	26.55	1,968	520	68.7%	2,866	3.64	10,435	**13,301**	3,383	**29,664**	7,280	2.49	2.23	90%	95%
2009	81	26.24	2,128	370	77.2%	2,755	3.64	10,033	**12,788**	2,260	**33,121**	5,918	2.65	2.59	98%	111%
2010	66	21.37	3,015	960	67.1%	4,489	3.64	16,349	**20,838**	5,984	**46,676**	15,131	2.56	2.24	87%	96%

SAGU Sabine's Gull



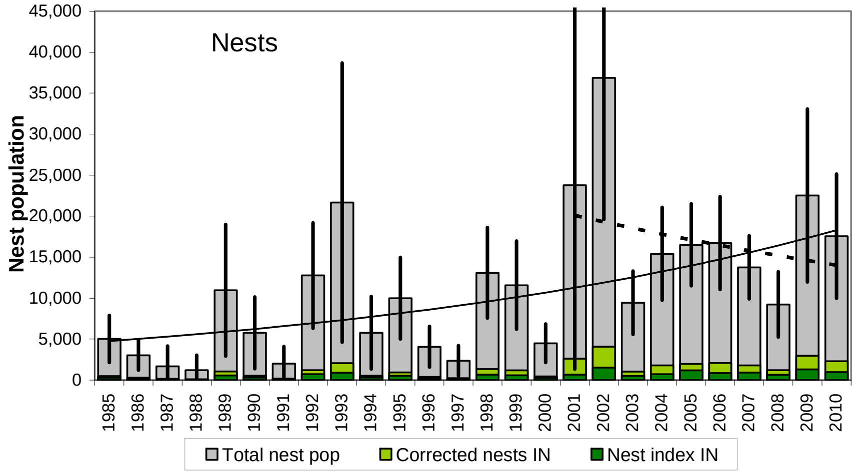
1985-2010 avg annual growth rate= 1.033 (90%c.i.= 1.011-1.056)
2001-2010 last 10 yrs annual growth rate= 1.039 (90%c.i.= 0.944-1.134)



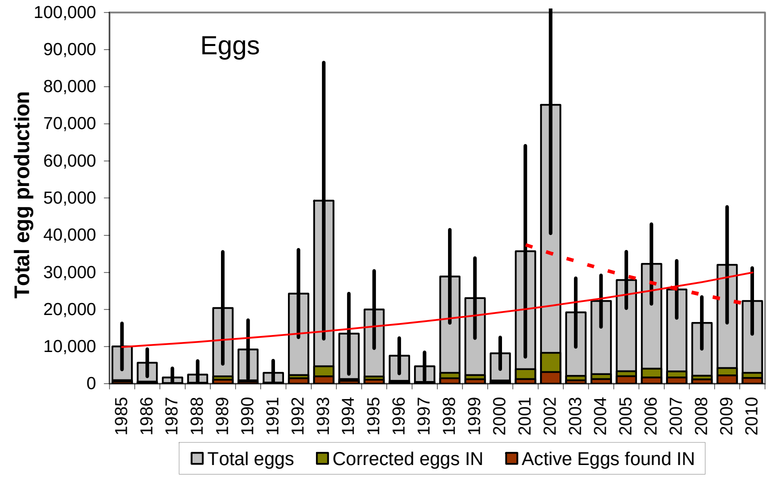
1985-2010 avg annual growth rate= 1.022 (90%c.i.= 0.995-1.049)
2001-2010 last 10 yrs annual growth rate= 1.032 (90%c.i.= 0.909-1.156)

Year	N plots	Sampled km2	Nest index IN	SE nest index IN	Avg nest detection rate	Corrected nests IN	7yr avg Aerial OUT:IN ratio	Corrected nests OUT	**Total nests IN+OUT**	SE total nests	**Total eggs IN+OUT**	SE total eggs	Total eggs / active nests	Total eggs / total nests	Corrected % nest success	Relative production rate
1985	49	24.57	195	99	39.6%	491	2.63	1,295	**1,786**	807	**5,146**	2,335	2.88	2.88	100%	125%
1986	46	22.16	129	78	31.5%	410	2.63	1,080	**1,490**	794	**4,470**	2,383	3.00	3.00	100%	130%
1987	37	12.67	113	76	25.9%	436	2.63	1,148	**1,584**	843	**4,751**	2,528	3.00	3.00	100%	130%
1988	32	10.48	341	142	54.3%	628	2.63	1,655	**2,284**	786	**6,217**	2,100	2.72	2.72	100%	118%
1989	23	7.45	673	291	32.8%	2,053	2.63	5,409	**7,463**	2,682	**21,378**	8,030	2.86	2.86	100%	125%
1990	33	10.70	669	223	33.3%	2,007	2.63	5,287	**7,294**	2,133	**17,988**	5,081	2.47	2.47	100%	107%
1991	36	11.66	675	192	31.6%	2,134	2.63	5,623	**7,757**	2,036	**12,913**	3,650	1.66	1.66	100%	72%
1992	42	13.39	802	291	28.3%	2,833	2.14	6,049	**8,882**	2,562	**22,779**	6,480	2.56	2.56	100%	112%
1993	47	15.23	1,410	724	33.4%	4,225	2.28	9,611	**13,836**	5,465	**30,198**	10,716	2.41	2.18	91%	95%
1994	41	13.27	647	220	29.7%	2,179	2.57	5,600	**7,779**	2,422	**20,007**	6,557	2.57	2.57	100%	112%
1995	50	22.56	698	185	34.5%	2,024	2.63	5,332	**7,356**	1,584	**18,669**	3,973	2.54	2.54	100%	110%
1996	54	19.44	736	216	28.4%	2,591	2.60	6,730	**9,321**	2,487	**17,755**	4,343	2.42	1.90	79%	83%
1997	72	23.31	460	136	38.5%	1,196	2.68	3,209	**4,405**	1,205	**9,625**	2,903	2.18	2.18	100%	95%
1998	64	20.71	1,486	720	49.1%	3,026	2.92	8,831	**11,857**	3,799	**24,397**	7,403	2.06	2.06	100%	90%
1999	53	16.97	1,181	560	37.9%	3,113	3.15	9,809	**12,921**	3,975	**28,388**	8,854	2.20	2.20	100%	96%
2000	80	25.86	775	182	32.2%	2,408	3.03	7,295	**9,703**	2,231	**24,834**	6,068	2.56	2.56	100%	111%
2001	81	26.23	1,201	423	24.4%	4,915	2.72	13,378	**18,293**	6,440	**37,355**	15,425	2.30	2.04	89%	89%
2002	84	27.15	1,239	404	32.8%	3,774	2.55	9,629	**13,402**	3,190	**32,140**	7,612	2.40	2.40	100%	104%
2003	83	26.87	692	186	26.1%	2,656	2.60	6,907	**9,563**	2,297	**17,726**	3,958	2.18	1.85	85%	81%
2004	81	26.22	600	148	27.3%	2,199	2.45	5,395	**7,594**	1,708	**11,787**	2,756	1.99	1.55	78%	68%
2005	83	26.87	1,145	256	32.0%	3,579	2.24	8,013	**11,592**	2,333	**24,651**	5,350	2.13	2.13	100%	93%
2006	75	24.28	1,061	372	40.6%	2,616	2.15	5,626	**8,242**	2,057	**18,497**	4,965	2.24	2.24	100%	98%
2007	79	25.58	1,819	398	30.4%	5,992	2.19	13,120	**19,111**	3,870	**43,850**	8,514	2.29	2.29	100%	100%
2008	82	26.55	944	151	33.5%	2,819	2.19	6,173	**8,993**	1,277	**20,379**	2,998	2.27	2.27	100%	99%
2009	81	26.24	764	187	24.4%	3,130	2.19	6,854	**9,984**	2,215	**11,750**	2,433	1.76	1.18	67%	51%
2010	66	21.37	5,326	3,366	46.2%	11,524	2.19	25,233	**36,757**	12,231	**90,190**	32,806	2.56	2.45	96%	107%

ARTE Arctic Tern



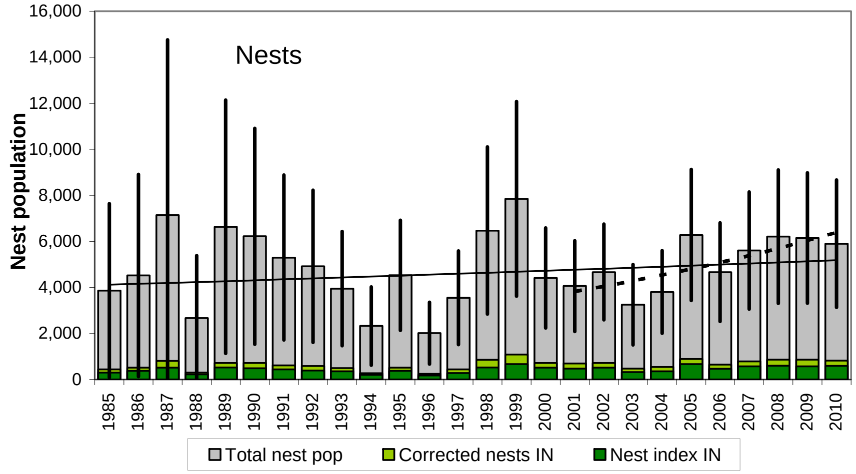
1985-2010 avg annual growth rate= 1.055 (90%c.i.= 1.016-1.095)
2001-2010 last 10 yrs annual growth rate= 0.961 (90%c.i.= 0.887-1.034)



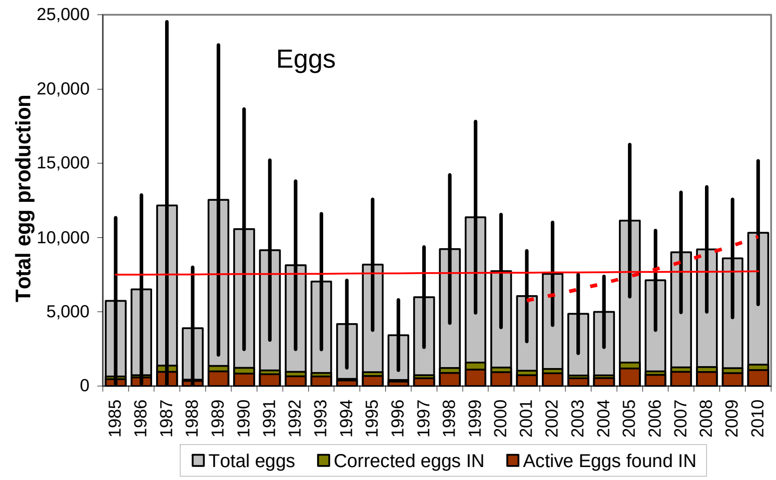
1985-2010 avg annual growth rate= 1.045 (90%c.i.= 1.004-1.087)
2001-2010 last 10 yrs annual growth rate= 0.939 (90%c.i.= 0.871-1.007)

Year	N plots	Sampled km2	Nest index IN	SE nest index IN	Avg nest detection rate	Corrected nests IN	7yr avg Aerial OUT:IN ratio	Corrected nests OUT	**Total nests IN+OUT**	SE total nests	**Total eggs IN+OUT**	SE total eggs	Total eggs / active nests	Total eggs / total nests	Corrected % nest success	Relative production rate
1985	49	24.57	291	110	60.3%	483	9.41	4,540	**5,023**	1,751	**10,046**	3,771	2.00	2.00	100%	110%
1986	46	22.16	194	77	66.6%	291	9.41	2,739	**3,030**	1,104	**5,658**	2,249	1.87	1.87	100%	103%
1987	37	12.67	113	112	70.1%	161	9.41	1,515	**1,676**	1,518	**1,676**	1,518	1.00	1.00	100%	55%
1988	32	10.48	68	68	57.9%	118	9.41	1,109	**1,227**	1,112	**2,453**	2,224	2.00	2.00	100%	110%
1989	23	7.45	577	284	54.7%	1,054	9.41	9,911	**10,964**	4,879	**20,427**	9,160	1.86	1.86	100%	103%
1990	33	10.70	335	168	60.3%	554	9.41	5,214	**5,769**	2,666	**9,230**	4,772	1.60	1.60	100%	88%
1991	36	11.66	123	85	63.3%	194	9.41	1,824	**2,018**	1,277	**2,978**	1,963	1.48	1.48	100%	81%
1992	42	13.39	748	235	61.1%	1,225	9.42	11,534	**12,758**	3,918	**24,279**	7,164	1.90	1.90	100%	105%
1993	47	15.23	893	482	43.2%	2,066	9.49	19,594	**21,660**	10,351	**49,285**	22,617	2.28	2.28	100%	126%
1994	41	13.27	323	163	59.5%	544	9.64	5,239	**5,782**	2,684	**13,466**	6,569	2.33	2.33	100%	128%
1995	50	22.56	539	165	56.1%	961	9.41	9,036	**9,996**	3,030	**19,991**	6,343	2.00	2.00	100%	110%
1996	54	19.44	221	85	52.5%	421	8.67	3,648	**4,068**	1,508	**7,547**	2,892	1.86	1.86	100%	102%
1997	72	23.31	154	78	64.6%	238	8.91	2,118	**2,355**	1,131	**4,710**	2,261	2.00	2.00	100%	110%
1998	64	20.71	691	193	51.3%	1,348	8.72	11,747	**13,094**	3,353	**28,923**	7,620	2.21	2.21	100%	122%
1999	53	16.97	591	170	49.6%	1,190	8.73	10,390	**11,580**	3,266	**23,034**	6,548	1.99	1.99	100%	110%
2000	80	25.86	277	90	58.6%	473	8.52	4,028	**4,500**	1,431	**8,198**	2,591	1.82	1.82	100%	100%
2001	81	26.23	682	269	26.0%	2,623	8.06	21,149	**23,772**	13,624	**35,683**	17,293	1.92	1.50	78%	83%
2002	84	27.15	1,529	434	37.4%	4,091	8.01	32,781	**36,872**	10,505	**75,148**	21,061	2.04	2.04	100%	112%
2003	83	26.87	506	136	49.2%	1,028	8.18	8,409	**9,436**	2,351	**19,180**	5,604	2.03	2.03	100%	112%
2004	81	26.22	737	137	41.2%	1,789	7.61	13,609	**15,398**	3,441	**22,248**	4,233	1.77	1.44	82%	80%
2005	83	26.87	1,199	258	60.4%	1,985	7.32	14,523	**16,509**	3,035	**27,956**	4,635	1.69	1.69	100%	93%
2006	75	24.28	884	175	42.4%	2,087	7.01	14,621	**16,708**	3,446	**32,248**	6,530	1.93	1.93	100%	106%
2007	79	25.58	923	169	51.1%	1,806	6.62	11,954	**13,759**	2,344	**25,420**	4,687	1.85	1.85	100%	102%
2008	82	26.55	647	170	53.4%	1,213	6.62	8,027	**9,240**	2,423	**16,391**	4,254	1.77	1.77	100%	98%
2009	81	26.24	1,309	463	44.3%	2,956	6.62	19,568	**22,524**	6,416	**32,018**	9,483	1.75	1.42	81%	78%
2010	66	21.37	971	216	42.1%	2,305	6.62	15,255	**17,560**	4,596	**22,297**	5,397	1.74	1.27	73%	70%

RTLO Red-throated Loon



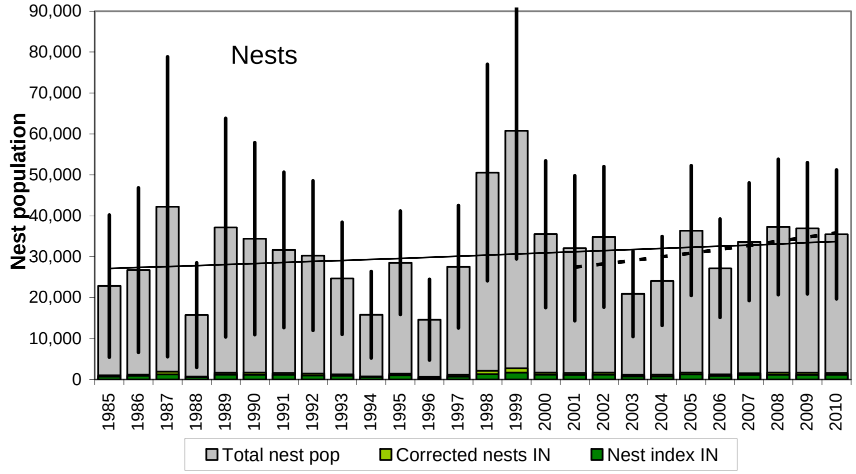
1985-2010 avg annual growth rate= 1.009 (90%c.i.= 0.990-1.028)
2001-2010 last 10 yrs annual growth rate= 1.059 (90%c.i.= 1.026-1.091)



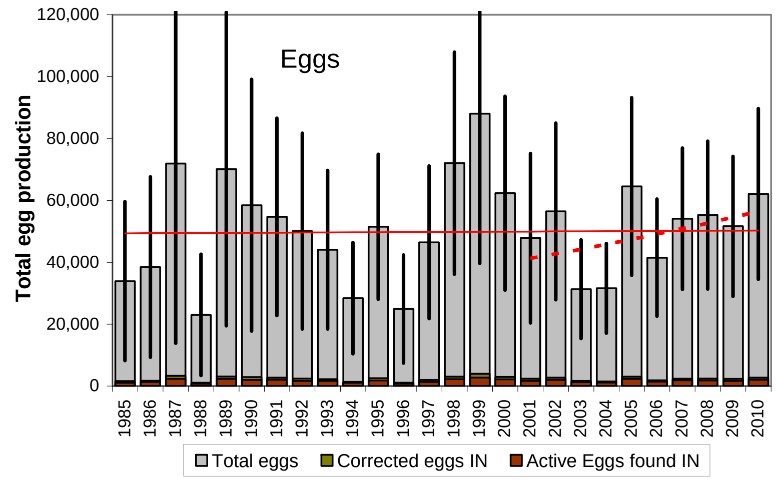
1985-2010 avg annual growth rate= 1.001 (90%c.i.= 0.982-1.020)
2001-2010 last 10 yrs annual growth rate= 1.064 (90%c.i.= 1.019-1.109)

Year	N plots	Sampled km2	Nest index IN	SE nest index IN	Avg nest detection rate	Corrected nests IN	7yr avg Aerial OUT:IN ratio	Corrected nests OUT	**Total nests IN+OUT**	SE total nests	**Total eggs IN+OUT**	SE total eggs	Total eggs / active nests	Total eggs / total nests	Corrected % nest success	Relative production rate
1985	49	24.57	300	126	68.7%	437	7.84	3,426	**3,863**	2,298	**5,738**	3,405	1.64	1.49	90%	92%
1986	46	22.16	381	160	74.4%	511	7.84	4,009	**4,520**	2,672	**6,504**	3,865	1.64	1.44	88%	89%
1987	37	12.67	516	234	63.9%	808	7.84	6,331	**7,139**	4,631	**12,164**	7,519	1.95	1.70	88%	106%
1988	32	10.48	221	103	73.5%	301	7.84	2,361	**2,663**	1,653	**3,892**	2,494	1.66	1.46	88%	91%
1989	23	7.45	523	236	72.9%	718	8.24	5,917	**6,635**	3,345	**12,539**	6,339	1.89	1.89	100%	117%
1990	33	10.70	481	200	66.6%	722	7.62	5,500	**6,223**	2,849	**10,567**	4,919	1.82	1.70	93%	105%
1991	36	11.66	441	172	71.9%	613	7.64	4,686	**5,299**	2,177	**9,153**	3,683	1.86	1.73	93%	107%
1992	42	13.39	389	157	66.8%	582	7.45	4,336	**4,918**	2,009	**8,138**	3,442	1.86	1.65	89%	103%
1993	47	15.23	358	144	71.8%	498	6.92	3,449	**3,947**	1,507	**7,037**	2,776	1.92	1.78	93%	111%
1994	41	13.27	208	100	77.2%	269	7.64	2,055	**2,324**	1,035	**4,175**	1,787	1.80	1.80	100%	111%
1995	50	22.56	378	124	73.0%	518	7.74	4,007	**4,524**	1,455	**8,171**	2,669	1.81	1.81	100%	112%
1996	54	19.44	172	71	71.6%	240	7.37	1,772	**2,013**	817	**3,432**	1,439	1.71	1.71	100%	106%
1997	72	23.31	281	97	63.7%	440	7.06	3,110	**3,550**	1,239	**5,988**	2,052	1.91	1.69	88%	105%
1998	64	20.71	526	167	61.5%	855	6.56	5,613	**6,468**	2,207	**9,224**	3,034	1.87	1.43	76%	88%
1999	53	16.97	673	205	61.8%	1,089	6.21	6,759	**7,847**	2,570	**11,369**	3,916	1.81	1.45	80%	90%
2000	80	25.86	509	145	71.2%	715	5.17	3,698	**4,413**	1,321	**7,749**	2,310	1.89	1.76	93%	109%
2001	81	26.23	476	146	68.4%	695	4.84	3,365	**4,060**	1,200	**6,055**	1,854	1.62	1.49	92%	92%
2002	84	27.15	512	139	71.7%	715	5.53	3,954	**4,668**	1,266	**7,562**	2,105	1.72	1.62	94%	100%
2003	83	26.87	316	102	66.4%	476	5.83	2,773	**3,249**	1,062	**4,864**	1,613	1.73	1.50	86%	93%
2004	81	26.22	355	102	64.9%	547	5.94	3,253	**3,801**	1,090	**4,992**	1,448	1.72	1.31	76%	81%
2005	83	26.87	666	186	74.8%	890	6.05	5,387	**6,277**	1,732	**11,138**	3,118	1.81	1.77	98%	110%
2006	75	24.28	469	135	72.0%	652	6.16	4,013	**4,665**	1,301	**7,124**	2,037	1.72	1.53	89%	95%
2007	79	25.58	575	158	73.4%	782	6.16	4,819	**5,601**	1,547	**9,004**	2,462	1.74	1.61	92%	100%
2008	82	26.55	600	169	69.2%	866	6.16	5,338	**6,204**	1,762	**9,198**	2,558	1.64	1.48	91%	92%
2009	81	26.24	569	157	66.3%	859	6.16	5,291	**6,149**	1,721	**8,593**	2,418	1.73	1.40	81%	87%
2010	66	21.37	596	174	72.3%	824	6.16	5,076	**5,900**	1,681	**10,333**	2,937	1.85	1.75	95%	109%

PALO Pacific Loon



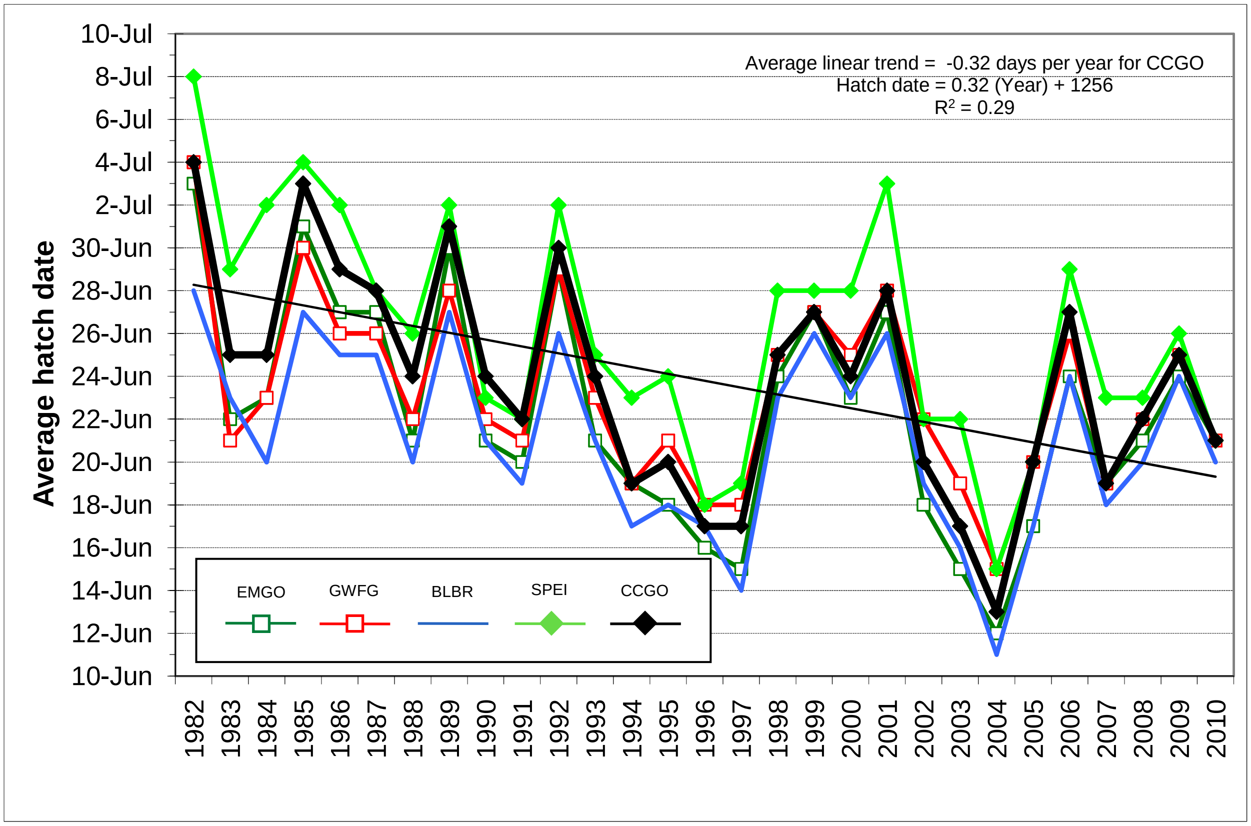
1985-2010 avg annual growth rate= 1.009 (90%c.i.= 0.990-1.027)
2001-2010 last 10 yrs annual growth rate= 1.030 (90%c.i.= 0.995-1.066)



1985-2010 avg annual growth rate= 1.001 (90%c.i.= 0.983-1.019)
2001-2010 last 10 yrs annual growth rate= 1.035 (90%c.i.= 0.989-1.082)

Year	N plots	Sampled km2	Nest index IN	SE nest index IN	Avg nest detection rate	Corrected nests IN	7yr avg Aerial OUT:IN ratio	Corrected nests OUT	**Total nests IN+OUT**	SE total nests	**Total eggs IN+OUT**	SE total eggs	Total eggs / active nests	Total eggs / total nests	Corrected % nest success	Relative production rate
1985	49	24.57	719	290	68.7%	1,046	20.83	21,796	**22,843**	10,554	**33,928**	15,613	1.64	1.49	90%	92%
1986	46	22.16	911	367	74.4%	1,224	20.83	25,506	**26,730**	12,226	**38,457**	17,741	1.64	1.44	88%	89%
1987	37	12.67	1,235	540	63.9%	1,933	20.83	40,280	**42,213**	22,293	**71,927**	35,319	1.95	1.70	88%	106%
1988	32	10.48	530	238	73.5%	721	20.83	15,023	**15,745**	7,782	**23,017**	11,935	1.66	1.46	88%	91%
1989	23	7.45	1,207	521	72.9%	1,656	21.42	35,463	**37,119**	16,241	**70,148**	30,812	1.89	1.89	100%	117%
1990	33	10.70	1,125	442	66.6%	1,689	19.37	32,720	**34,409**	14,264	**58,432**	24,749	1.82	1.70	93%	105%
1991	36	11.66	1,155	400	71.9%	1,607	18.71	30,067	**31,674**	11,555	**54,708**	19,399	1.86	1.73	93%	107%
1992	42	13.39	1,001	359	66.8%	1,498	19.21	28,775	**30,273**	11,093	**50,095**	19,226	1.86	1.65	89%	103%
1993	47	15.23	911	310	71.8%	1,269	18.48	23,465	**24,734**	8,339	**44,099**	15,566	1.92	1.78	93%	111%
1994	41	13.27	601	252	77.2%	779	19.31	15,041	**15,820**	6,419	**28,424**	10,937	1.80	1.80	100%	111%
1995	50	22.56	1,018	268	73.0%	1,395	19.44	27,114	**28,508**	7,689	**51,490**	14,228	1.81	1.81	100%	112%
1996	54	19.44	454	169	71.6%	633	22.07	13,977	**14,610**	6,012	**24,912**	10,618	1.71	1.71	100%	106%
1997	72	23.31	733	218	63.7%	1,149	22.97	26,407	**27,557**	9,100	**46,476**	14,995	1.91	1.69	88%	105%
1998	64	20.71	1,305	355	61.5%	2,122	22.82	48,423	**50,545**	16,079	**72,076**	21,823	1.87	1.43	76%	88%
1999	53	16.97	1,689	450	61.8%	2,732	21.23	58,009	**60,742**	19,020	**87,999**	29,367	1.81	1.45	80%	90%
2000	80	25.86	1,207	300	71.2%	1,695	19.95	33,814	**35,509**	10,904	**62,344**	19,048	1.89	1.76	93%	109%
2001	81	26.23	1,080	302	68.4%	1,578	19.32	30,483	**32,061**	10,782	**47,816**	16,646	1.62	1.49	92%	92%
2002	84	27.15	1,201	292	71.7%	1,677	19.79	33,182	**34,859**	10,435	**56,469**	17,358	1.72	1.62	94%	100%
2003	83	26.87	749	218	66.4%	1,129	17.53	19,801	**20,930**	6,363	**31,339**	9,702	1.73	1.50	86%	93%
2004	81	26.22	764	191	64.9%	1,176	19.46	22,888	**24,064**	6,616	**31,607**	8,818	1.72	1.31	76%	81%
2005	83	26.87	1,279	320	74.8%	1,709	20.27	34,658	**36,368**	9,656	**64,533**	17,455	1.81	1.77	98%	110%
2006	75	24.28	886	234	72.0%	1,231	21.09	25,955	**27,186**	7,305	**41,516**	11,509	1.72	1.53	89%	95%
2007	79	25.58	1,104	272	73.4%	1,504	21.39	32,157	**33,661**	8,748	**54,108**	13,878	1.74	1.61	92%	100%
2008	82	26.55	1,153	293	69.2%	1,666	21.39	35,618	**37,283**	10,050	**55,272**	14,502	1.64	1.48	91%	92%
2009	81	26.24	1,095	272	66.3%	1,651	21.39	35,304	**36,954**	9,777	**51,642**	13,755	1.73	1.40	81%	87%
2010	66	21.37	1,146	304	72.3%	1,584	21.39	33,870	**35,454**	9,598	**62,093**	16,765	1.85	1.75	95%	109%

Figure 3. Estimated average hatch dates of emperor geese, greater white-fronted geese, black brant, spectacled eiders, and cackling geese, based on egg float angles, 1982-2010. Linear regression on cackling goose hatch date indicates an average linear advance of 0.32 days per year.



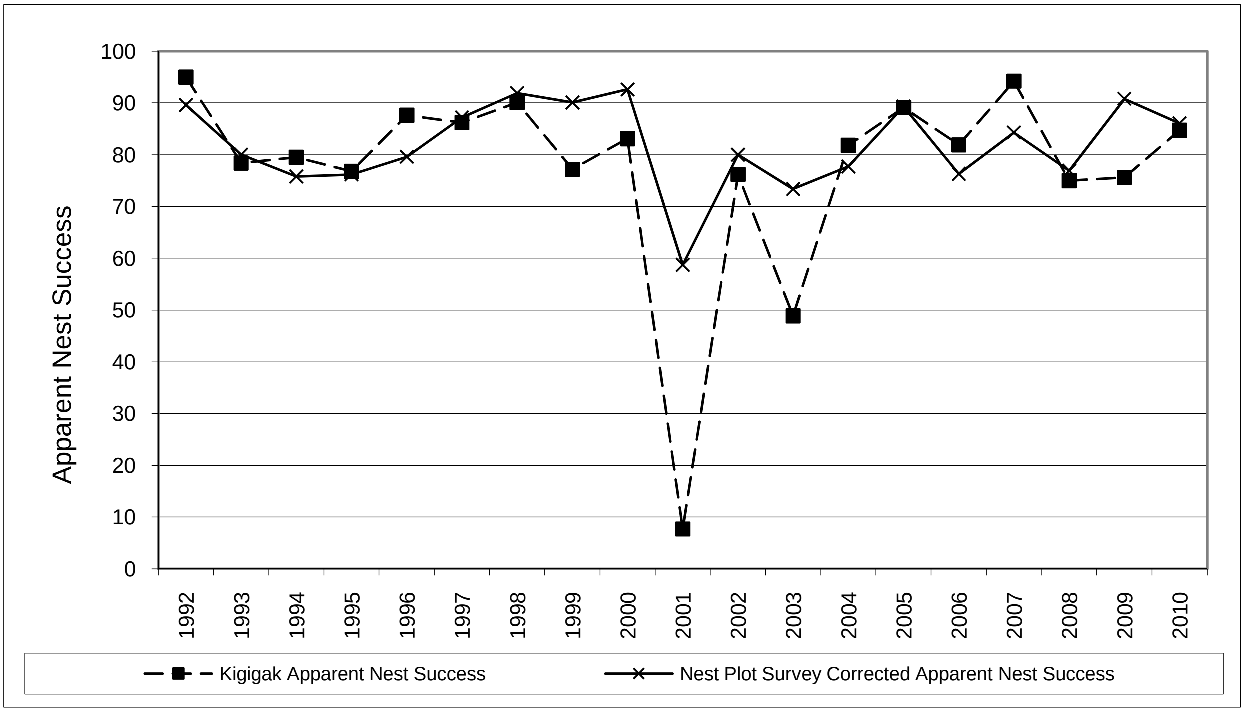


Figure 4. Comparison of spectacled eider apparent nest success measures at Kigigak Island (successful hatched nests/total nests; Gabrielson et al. 2010) and the Yukon-Kuskokwim Delta nest plot survey (active nests at time of search/total nests, corrected for nest detection rate), 1992-2010.

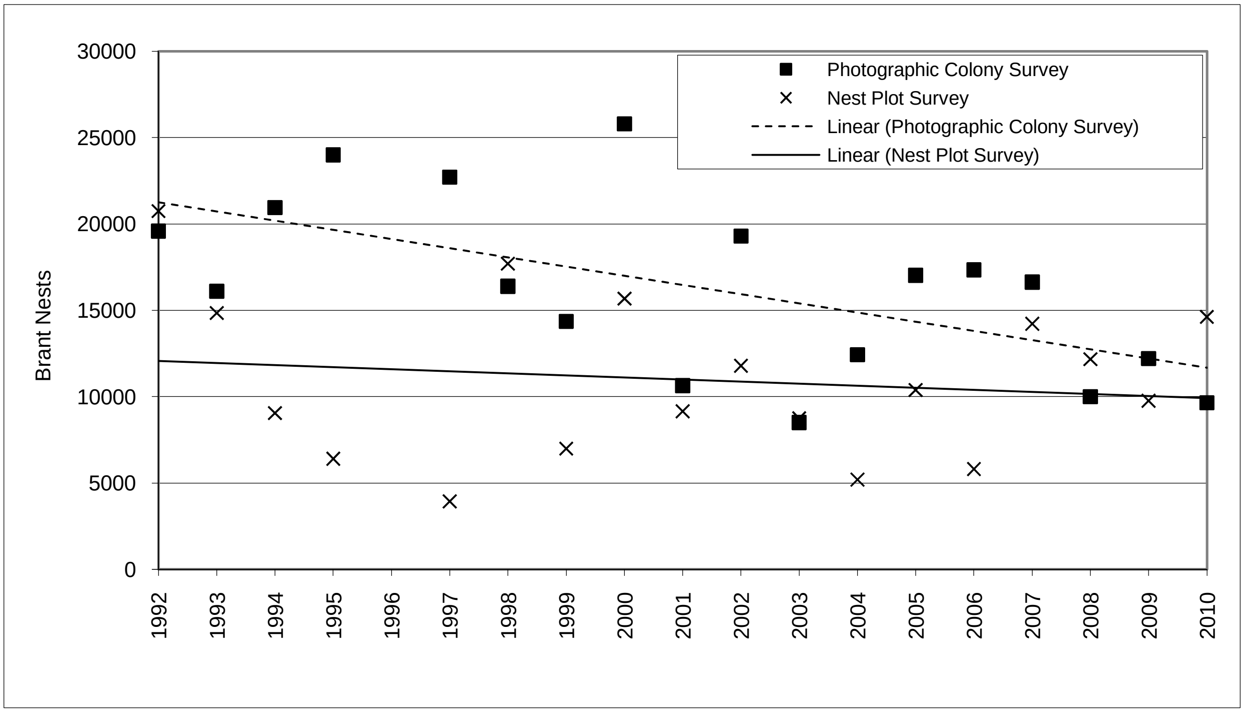


Figure 5. Numbers and trends of black brant nests as measured by an aerial photographic survey in five primary colonies (black squares, dashed line; Wilson 2010) and by the nest plot survey (black crosses, solid line). Nest estimates presented in this figure represent the ground sampled area only, not expanded to entire coastal zone). The aerial photographic survey and ground survey both include the colony at Kigigak Island.

Table 1. Estimated 10-year average (2001-2010) population sizes and growth rates (90% CI) of nests and eggs on the YKD coastal zone (12,832 km^2). Nest and egg estimates are corrected for average nest detection rate. Growth rates significantly different from zero are indicated by bold font.

Species	Mean Nest Population	Nest Population Growth Rate (90% CI)	Mean Egg Production	Egg Production Growth Rate (90% CI)
Cackling Goose	112100	**1.061 (1.031-1.092)**	392058	**1.108 (1.050-1.167)**
Emperor Goose	37059	**1.070 (1.029-1.111)**	165572	**1.088 (1.032-1.143)**
White-fronted Goose	144526	**1.073 (1.048-1.097)**	590393	**1.076 (1.043-1.109)**
Black Brant	33207	1.030 (0.966-1.094)	82384	1.120 (0.997-1.242)
Tundra Swan	11706	0.997 (0.968-1.026)	44209	0.979 (0.917-1.040)
Sandhill Crane	17216	1.028 (0.952-1.104)	31202	1.032 (0.946-1.119)
Spectacled Eider	4920	**1.098 (1.057-1.138)**	19138	**1.137 (1.078-1.196)**
Common Eider	3152	**1.152 (1.082-1.222)**	13412	**1.168 (1.091-1.246)**
Glaucous Gull	17518	1.007 (0.962-1.053)	40840	**1.045 (1.004-1.087)**
Mew Gull	12190	**1.072 (1.016-1.128)**	28892	**1.075 (1.021-1.128)**
Sabine's Gull	14353	1.039 (0.944-1.134)	30832	1.032 (0.909-1.156)
Arctic Tern	18178	0.961 (0.887-1.034)	30859	0.939 (0.871-1.007)
Red-throated Loon	5057	**1.059 (1.026-1.091)**	7886	**1.064 (1.019-1.109)**
Pacific Loon	31882	1.030 (0.995-1.066)	49640	1.035 (0.989-1.082)

Table 2. Estimated 26-year average (1985-2010) population sizes and growth rates (90% CI) of nests and eggs on the YKD coastal zone (12,832 km^2). Nest and egg estimates are corrected for average nest detection rate. Growth rates significantly different from zero are indicated by bold font.

Species	Mean Nest Population	Nest Population Growth Rate (90% CI)	Mean Egg Production	Egg Production Growth Rate (90% CI)
Cackling Goose	87825	**1.044 (1.031-1.057)**	317449	**1.040 (1.020-1.059)**
Emperor Goose	36649	1.010 (0.998-1.023)	165084	1.013 (0.997-1.030)
White-fronted Goose	93706	**1.094 (1.080-1.108)**	388170	**1.094 (1.077-1.111)**
Black Brant	39096	0.998 (0.976-1.021)	105149	1.004 (0.971-1.037)
Tundra Swan	10242	**1.018 (1.010-1.026)**	38261	**1.016 (1.003-1.029)**
Sandhill Crane	17155	1.011 (0.995-1.027)	29323	1.017 (0.999-1.036)
Spectacled Eider	4821	0.998 (0.984-1.011)	18728	1.006 (0.988-1.023)
Common Eider	2046	**1.092 (1.067-1.116)**	8712	**1.098 (1.068-1.128)**
Glaucous Gull	16004	1.012 (0.992-1.032)	36757	1.016 (0.996-1.036)
Mew Gull	10317	1.021 (0.989-1.053)	24259	1.020 (0.988-1.052)
Sabine's Gull	9971	**1.033 (1.011-1.056)**	22225	1.022 (0.995-1.049)
Arctic Tern	11434	**1.055 (1.016-1.095)**	20788	**1.045 (1.004-1.087)**
Red-throated Loon	4882	1.009 (0.990-1.028)	7873	1.064 (0.982-1.020)
Pacific Loon	31456	1.009 (0.990-1.027)	50574	1.001 (0.983-1.019)

Table 3. Estimated nest initiation and hatch date based on egg float angles (1982-2010). Means calculated using nest as sample unit. Years with fewer than 3 nests per species not included in calculations.

Cackling Goose

Year	Mean Initiation	90% CI (days)	Mean Hatch	90% CI (days)	n (nests)
1982	5-Jun	9.3	4-Jul	6.8	170
1983	25-May	9.5	24-Jun	8.2	428
1984	29-May	9.4	27-Jun	8.5	328
1985	4-Jun	8.0	2-Jul	6.3	278
1986	31-May	8.1	30-Jun	6.3	347
1987	29-May	8.0	28-Jun	6.3	209
1988	26-May	10.7	24-Jun	9.0	88
1989	1-Jun	8.1	30-Jun	6.5	55
1990	25-May	7.8	24-Jun	6.9	195
1991	24-May	7.7	22-Jun	6.5	356
1992	1-Jun	7.1	1-Jul	6.0	397
1993	26-May	7.1	24-Jun	6.0	358
1994	21-May	7.8	19-Jun	6.5	409
1995	22-May	7.0	20-Jun	6.2	725
1996	20-May	7.7	18-Jun	6.7	755
1997	19-May	7.3	17-Jun	6.7	812
1998	27-May	6.1	25-Jun	5.2	889
1999	29-May	7.3	27-Jun	6.4	772
2000	27-May	6.8	25-Jun	6.0	1014
2001	31-May	6.3	28-Jun	5.8	522
2002	22-May	6.4	20-Jun	5.3	930
2003	19-May	9.1	17-Jun	7.9	562
2004	16-May	7.9	14-Jun	7.1	964
2005	22-May	8.4	20-Jun	7.4	957
2006	29-May	6.4	27-Jun	5.3	845
2007	21-May	7.1	19-Jun	6.2	1027
2008	25-May	6.1	23-Jun	5.2	906
2009	27-May	6.4	25-Jun	5.6	1374
2010	23-May	6.5	21-Jun	5.7	773
Mean	25-May		23-Jun		

Emperor Geese

Year	Mean Initiation	90% CI (days)	Mean Hatch	90% CI (days)	n (nests)
1982	5-Jun	8.2	4-Jul	6.4	71
1983	22-May	9.3	20-Jun	7.7	177
1984	26-May	10.3	24-Jun	8.2	161
1985	2-Jun	7.6	1-Jul	5.7	107
1986	29-May	7.4	27-Jun	5.6	197
1987	30-May	7.3	27-Jun	5.5	142
1988	24-May	8.9	22-Jun	6.8	102
1989	1-Jun	8.1	30-Jun	6.0	63
1990	23-May	8.6	21-Jun	6.5	100
1991	22-May	7.2	20-Jun	6.0	263
1992	1-Jun	6.5	30-Jun	5.0	184
1993	24-May	7.2	21-Jun	5.9	139
1994	21-May	7.4	19-Jun	5.8	192
1995	21-May	7.4	18-Jun	6.0	188
1996	19-May	6.3	17-Jun	5.1	185
1997	18-May	7.5	15-Jun	5.8	153
1998	27-May	6.5	24-Jun	5.2	215
1999	30-May	6.5	27-Jun	5.6	188
2000	26-May	7.2	24-Jun	5.9	280
2001	29-May	7.5	27-Jun	5.4	104
2002	20-May	6.6	17-Jun	5.3	249
2003	18-May	8.6	15-Jun	6.8	153
2004	15-May	7.7	13-Jun	6.2	253
2005	19-May	9.4	17-Jun	7.2	303
2006	27-May	6.3	24-Jun	5.0	253
2007	21-May	7.0	19-Jun	5.4	275
2008	24-May	6.9	22-Jun	5.2	240
2009	26-May	6.5	24-Jun	5.1	349
2010	23-May	6.4	20-Jun	5.2	189
Mean	24-May		22-Jun		

Table 3. Estimated nest initiation and hatch date continued.

White-fronted Geese

Year	Mean Initiation	90% CI (days)	Mean Hatch	90% CI (days)	n (nests)
1982	6-Jun	7.0	4-Jul	6.4	14
1983	22-May	7.5	20-Jun	7.1	172
1984	24-May	10.3	22-Jun	8.7	84
1985	31-May	6.6	30-Jun	4.7	42
1986	28-May	7.4	26-Jun	6.6	102
1987	28-May	6.5	26-Jun	5.2	61
1988	25-May	9.0	23-Jun	7.3	32
1989	30-May	8.1	28-Jun	6.2	21
1990	24-May	7.2	22-Jun	6.4	52
1991	23-May	7.9	21-Jun	6.7	138
1992	1-Jun	6.8	30-Jun	5.6	115
1993	26-May	6.3	23-Jun	5.7	84
1994	21-May	8.0	19-Jun	5.9	129
1995	23-May	8.0	21-Jun	6.8	178
1996	21-May	8.6	19-Jun	7.5	144
1997	20-May	8.0	18-Jun	6.6	184
1998	28-May	6.7	25-Jun	5.5	261
1999	30-May	7.6	27-Jun	6.7	208
2000	27-May	8.2	26-Jun	6.6	334
2001	31-May	6.9	28-Jun	5.8	311
2002	24-May	6.3	22-Jun	5.0	306
2003	21-May	8.7	19-Jun	7.4	272
2004	17-May	8.0	16-Jun	6.5	364
2005	23-May	8.0	20-Jun	6.9	438
2006	28-May	7.2	26-Jun	5.9	370
2007	21-May	7.6	19-Jun	6.2	446
2008	25-May	6.8	23-Jun	5.6	327
2009	27-May	6.7	25-Jun	5.6	477
2010	23-May	7.3	21-Jun	6.0	353
Mean	25-May		23-Jun		

Black Brant

Year	Mean Initiation	90% CI (days)	Mean Hatch	90% CI (days)	n (nests)
1982	--	--	--	--	--
1983	24-May	9.1	19-Jun	6.7	448
1984	30-May	7.4	25-Jun	6.6	440
1985	1-Jun	4.8	27-Jun	6.0	29
1986	30-May	5.6	26-Jun	4.7	131
1987	1-Jun	5.2	25-Jun	3.5	172
1988	25-May	9.0	20-Jun	7.2	51
1989	1-Jun	6.4	27-Jun	5.6	40
1990	25-May	5.8	22-Jun	6.2	130
1991	24-May	6.6	19-Jun	6.0	183
1992	1-Jun	6.5	27-Jun	5.9	152
1993	26-May	6.0	21-Jun	5.5	107
1994	21-May	6.8	17-Jun	5.9	93
1995	23-May	7.7	18-Jun	6.7	41
1996	23-May	6.4	18-Jun	4.9	44
1997	19-May	7.6	14-Jun	7.0	100
1998	28-May	6.5	23-Jun	5.5	260
1999	31-May	7.2	26-Jun	6.6	108
2000	29-May	6.3	24-Jun	5.7	216
2001	1-Jun	6.2	26-Jun	5.5	77
2002	24-May	7.5	19-Jun	6.6	163
2003	21-May	8.2	16-Jun	7.5	56
2004	17-May	8.5	12-Jun	7.9	101
2005	22-May	6.9	17-Jun	6.6	148
2006	29-May	6.5	23-Jun	5.7	123
2007	22-May	7.1	17-Jun	6.1	147
2008	27-May	5.9	21-Jun	5.3	103
2009	29-May	7.7	24-Jun	6.7	202
2010	25-May	7.9	20-Jun	7.0	134
Mean	26-May		21-Jun		

Table 3. Estimated nest initiation and hatch date continued.

Tundra Swan

Year	Mean Initiation	90% CI (days)	Mean Hatch	90% CI (days)	n (nests)
1982	2-Jun	10.1	5-Jul	9.6	11
1983	19-May	6.3	24-Jun	6.5	11
1984	23-May	10.2	26-Jun	9.7	9
1985	31-May	8.0	4-Jul	7.0	14
1986	25-May	8.7	28-Jun	8.6	24
1987	27-May	7.1	30-Jun	6.5	12
1988	23-May	11.9	26-Jun	10.6	5
1989	27-May	3.2	2-Jul	2.7	4
1990	22-May	4.1	24-Jun	3.6	4
1991	21-May	9.8	25-Jun	9.5	12
1992	29-May	9.0	1-Jul	8.8	9
1993	22-May	7.4	26-Jun	7.7	6
1994	18-May	8.7	22-Jun	7.5	9
1995	23-May	4.6	26-Jun	4.7	9
1996	17-May	8.4	20-Jun	9.3	9
1997	18-May	7.6	21-Jun	5.8	13
1998	28-May	8.4	30-Jun	7.7	20
1999	29-May	7.1	1-Jul	7.1	14
2000	24-May	8.4	27-Jun	7.6	22
2001	28-May	9.2	1-Jul	9.0	16
2002	22-May	5.2	26-Jun	4.9	10
2003	13-May	7.2	18-Jun	6.5	21
2004	14-May	8.1	20-Jun	7.7	16
2005	21-May	7.9	23-Jun	6.8	18
2006	29-May	6.0	1-Jul	6.9	14
2007	21-May	7.2	24-Jun	6.7	19
2008	26-May	6.2	29-Jun	5.3	19
2009	29-May	7.7	2-Jul	6.6	19
2010	23-May	8.3	27-Jun	8.5	14
Mean	23-May		26-Jun		

Sandhill Crane

Year	Mean Initiation	90% CI (days)	Mean Hatch	90% CI (days)	n (nests)
1982	24-May	2.0	24-Jun	2.0	4
1983	23-May	11.9	22-Jun	11.5	21
1984	19-May	4.5	20-Jun	8.5	9
1985	30-May	7.0	30-Jun	6.6	13
1986	27-May	8.8	26-Jun	9.3	26
1987	25-May	8.6	24-Jun	8.4	16
1988	20-May	4.4	20-Jun	4.4	6
1989	19-May	3.3	19-Jun	3.3	2
1990	19-May	4.4	18-Jun	4.5	9
1991	16-May	7.1	16-Jun	7.0	25
1992	30-May	5.2	30-Jun	5.2	11
1993	19-May	4.6	19-Jun	4.8	14
1994	14-May	2.1	14-Jun	2.6	5
1995	18-May	9.0	17-Jun	8.7	10
1996	15-May	5.9	15-Jun	5.8	14
1997	15-May	7.3	14-Jun	7.2	8
1998	20-May	4.5	20-Jun	4.5	19
1999	23-May	4.9	23-Jun	4.5	12
2000	20-May	7.1	20-Jun	7.0	22
2001	21-May	2.5	20-Jun	1.9	7
2002	19-May	10.5	19-Jun	10.5	12
2003	13-May	9.6	13-Jun	9.6	13
2004	16-May	6.8	16-Jun	6.5	10
2005	15-May	6.4	15-Jun	6.4	23
2006	23-May	8.9	23-Jun	8.5	19
2007	12-May	7.8	12-Jun	7.8	16
2008	21-May	4.3	21-Jun	4.2	12
2009	23-May	8.8	22-Jun	8.9	20
2010	18-May	5.3	18-Jun	5.5	17
Mean	19-May		19-Jun		

Table 3. Estimated nest initiation and hatch date continued.

Spectacled Eider

Year	Mean Initiation	90% CI (days)	Mean Hatch	90% CI (days)	n (nests)
1982	13-Jun	9.4	8-Jul	5.2	18
1983	28-May	12.3	24-Jun	11.6	35
1984	6-Jun	9.1	30-Jun	8.8	9
1985	7-Jun	9.0	4-Jul	7.6	20
1986	8-Jun	10.7	3-Jul	9.0	38
1987	31-May	8.2	28-Jun	7.4	28
1988	30-May	6.8	27-Jun	7.0	19
1989	4-Jun	10.6	2-Jul	9.0	5
1990	26-May	5.4	23-Jun	4.9	15
1991	24-May	10.1	22-Jun	9.3	25
1992	4-Jun	7.5	3-Jul	6.0	18
1993	28-May	7.1	24-Jun	7.3	18
1994	26-May	13.0	23-Jun	11.2	15
1995	26-May	8.0	24-Jun	7.3	44
1996	22-May	7.1	19-Jun	6.9	33
1997	23-May	8.1	19-Jun	7.2	39
1998	31-May	8.6	28-Jun	7.4	52
1999	31-May	10.3	28-Jun	9.7	51
2000	31-May	8.2	28-Jun	8.0	52
2001	6-Jun	8.8	3-Jul	6.7	32
2002	24-May	7.4	21-Jun	6.5	59
2003	25-May	11.0	22-Jun	10.1	36
2004	19-May	10.3	16-Jun	9.3	57
2005	24-May	9.2	20-Jun	8.7	101
2006	1-Jun	9.4	29-Jun	8.5	78
2007	26-May	8.8	23-Jun	8.0	68
2008	27-May	10.2	24-Jun	9.3	73
2009	30-May	9.2	26-Jun	8.3	124
2010	24-May	7.5	21-Jun	6.8	71
Mean	29-May		25-Jun		

Common Eider

Year	Mean Initiation	90% CI (days)	Mean Hatch	90% CI (days)	n (nests)
1982	11-Jun	3.0	9-Jul	1.4	4
1983	29-May	5.6	26-Jun	6.2	3
1984	--	--	--	--	--
1985	--	--	--	--	--
1986	--	--	--	--	--
1987	1-Jun	5.3	29-Jun	5.7	10
1988	--	--	--	--	--
1989	2-Jun	7.4	2-Jul	6.1	4
1990	23-May	3.3	22-Jun	2.1	3
1991	28-May	5.9	26-Jun	5.7	27
1992	4-Jun	6.2	3-Jul	5.3	12
1993	25-May	5.4	24-Jun	5.2	5
1994	26-May	10.1	24-Jun	9.2	9
1995	25-May	11.2	23-Jun	10.7	13
1996	22-May	11.1	20-Jun	10.5	14
1997	22-May	9.4	19-Jun	8.0	15
1998	30-May	6.8	28-Jun	6.2	18
1999	2-Jun	9.5	30-Jun	9.8	12
2000	1-Jun	5.8	30-Jun	4.9	23
2001	2-Jun	7.6	30-Jun	7.0	23
2002	25-May	7.7	24-Jun	6.8	17
2003	25-May	12.1	22-Jun	10.8	16
2004	21-May	9.5	18-Jun	8.7	18
2005	21-May	8.4	19-Jun	8.2	34
2006	2-Jun	7.7	1-Jul	6.8	52
2007	22-May	7.2	20-Jun	6.9	50
2008	27-May	7.4	25-Jun	6.8	34
2009	28-May	5.7	26-Jun	5.5	33
2010	26-May	5.7	24-Jun	5.4	41
Mean	27-May		25-Jun		

Table 3. Estimated nest initiation and hatch date continued.

Pacific Loon, Red-throated Loon

Year	Mean Initiation	90% CI (days)	Mean Hatch	90% CI (days)	n (nests)
1982	13-Jun	7.7	8-Jul	3.7	25
1983	2-Jun	11.7	29-Jun	9.9	16
1984	5-Jun	6.3	3-Jul	6.3	5
1985	12-Jun	10.9	7-Jul	6.7	15
1986	8-Jun	9.3	5-Jul	6.2	38
1987	5-Jun	6.5	3-Jul	5.9	35
1988	31-May	11.2	28-Jun	11.7	5
1989	5-Jun	12.3	2-Jul	10.4	5
1990	3-Jun	6.8	1-Jul	6.6	11
1991	29-May	7.1	26-Jun	6.9	21
1992	9-Jun	7.0	6-Jul	4.8	15
1993	28-May	6.9	25-Jun	6.6	12
1994	27-May	6.0	24-Jun	5.7	6
1995	29-May	5.7	26-Jun	5.4	10
1996	27-May	7.2	23-Jun	7.3	9
1997	25-May	6.6	22-Jun	6.5	17
1998	3-Jun	8.5	30-Jun	8.0	37
1999	5-Jun	8.6	3-Jul	8.1	48
2000	3-Jun	7.8	1-Jul	7.7	40
2001	6-Jun	8.4	4-Jul	7.2	27
2002	29-May	6.2	26-Jun	5.9	42
2003	27-May	8.9	24-Jun	9.0	14
2004	27-May	9.7	24-Jun	9.4	10
2005	30-May	10.3	27-Jun	10.0	42
2006	4-Jun	4.1	2-Jul	4.0	22
2007	27-May	7.1	24-Jun	7.3	31
2008	1-Jun	8.5	29-Jun	8.1	46
2009	4-Jun	8.4	1-Jul	7.9	35
2010	31-May	6.4	28-Jun	6.2	28
Mean	1-Jun		29-Jun		

Glaucous Gull

Year	Mean Initiation	90% CI (days)	Mean Hatch	90% CI (days)	n (nests)
1982	11-Jun	8.0	5-Jul	6.2	23
1983	28-May	10.4	21-Jun	9.9	19
1984	30-May	4.8	25-Jun	9.7	8
1985	8-Jun	6.1	3-Jul	6.3	23
1986	2-Jun	8.0	27-Jun	7.4	19
1987	3-Jun	8.4	27-Jun	8.1	19
1988	29-May	8.9	23-Jun	9.1	9
1989	28-May	0.0	22-Jun	0.0	3
1990	24-May	2.5	19-Jun	4.1	3
1991	24-May	7.2	18-Jun	7.3	26
1992	3-Jun	5.9	27-Jun	5.6	24
1993	26-May	9.9	20-Jun	9.4	11
1994	23-May	7.5	17-Jun	7.0	17
1995	24-May	4.2	17-Jun	4.4	17
1996	22-May	4.3	15-Jun	4.2	15
1997	23-May	8.8	17-Jun	8.2	19
1998	28-May	7.5	22-Jun	7.2	64
1999	2-Jun	9.5	26-Jun	9.1	25
2000	29-May	8.8	23-Jun	8.6	72
2001	31-May	7.9	24-Jun	7.9	50
2002	23-May	7.7	17-Jun	7.4	56
2003	20-May	7.8	13-Jun	7.4	58
2004	17-May	7.2	11-Jun	7.0	21
2005	20-May	8.0	14-Jun	7.7	69
2006	31-May	8.6	24-Jun	8.3	46
2007	22-May	7.2	15-Jun	7.1	76
2008	27-May	7.2	21-Jun	6.8	67
2009	29-May	7.7	23-Jun	7.6	59
2010	27-May	9.1	20-Jun	8.5	28
Mean	27-May		21-Jun		

Table 3. Estimated nest initiation and hatch date continued.

Mew Gull

Year	Mean Initiation	90% CI (days)	Mean Hatch	90% CI (days)	n (nests)
1982	17-Jun	4.6	9-Jul	1.9	11
1983	30-May	11.3	23-Jun	11.0	9
1984	--	--	--	--	--
1985	11-Jun	7.2	4-Jul	6.4	8
1986	7-Jun	13.0	2-Jul	10.6	18
1987	2-Jun	8.5	26-Jun	7.4	8
1988	25-May	7.1	19-Jun	6.5	4
1989	--	--	--	--	--
1990	--	--	--	--	--
1991	26-May	7.6	20-Jun	8.1	8
1992	4-Jun	5.1	28-Jun	4.9	10
1993	31-May	9.3	24-Jun	8.9	7
1994	21-May	6.4	15-Jun	6.1	8
1995	24-May	3.3	18-Jun	3.5	16
1996	21-May	6.0	15-Jun	5.5	10
1997	25-May	5.7	19-Jun	5.7	8
1998	30-May	7.0	24-Jun	6.5	19
1999	1-Jun	9.1	25-Jun	8.8	25
2000	1-Jun	8.4	26-Jun	8.0	17
2001	2-Jun	8.7	27-Jun	8.2	18
2002	22-May	8.3	16-Jun	8.0	40
2003	23-May	8.3	17-Jun	8.1	20
2004	21-May	4.4	14-Jun	3.9	19
2005	26-May	8.9	19-Jun	8.5	32
2006	2-Jun	9.3	26-Jun	9.1	45
2007	24-May	8.3	18-Jun	7.8	32
2008	27-May	7.2	20-Jun	6.9	42
2009	30-May	7.4	24-Jun	7.2	54
2010	26-May	5.4	20-Jun	5.1	44
Mean	29-May		22-Jun		

Sabine's Gull

Year	Mean Initiation	90% CI (days)	Mean Hatch	90% CI (days)	n (nests)
1982	--	--	--	--	--
1983	28-May	11.9	21-Jun	13.0	3
1984	--	--	--	--	--
1985	9-Jun	12.7	2-Jul	9.7	3
1986	31-May	11.2	24-Jun	10.1	7
1987	28-May	10.1	21-Jun	9.1	7
1988	1-Jun	9.6	25-Jun	9.1	8
1989	--	--	--	--	--
1990	--	--	--	--	--
1991	22-May	5.5	15-Jun	5.9	9
1992	--	--	--	--	--
1993	24-May	5.8	17-Jun	5.6	8
1994	18-May	6.6	11-Jun	5.4	6
1995	25-May	9.8	18-Jun	8.6	6
1996	18-May	5.4	12-Jun	4.7	3
1997	21-May	6.7	14-Jun	6.9	8
1998	28-May	10.1	20-Jun	9.4	11
1999	27-May	7.2	20-Jun	7.4	20
2000	30-May	9.8	23-Jun	9.8	7
2001	3-Jun	6.6	27-Jun	6.4	10
2002	21-May	8.4	14-Jun	8.2	28
2003	19-May	7.7	12-Jun	7.5	5
2004	17-May	13.2	10-Jun	12.0	3
2005	23-May	9.7	16-Jun	9.3	30
2006	28-May	3.9	22-Jun	3.7	23
2007	24-May	8.9	17-Jun	8.2	30
2008	25-May	7.0	18-Jun	6.7	17
2009	29-May	10.0	22-Jun	9.6	17
2010	22-May	3.0	15-Jun	2.6	20
Mean	26-May		19-Jun		

Table 3. Estimated nest initiation and hatch date continued.

Arctic Tern

Year	Mean Initiation	90% CI (days)	Mean Hatch	90% CI (days)	n (nests)
1982	--	--	--	--	--
1983	--	--	--	--	--
1984	--	--	--	--	--
1985	6-Jun	6.1	29-Jun	5.7	8
1986	3-Jun	14.7	26-Jun	13.7	6
1987	1-Jun	4.7	24-Jun	4.7	3
1988	--	--	--	--	--
1989	--	--	--	--	--
1990	--	--	--	--	--
1991	24-May	4.8	17-Jun	4.8	4
1992	8-Jun	8.6	2-Jul	8.1	6
1993	23-May	2.8	17-Jun	3.9	3
1994	--	--	--	--	--
1995	23-May	4.7	16-Jun	5.1	3
1996	--	--	--	--	--
1997	--	--	--	--	--
1998	3-Jun	10.5	26-Jun	10.0	5
1999	2-Jun	5.2	26-Jun	5.1	8
2000	3-Jun	4.8	26-Jun	4.8	5
2001	29-May	7.7	22-Jun	8.2	5
2002	25-May	6.2	18-Jun	5.8	37
2003	21-May	7.8	13-Jun	7.2	5
2004	25-May	11.5	17-Jun	10.9	9
2005	28-May	8.1	21-Jun	7.7	15
2006	30-May	5.9	23-Jun	5.7	17
2007	23-May	7.5	16-Jun	7.3	18
2008	28-May	7.9	21-Jun	7.5	16
2009	2-Jun	7.5	26-Jun	7.4	30
2010	30-May	8.8	22-Jun	8.5	9
Mean	29-May		22-Jun		

Greater Scaup, Long-tailed Duck

Year	Mean Initiation	90% CI (days)	Mean Hatch	90% CI (days)	n (nests)
1982	18-Jun	5.8	10-Jul	0.0	5
1983	--	--	--	--	--
1984	--	--	--	--	--
1985	--	--	--	--	--
1986	7-Jun	5.9	9-Jul	3.4	4
1987	6-Jun	6.7	7-Jul	5.4	4
1988	--	--	--	--	--
1989	--	--	--	--	--
1990	--	--	--	--	--
1991	--	--	--	--	--
1992	7-Jun	6.3	8-Jul	5.4	21
1993	2-Jun	5.7	2-Jul	3.3	18
1994	2-Jun	3.8	2-Jul	1.4	7
1995	3-Jun	7.9	3-Jul	8.7	14
1996	31-May	11.7	29-Jun	9.3	7
1997	27-May	10.4	27-Jun	10.0	10
1998	2-Jun	7.5	4-Jul	6.4	14
1999	8-Jun	8.0	8-Jul	3.9	10
2000	5-Jun	5.5	7-Jul	5.2	26
2001	11-Jun	8.1	7-Jul	4.0	6
2002	31-May	6.0	1-Jul	2.3	8
2003	30-May	3.6	30-Jun	1.3	3
2004	--	--	--	--	--
2005	1-Jun	9.4	1-Jul	7.1	9
2006	3-Jun	6.4	5-Jul	5.2	5
2007	2-Jun	5.0	2-Jul	2.5	5
2008	--	--	--	--	--
2009	3-Jun	9.5	3-Jul	8.1	7
2010	29-May	10.0	29-Jun	10.9	6
Mean	3-Jun		3-Jul		

Table 3. Estimated nest initiation and hatch date continued.

Pintail, Shoveler, Mallard, Teal

Year	Mean Initiation	90% CI (days)	Mean Hatch	90% CI (days)	n (nests)
1982	--	--	--	--	--
1983	--	--	--	--	--
1984	--	--	--	--	--
1985	--	--	--	--	--
1986	6-Jun	8.0	3-Jul	7.4	13
1987	6-Jun	8.4	3-Jul	8.1	12
1988	--	--	--	--	--
1989	9-Jun	0.0	6-Jul	0.0	4
1990	1-Jun	2.5	28-Jun	4.1	4
1991	27-May	7.2	24-Jun	7.3	13
1992	7-Jun	5.9	5-Jul	5.6	18
1993	1-Jun	9.9	28-Jun	9.4	16
1994	31-May	7.5	28-Jun	7.0	5
1995	1-Jun	4.2	27-Jun	4.4	11
1996	28-May	4.3	26-Jun	4.2	10
1997	20-May	8.8	17-Jun	8.2	4
1998	4-Jun	7.5	1-Jul	7.2	39
1999	3-Jun	9.5	2-Jul	9.1	17
2000	3-Jun	8.8	1-Jul	8.6	28
2001	5-Jun	7.9	2-Jul	7.9	13
2002	28-May	7.7	24-Jun	7.4	21
2003	22-May	7.8	20-Jun	7.4	8
2004	21-May	7.2	19-Jun	7.0	19
2005	26-May	8.0	23-Jun	7.7	24
2006	3-Jun	8.6	1-Jul	8.3	15
2007	25-May	7.2	22-Jun	7.1	17
2008	30-May	7.2	27-Jun	6.8	21
2009	31-May	7.7	28-Jun	7.6	16
2010	27-May	9.1	24-Jun	8.5	18
Mean	30-May		27-Jun		

Small Shorebirds

Year	Mean Initiation	90% CI (days)	Mean Hatch	90% CI (days)	n (nests)
1982	--	--	--	--	--
1983	--	--	--	--	--
1984	--	--	--	--	--
1985	13-Jun	12.9	3-Jul	11.6	4
1986	1-Jun	13.3	27-Jun	9.6	23
1987	28-May	5.9	21-Jun	4.7	7
1988	--	--	--	--	--
1989	1-Jun	12.8	24-Jun	11.7	3
1990	--	--	--	--	--
1991	28-May	12.2	22-Jun	11.9	21
1992	3-Jun	4.0	28-Jun	4.2	11
1993	27-May	7.1	20-Jun	6.9	15
1994	--	--	--	--	--
1995	26-May	7.6	19-Jun	7.6	6
1996	27-May	13.7	20-Jun	13.9	10
1997	19-May	3.6	12-Jun	3.4	3
1998	29-May	8.3	22-Jun	7.3	8
1999	31-May	7.0	25-Jun	6.9	17
2000	30-May	7.2	24-Jun	6.4	13
2001	2-Jun	8.3	27-Jun	8.1	22
2002	25-May	5.7	19-Jun	5.8	21
2003	21-May	2.8	15-Jun	2.8	3
2004	20-May	5.9	13-Jun	6.1	10
2005	26-May	7.3	20-Jun	6.7	30
2006	2-Jun	9.0	26-Jun	8.1	29
2007	24-May	7.5	19-Jul	14.5	33
2008	26-May	8.3	20-Jun	7.8	53
2009	1-Jun	8.2	26-Jun	8.0	23
2010	27-May	9.2	21-Jun	8.9	29
Mean	28-May		29-Jun		

Table 4. Numbers and proportions of plots with fox sign (presence of fox, scat, fur, tracks, and active dens) and vole sign (presence of voles, digging, runways), 1988-2010.

Year	Number Plots Sampled	Number Plots with Fox Sign	Number Plots with Vole Sign	Proportion of Plots with Fox Sign	Proportion of Plots with Vole Sign
1988	26	15	10	0.58	0.38
1989	20	8	8	0.40	0.40
1990	30	13	16	0.43	0.53
1991	33	7	12	0.21	0.36
1992	41	15	9	0.37	0.22
1993	45	7	8	0.16	0.18
1994	38	6	4	0.16	0.11
1995	48	21	14	0.44	0.29
1996	44	20	15	0.45	0.34
1997	72	25	18	0.35	0.25
1998	62	21	21	0.34	0.34
1999	53	24	20	0.45	0.38
2000	79	24	62	0.30	0.78
2001	80	71	31	0.89	0.39
2002	84	50	19	0.60	0.23
2003	83	69	44	0.83	0.53
2004	81	53	16	0.65	0.20
2005	83	46	10	0.55	0.12
2006	74	44	11	0.59	0.15
2007	79	26	26	0.33	0.33
2008	82	58	33	0.71	0.40
2009	81	33	58	0.41	0.72
2010	66	28	38	0.42	0.58
Mean	60	30	22	0.46	0.36