Abundance and Trends of Waterbird Breeding Populations on the Arctic Coastal Plain, Alaska, 1986-2017

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ABSTRACT The Arctic Coastal Plain (ACP) Aerial Waterbird Breeding Population Survey provides data on the distribution, abundance, and trend of 33 bird species (including 29 waterbird species) that nest in northern Alaska. Among the species included are threatened Spectacled and Steller's Eiders, Yellow-billed Loons, and Snow Geese. This report focuses on results from the 2014–2017 ACP Surveys, and presents population and growth information for all species from 1986–2017. The respective 2014, 2015, 2016, and 2017 indicated total population indices for Spectacled Eiders were 6,986 (95% CI = 4,926–9,047), 5,496 (95% CI = 4,038–6,955), 4,833 (95% CI =3,276–6,390), and 5,122 (95% CI = 3,633–6,612); and for Steller' Eiders were 47 (95% CI = 0–141), 0 (95% CI = 0–0), 220 (95% CI =0–564), and 168 (95% CI = 0–412). Long-term mean annual indicated total population indices and growth rates for these species and others of conservation concern, were as follows: Spectacled Eiders: (1992–2017) 6,956 birds (95% CI = 6,302–7,610), growth rate: 0.988 (95% CI = 0.977–1.000); Steller's Eiders: (1989–2017) 199 birds (95% CI = 116–282), growth rate: 0.969, (95% CI = 0.913–1.028); Yellow-billed Loons: (1986–2017) 2,006 birds (95% CI = 1,797–2,215), growth rate: 1.013 (95% CI = 1.002–1.024); and Snow Geese: (1986–2017) 13,078 birds (95% CI = 6,313–19,842), growth rate: 1.242 (95% CI = 1.193–1.293). Our population indices do not account for incomplete detection or other sources of bias at this time, though efforts are underway to incorporate detection rates into our total population estimates. The lower 95% confidence bounds for long-term (1986–2017) growth rates of Yellow-billed Loon, Tundra Swan, Greater White-fronted Goose, Snow Goose, Pacific Black Brant, King and Common Eiders, White-winged Scoter, Red-breasted Merganser, Golden Eagle, Glaucous and Sabine's Gulls, Arctic Tern, and Short-eared Owl were all > 1.000 (indicating increase), while upper 95% confidence bounds for Long-tailed Ducks and Black Scoters were <1.000 (indicating decline). Long-term growth rates for all other species were not significantly different from 1.000.

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KEY WORDS: aerial breeding pair survey, Alaska, Arctic Coastal Plain, population index, growth rate, Spectacled Eider *Somateria fischeri*, Steller's Eider *Polysticta stelleri*, Yellow-billed Loon *Gavia adamsii*, Snow Goose *Chen caerulescens,* trend, waterfowl, waterbird.

The Arctic Coastal Plain (ACP) is a vast area of arctic lowland tundra in far northern Alaska that serves as a highly important region for many species of breeding birds (Johnson et al. 2007, Bart et al. 2013); especially waterbirds. Importantly, it is the only regularly used breeding area in Alaska for threatened Steller's Eiders (*Polysticta stelleri*; U. S. Fish and Wildlife Service 2002), and one of only three primary breeding areas for the

threatened Spectacled Eider (*Somateria fischeri*; U. S. Fish and Wildlife Service 1996). Additionally, the ACP hosts many other waterbird species of conservation concern, including Red-throated (*Gavia stellata*) and Yellow-billed Loons (*G. adamsii*), Snow Geese (*Chen caerulescens*), Pacific Black Brant (*Branta bernicla nigricans*), Common Eiders (*S. mollissima*), Black (*Melanitta nigra*) and White-winged Scoters (*Melanitta fusca*), and Long-tailed Ducks (*Clangula hyemalis*).

Annual aerial surveys of waterbirds on the ACP have been conducted since 1986. Prior to 2007, two surveys with different timing and coverage (i.e., the original Arctic Coastal Plain [Original ACP] Survey [1986–2006; Brackney and King 1993, Mallek et al. 2007], and the North Slope Eider [NSE] survey [1992–2006; Larned et al. 2006]) were used to monitor waterbirds on the ACP. In 2007, the two historical surveys were merged (Stehn et al. 2013), and the amalgamated survey (hereafter, "ACP Survey"; Larned et al. 2008, Larned et al. 2012, Stehn et al. 2013, Stehn 2014) has been flown annually since 2007. The survey provides annual data on the distribution, abundance, and growth rate of 33 species of birds, including loons, geese, ducks, jaegers, and selected landbird species breeding in northern Alaska. These results provide population status and distribution information to the Pacific Flyway Council, the Alaska Migratory Bird Co-management Council, Spectacled and Steller's Eider Recovery Teams, U.S. Fish and Wildlife Service, U.S. Geological Survey, Bureau of Land Management, North Slope Borough, various NGO's, consulting firms, and industry. This report focuses on the 2014–2017 surveys, and presents updated population and trend information for all 33 bird species monitored from 1986 to 2017.

METHODS

Survey Design

The ACP Survey study area encompasses 57,339 km^2 of tundra wetlands, extending from the Chukchi Sea coast in the west, to the Canadian border in the east, and from the foothills of the Brooks Range to the Beaufort Sea. As flown since 2007, the ACP Survey is broken into four physiographic-based strata, with a 4-year rotating panel of systematic strip-transects within each stratum (Fig. 1). Herein, the within-strata sampling effort is proportional to bird densities within each stratum; such that fewer transects are surveyed in strata where bird densities are lower. The four-year rotating panel design results in the panel (i.e., group) of transects being shifted by ¼ the inter-transect distance each year. The annual inter-transect distances for each of the four ACP Survey strata are 4.8 km (Teshekpuk High), 9.6 km (High), 19.2 km (Medium), and 28.8 km (Low; Larned et al. 2012, Fig. 1), resulting in average annual sampling fractions of ~7.3%, 3.7%, 1.8%, and 1.1%, in the respective strata. Thus, within a 4-year panel of transects the inter-transect distances for each of the four ACP Survey strata become 1.2 km (Teshekpuk High), 2.4 km (High), 4.8 km (Medium), and 7.2 km (Low); (Larned et al. 2012, Fig. 1), resulting in sampling fractions of ~29.1%, 14.7%, 7.2%, and 4.2%, in the respective strata over a four year period. Total areas of each stratum are Teshekpuk High: 5,654 km^2, High: 20,351 km^2, Medium: 13,065 km^2, and Low: 18,266 km^2.

Survey Methods

The ACP Survey methodology is based on standard operating procedures for the North American Waterfowl Breeding Population and Habitat Survey (USFWS and CWS 1987), with both the left-front seat biologist-pilot and right-front seat observers recording all waterfowl, loons, gulls, and terns seen within 200 m either side of the flight path. To estimate the outer transect boundary, crews determine the required viewing angle trigonometrically and mark a reference point on the wing strut and side window for each observer, using a clinometer and marking tape/pens. Surveys are flown at an approximate ground speed of 161 km/hr (~87 kts; though actual ground speeds vary due to winds), and an altitude of 38 m (125 ft) AGL, as referenced by a radar altimeter installed in the aircraft. Georeferenced observations made from both sides of the aircraft are voice recorded into panel-mounted computers for later transcription using custom software packages (RECORD, TRANSCRIBE; J. I. Hodges, USFWS-Migratory Bird Management, Juneau, AK).

From 2014 to 2017, we used a Cessna 206 amphibious-equipped aircraft [Cessna Aircraft Company, Wichita, KS], and the same survey crew in all four years (Table 1). The survey required 46, 43, 44, and 49 flight hours to complete, respectively, in 2014–2017, not including ferry time to and from the study area.

Survey timing and weather conditions

Timing of survey initiation is intended to coincide with the egg laying/early incubation period of nesting geese and eiders on the ACP, and the peak presence of male ducks and pairs of other species. This is a period when nesting habitat is just becoming available (e.g., ice-free water is visible in most shallow vegetated wetlands, and tundra vegetation is mostly snow-free around pond margins); typically within the first three weeks of June. According to Troy (1997), median nest initiation dates for Spectacled Eiders at Prudhoe Bay averaged 15 June from 1982 to 1996 (with males departing within 3–5 days of median initiation; Troy 1997). Within the first two weeks of June, we refine our precise arrival dates each year based on close monitoring of weather and temperature data, examining snow and ice cover changes via satellite (NASA MODIS) and web-camera imagery (https://avcams.faa.gov/, https://www.teshekpuklake.org/teshekpuk-cam.html), and by receiving updates on current landscape conditions from biologists on the ACP. From 2014–2017, weather conditions varied considerably within and among survey years. Reduced visibility and ceilings due to coastal fog were the most consistent weather impediments to surveying in all years of the survey. Fog was particularly troublesome along the northern coastal fringe of the study area, where on-shore winds (blowing over the ice), small temperature/dew-point spreads, and daily temperature cycles, could instantaneously create low-visibility conditions.

Data Analysis

Population Indices

We calculated population indices as follows:

For dimorphic species (e.g., ducks [except scaup[a]]) and monomorphic cranes, dark geese (e.g., Sand hill Cranes, Greater White-fronted Geese, Canada/Taverner Geese, and Brant).

Indicated breeding birds (IBB) = 2 x (number of singles + number of pairs [b])

Indicated total birds (ITB) = 2 x (number of singles + number of pairs [b]) + flocked birds [c]

For monomorphic species (with the exception of cranes and dark geese, e.g., swans, snow geese, grebes, loons, terns, gulls, and scaup[a])

Breeding birds (BB) = number of singles + (2 x number of pairs [b])

Total birds (TB) = number of singles + (2 x number of pairs [b]) + flocked birds [c]

[a] For scaup, single drakes were not doubled because sex ratios lean heavily towards males (USFWS and CWS 1987)

[b] *number of pairs* = number of male-female pairs, not the total number of birds in pairs

[c] *flocked birds* = a closely associated single-sex or mixed-sex grouping of > 5 ducks or > 2 birds of other species that cannot be separated into singles and pairs.

During data analysis, the aerial observations and transects were intersected with the strata via Geographic Information Systems (GIS). Population estimates (B_j) were calculated per strata using a ratio estimator (Cochran 1977) with transects as the sample units:

$$Bj = \frac{\sum_{k=1}^{n} Ikj}{\sum_{k=1}^{n} Tkj} Aj$$

where I was the number of bird observations recorded within area (T) of transect (k) per stratum (j) with an area (A). Estimates per strata were combined into a population index, including standard error ($\pm$ SE), that was based on the inter-transect variance.

From 1986 to 2014, the sampled area was calculated from the straight-line distances of the designed

transects. However, in 2015–2017, aerial observations were used to construct flight lines, which resulted in a slightly larger sampled area, but accommodated even slight aircraft deviations from the original transects (due to weather avoidance or other factors). From 1986–2014, data analysis was completed with ArcInfo Workstation and True BASIC, using customized code. In 2015–2017 the spatial overlay analysis was performed using ModelBuilder in ArcGIS, while all statistical computations were completed in Excel.

Due to the change in survey design in 2007, the 1986–2006 survey data were reanalyzed to adjust for differences in survey timing and geographic extent (Stehn et al. 2013). Annual estimates were adjusted using a ratio between the early (NSE Survey) versus the late (Original ACP) Survey; reflecting changes in distribution, behavior, group size, and arrival or departure of population components for each species as observed (Stehn et al. 2013). Because separate adjustment ratios for singles, pairs, flocked birds, breeding birds, and total bird indices were applied, the components did not necessarily add to equal the Total Bird or Total Indicated Bird indices. This also resulted in occasional Indicated Breeding Bird indices that were larger than Indicated Total Bird Indices. Spectacled and King Eiders had the highest adjustment ratios, with early-flown densities much greater than later aerial index densities (Stehn et al. 2013).

The full time series (i.e., 1986–2006 adjusted for survey timing and extent, and 2007–2017) are combined in summary figures and tables in this report with a line denoting the transition from older to newer survey design in 2007 (Table 2, Figures 2–34). Population indices presented here do not account for incomplete detection, though efforts to incorporate detection data (collected since 2015) into annual population estimates (Wilson et al. 2017), is underway.

Population Trends

Annual population indices were summarized for each bird species, including the mean, standard deviation, standard error, and 95% confidence intervals. Long-term and ten-year trend lines were generated from log-transformed data using a linear least squares regression. The mean annual growth rate (λ) was calculated from the log-linear slope (s) as $\lambda = e^s$ with 95% confidence intervals. Most species were surveyed in all years (1986–2017), but some had reduced time series, due to differences among early surveys (e.g., Spectacled Eiders were not counted on an appropriately timed survey until 1992). Species with time series <32 years are as follows: Steller's Eider (1989–2017); and Spectacled Eider, Glaucous and Sabine's Gulls, Arctic Tern, Common Raven, and Short-eared Owl (1992–2017).

As of 2018, the analysis methods for this survey were being revised in the R environment (R Core Team 2013). Upon completion of this revision, we expect annual estimates and population trends to differ slightly from those presented here.

RESULTS

Survey timing and weather conditions

Dates of data collection for 2014–2017 were: 10–20, 8–14, 6–13, and 11–19 June, respectively. Survey timing was the earliest on record for the survey in 2016 (6–13 June), and second earliest in the history of the survey in 2015 (8–14 June; Table 2). Both of these years corresponded to mild winters and early phenology of available nesting habitat. In contrast, phenology on the ACP in 2014 and 2017 was 7–10 days delayed relative to 2015 and 2016 and was more similar to historical phenologies (i.e., pre 2014). In 2017, in particular, sustained cold temperatures, strong east winds, and significant snow and ice covered much of the northern ACP landscape into early June, delaying surveying in those areas until 18–19 June (approximately one week after the initiation of the survey on 11 June). By the last two days of the 2017 survey (18–19 June) lake-edge moats and sheet-water began to appear on the landscape, but persistent snow drifts and coastal fog continued to delay survey completion.

Population indices

Red-throated Loon (*Gavia stellata*)

The population index for Red-throated Loons was 1,408 (95% CI = 753–2,062), 2,404 (95% CI = 1,637–3,171), 4,244 (95% CI = 2,867–5,621), and 3,256 (95% CI = 2,297–4,215) in 2014, 2015, 2016, and 2017, respectively (Fig. 2), with a long-term (1986–2017) mean annual index of 2,985 total birds (95% CI = 2,621–3,349; Table 2). From 1986–2017, the mean annual growth rate of Red-throated Loons was 0.994 (95% CI = 0.980–1.007).

Pacific Loon (*Gavia pacifica*)

The population index for Pacific Loons was 34,778 (95% CI = 26,694–39,861), 46,218 (95% CI = 38,764–53,673), 27,090 (95% CI = 23,527–30,652), and 25,425 (95% CI = 21,342–29,508) in 2014, 2015, 2016, and 2017, respectively (Fig. 3), with a long-term (1986–2017) mean annual index of 32,561 total birds (95% CI = 30,587–34,535; Table 2). From 1986–2017, the mean annual growth rate of Pacific Loons was 1.003 (95% CI = 0.997–1.010).

Yellow-billed Loon (*Gavia adamsii*)

The population index (indicated total birds) for Yellow-billed Loons was 2,624 (95% CI = 1,737–3,512), 3,521 (95% CI = 2,583–4,458), 2,121 (95% CI = 1,321–2,921), and 1,311 (95% CI = 725–1,898) in 2014, 2015, 2016, and 2017, respectively (Fig. 4), with a long-term (1986–2017) mean annual index of 2,006 total birds (95% CI = 1,797–2,215; Table 2). From 1986–2017, the mean annual growth rate (total birds) of Yellow-billed Loons was 1.013 (95% CI = 1.002–1.024).

Red-necked Grebe (*Podiceps grisegena*)

The population index for Red-necked Grebes was 55 (95% CI = 0–153), 71 (95% CI = 0–170), 28 (95% CI = 0–81), and 27 (95% CI = 0–80) in 2014, 2015, 2016, and 2017, respectively (Fig. 5), with a long-term (1986–2017) mean annual index of 125 total birds (95% = CI 65–184; Table 2). From 1986–2017, the mean annual growth rate of for Red-necked Grebes was 0.969 (95% CI = 0.925–1.015).

Tundra Swan (*Cygnus columbianus*)

The population index for Tundra Swans was 12,965 (95% CI = 10,840–15,090), 19,921 (95% CI = 11,029–28,812), 17,637 (95% CI = 15,092–20,183), and 16,735 (95% CI = 14,071–19,400) in 2014, 2015, 2016, and 2017, respectively (Fig. 6; Table 2), with a long-term (1986–2017) mean annual index of 10,258 total birds (95% CI = 8,696–11,820; Table 2). From 1986–2017, the mean annual growth rate for Tundra Swans was 1.045 (95% CI = 1.038–1.051).

Greater White-fronted Goose (*Anser albifrons*)

The population index for Greater White-fronted Geese was 144,271 (95% CI = 127,525–161,017) 243,561 (95% CI = 209,003–278,119), 406,515 (95% CI = 338,230–474,800), and 387,991 (95% CI = 330,699–445,283) in 2014, 2015, 2016, and 2017, respectively (Fig. 7), with a long-term (1986–2017) mean annual index of 153,372 indicated total birds (95% CI = 121,931–184,814; Table 2). From 1986–2017, the mean annual growth rate for Greater White-fronted Geese was 1.047 (95% CI = 1.036–1.058).

Snow Goose (*Chen caerulescens*)

The population index for Snow Geese was 22,811 (95% CI = 2,203–43,418), 60,837 (95% CI = 0–123,656), 25,845 (95% CI = 9,757–41,932), and 58,265 (95% CI = 16,409–100,120) in 2014, 2015, 2016, and 2017, respectively (Fig. 8; Table 2), with a long-term (1986–2017) mean annual index of 13,078 total birds (95% CI = 6,313–19,842; Table 2). However, the more recent 10-yr (2008–2017) mean annual index was 31,199 (95% CI = 19,908–42,489; Table 2). From 1986–2017, the mean annual growth rate for Snow Geese was 1.242 (95% CI = 1.193–1.293).

Taverner's Cackling Goose (*Branta hutchinsii taverneri*)

The population index for Taverner's Cackling Geese was 7,110 (95% CI = 4,181–10,039), 8,432 (95% CI = 5,516–11,347), 17,927 (95% CI = 12,665–23,189), and 16,719 (95% CI = 10,294-23,145) in 2014, 2015, 2016, and 2017, respectively (Fig. 9), with a long-term (1986–2017) mean annual index of 10,909 indicated total birds (95% CI = 8,741–13,077). From 1986–2017, the mean annual growth rate for Taverner's Cackling Geese was 1.018 (95% CI = 0.993–1.043).

Pacific Black Brant (*Branta bernicla nigricans*)

The population index for Pacific Black Brant was 11,610 (95% CI = 5,497–17,723), 15,777 (95% CI = 7,836–23,719), 18,095 (95% CI = 9,304–26,886), and 18,192 (95% CI = 10,571–25,813) in 2014, 2015, 2016, and 2017, respectively (Fig. 10; Table 2), with a long-term (1986–2017) mean annual index of 8,634 indicated total birds (95% CI = 6,592–10,675). From 1986–2017, the mean annual growth rate for Pacific Black Brant was 1.084 (95% CI = 1.062–1.105).

Mallard (*Anas platyrhynchos*)

The population index for Mallard ducks was 340 (95% CI = 1–680), 23 (95% CI = 0–67), 1,923 (95% CI = 578–3,268), and 202 (95% CI = 0–487) in 2014, 2015, 2016, and 2017, respectively (Fig. 11), with a long-term (1986–2017) mean annual index of 472 indicated total birds (95% CI = 309–635; Table 2). From 1986–2017, the mean annual growth rate for Mallard ducks was 0.991 (95% CI = 0.941-1.043).

Northern Pintail (*Anas acuta*)

The population index for Northern Pintail was 59,377 (95% CI = 48,665–70,088), 92,056 (95% CI = 74,361–109,750), 105,673 (95% CI = 78,123–133,223), and 71,852 (95% CI = 59,011–84,693) in 2014, 2015, 2016, and 2017, respectively (Fig. 12), with a long-term (1986–2017) mean annual index of 66,630 indicated total birds (95% CI = 59,998–73,262; Table 2). From 1986–2017, the mean annual growth rate for Northern Pintail was 1.004 (95% CI = 0.992–1.016).

American Wigeon (*Anas americana*)

The population index for American Wigeon was 125 (95% CI =0–331), 1,042 (95% CI =379–1,706), 2,025 (95% CI =642–3,409), and 1,358 (95% CI =92–2,624) in 2014, 2015, 2016, and 2017, respectively (Fig. 13), with a long-term (1986–2017) mean annual index of 672 indicated total birds (95% CI = 491–852; Table 2). From 1986–2017, the mean annual growth rate for American Wigeon was 1.015 (95% CI = 0.976-1.056).

Northern Shoveler (*Anas clypeata*)

The population index for Northern Shoveler was 484 (95% CI = 0–984), 1,504 (95% CI = 580–2,429), 1,481 (95% CI = 459–2,503), and 55 (95% CI = 1–164) in 2014, 2015, 2016, and 2017, respectively (Fig. 14), with a long-term (1986–2017) mean annual index of 435 indicated total birds (95% CI = 257–613; Table 2). From 1986–2017, the mean annual growth rate for Northern Shoveler was 1.001 (95% CI = 0.948–1.057).

American Green-winged Teal (*Anas crecca*)

The population index for American Green-winged Teal was 1,384 (95% CI = 460–2,308), 594 (95% CI = 82–1,105), 742 (95% CI = 226–1,257), and 453 (95% CI = 0–1,011) in 2014, 2015, 2016, and 2017, respectively (Fig. 15), with a long-term (1986–2017) mean annual index of 659 indicated total birds (95% CI = 444-–875; Table 2). From 1986–2017, the mean annual growth rate for American Green-winged Teal was 0.986 (95% CI = 0.948–1.024).

Scaup Species (*Aythya affinis* and *A. marila*)

The population index for Scaup species was 21,796 (95% CI = 13,126–30,466), 19,915 (95% CI = 13,061–26,769), 19,195 (95% CI = 12,121–26,270), and 7,541 (95% CI = 4527–10,555) in 2014, 2015, 2016, and 2017, respectively (Fig. 16), with a long-term (1986–2017) mean annual index of 15,831 total birds (95% CI = 13,989–17,673; Table 2). From 1986–2017, the mean annual growth rate for Scaup Species was 1.011 (95% CI = 0.998–1.024).

Long-tailed Duck (*Clangula hyemalis*)

The population index for Long-tailed Duck was 43,799 (95% CI = 35,437–52,162), 55,751 (95% CI = 46,091–65,410), 43,376 (95% CI = 37,204–49,549), and 37,855 (95% CI = 32,265–43,445) in 2014, 2015, 2016, and 2017, respectively (Fig. 17), with a long-term (1986–2017) mean annual index of 51,151 indicated total birds (95% CI = 47,767–54,534; Table 2). From 1986–2017, the mean annual growth rate for Long-tailed Duck was 0.991 (95% CI = 0.985–0.998).

King Eider (*Somateria spectabilis*)
The population index for King Eiders was 15,136 (95% CI = 11,483–18,789), 22,904 (95% CI = 18,942–26,866), 20,116 (95% CI = 13,766–26,467), and 19,171 (95% CI = 14,326–24,017) in 2014, 2015, 2016, and 2017, respectively (Fig. 18), with a long-term (1986–2017) mean annual index of 16,349 indicated total birds (95% CI = 14,707–17,990; Table 2). From 1986–2017, the mean annual growth rate for King Eiders was 1.025 (95% CI = 1.016–1.034).

Common Eider (*Somateria mollissima*)
The population index for Common Eiders was 850 (95% CI = 1–1,710), 335 (95% CI = 1–895), 2,666 (95% CI = 1–6,586), and 1,132 (95% CI = 171–2,093) in 2014, 2015, 2016, and 2017, respectively (Fig. 19), with a long-term (1986–2017) mean annual index of 609 indicated total birds (95% CI = 324–894; Table 2). From 1986–2017, the mean annual growth rate for Common Eiders was 1.058 (95% CI = 1.018–1.100).

Spectacled Eider (*Somateria fischeri*)
The population index for Spectacled Eiders was 6,986 (95% CI = 4,926–9,047), 5,496 (95% CI = 4,038–6,955), 4,833 (95% CI =3,276–6,390), and 5,122 (95% CI = 3,633–6,612) in 2014, 2015, 2016, and 2017, respectively (Fig. 20), with a long-term (1992–2017) mean annual index of 6,956 indicated total birds (95% CI = 6,302–7,610; Table 2). From 1992–2017, the mean annual growth rate for Spectacled Eiders was 0.988 (95% CI = 0.977–1.000).

Steller's Eider (*Polysticta stelleri*)
The population index for Steller's Eiders was 47 (95% CI = 0–141), 0 (95% CI = 0–0), 220 (95% CI =0–564), and 168 (95% CI = 0–412) in 2014, 2015, 2016, and 2017, respectively (Fig. 21), with a long-term (1989–2017) mean annual index of 199 indicated total birds (95% CI = 116–282; Table 2). From 1989–2017, the mean annual growth rate for Steller's Eiders was 0.969 (95% CI = 0.913–1.028).

Surf Scoter (*Melanitta perspicillata*)
The population index for Surf Scoters was 0 (95% CI = 0–0), 164 (95% CI = 164–493), 289 (95% CI =0–890), and 202 (95% CI = 0–470) in 2014, 2015, 2016, and 2017, respectively (Fig. 22), with a long-term (1986–2017) mean annual index of 98 indicated total birds (95% CI = 49–146; Table 2). From 1986–2017, the mean annual growth rate for Surf Scoters was 1.022 (95% CI = 0.979–1.067).

Black Scoter (*Melanitta nigra*)
The population index for Black Scoters was 0 (95% CI = 0-0), 328 (95% CI = 0-990), 0 (95% CI = 0-0), and 101 (95% CI = 0-294) in 2014, 2015, 2016, and 2017, respectively (Fig. 23), with a long-term (1986–2017) mean annual index of 276 indicated total birds (95% CI = 181-372; Table 2). From 1986–2017, the mean annual growth rate for Black Scoters was 0.947 (95% CI = 0.903-0.993).

White-winged Scoter (*Melanitta fusca*)
The population index for White-winged Scoters was 19,162 (95% CI = 7,803–30,520), 23,602 (95% CI = 4,881–42,323), 9,414 (95% CI =2,419–16,408), and 3,658 (95% CI = 597–6,718) in 2014, 2015, 2016, and 2017, respectively (Fig. 24), with a long-term (1986–2017) mean annual index of 4,357 indicated total birds (95% CI = 2,123–6,591; Table 2). From 1986–2017, the mean annual growth rate for White-winged Scoters was 1.140 (95% CI = 1.107–1.175).

Red-breasted Merganser (*Mergus serrator*)
The population index for Red-breasted Mergansers was 1,344 (95% CI = 582–2,105), 3,248 (95% CI = 1,913–4,582), 2,323 (95% CI = 1,390–3,255), and 1,228 (95% CI = 511–1,943) in 2014, 2015, 2016, and 2017, respectively (Fig. 25), with a long-term (1986–2017) mean annual index of 981 indicated total birds (95% CI = 747–1,215; Table 2). From 1986–2017, the mean annual growth rate for Red-breasted Mergansers was 1.063 (95% CI = 1.047–1.078).

Golden Eagle (*Aquila chrysaetos*)
The population index for Golden Eagle was 68 (95% CI = 0–169), 371 (95% CI = 56–687), 317 (95% CI = 62–572), and 278 (95% CI = 0–673) in 2014, 2015, 2016, and 2017, respectively (Fig. 26), with a long-term (1986–2017) mean annual index of 136 total birds (95% CI = 92–180; Table 2). From 1986–2017, the

mean annual growth rate for Golden Eagle was 1.068 (95% CI = 1.040–1.097).

Sandhill Crane (*Grus canadensis*)

The population index for Sandhill Cranes was 280 (95% CI = 29–531), 310 (95% CI = 21–600), 192 (95% CI = 0–384), and 2,150 (95% CI = 72–4,228) in 2014, 2015, 2016, and 2017, respectively (Fig. 27), with a long-term (1986–2017) mean annual index of 308 indicated total birds (95% CI = 174–441; Table 2). From 1986–2017, the mean annual growth rate for Sandhill Cranes was 1.071 (95% CI = 1.042–1.100).

Jaeger Species (*Stercorarius pomarinus, S. parasiticus, and S. longicaudus*)

The population index for Jaeger Species was 9,377 (95% CI = 7,147–11,607), 7,517 (95% CI = 5,749–9,283), 5,997 (95% CI = 4,364–7,630), and 9,096 (95% CI = 7,395–10,798) in 2014, 2015, 2016, and 2017, respectively (Fig. 28), with a long-term (1986–2017) mean annual index of 8,651 total birds (95% CI = 7,822–9,481; Table 2). From 1986–2017, the mean annual growth rate for Jaeger Species was 1.000 (95% CI = 0.990–1.011).

Glaucous Gull (*Larus hyperboreus*)

The population index for Glaucous Gulls was 21,258 (95% CI = 17,836–24,679), 40,626 (95% CI = 23,285–57,967), 51,272 (95% CI = 4,353–98,191), and 30,844 (95% CI = 14,358–47,331) in 2014, 2015, 2016, and 2017, respectively (Fig. 29), with a long-term (1992–2017) mean annual index of 20,681 total birds (95% CI = 17,162–24,200; Table 2). From 1992–2017, the mean annual growth rate for Glaucous Gulls was 1.034 (95% CI = 1.021–1.048).

Sabine's Gull (*Xema sabini*)

The population index for Sabine's Gulls was 12,282 (95% CI = 9,594–14,970), 15,391 (95% CI = 11,124–19657), 13,073 (95% CI = 9,654–16,493), and 14,270 (95% CI = 10,759–17,780) in 2014, 2015, 2016, and 2017, respectively (Fig. 30), with a long-term (1992–2017) mean annual index of 10,241 total birds (95% CI = 8,749–11,732; Table 2). From 1992–2017, the mean annual growth rate for Sabine's Gulls was 1.042 (95% CI = 1.028–1.056).

Arctic Tern (*Sterna paradisaea*)

The population index for Arctic Terns was 20,016 (95% CI = 14,854–25,179), 21,741 (95% CI = 16,249–27,234), 26,191 (95% CI = 17,192–35,191), and 18,913 (95% CI = 14,888–22,938) in 2014, 2015, 2016, and 2017, respectively (Fig. 31), with a long-term (1992–2017) mean annual index of 19,202 total birds (95% CI = 17,842–20,563; Table 2). From 1992–2017, the mean annual growth rate for Arctic Terns was 1.019 (95% CI = 1.012–1.026).

Common Raven (*Corvus corax*)

The population index for Common Ravens was 353 (95% CI = 60–645), 461 (95% CI = 91–832), 234 (95% CI = 0–476), and 51 (95% CI = 0–157) in 2014, 2015, 2016, and 2017, respectively (Fig. 32), with a long-term (1992–2017) mean annual index of 305 total birds (95% CI = 231–379; Table 2). From 1992–2017, the mean annual growth rate for Common Ravens was 1.011 (95% CI = 0.969–1.055).

Short-eared Owl (*Asio flammeus*)

The population index for Short-eared Owls was 438 (95% CI = 72–803), 343 (95% CI = 53–632), 593 (95% CI = 232–955), and 203 (95% CI = 0–444) in 2014, 2015, 2016, and 2017, respectively (Fig. 33), with a long-term (1992–2017) mean annual index of 332 total birds (95% CI = 155–510; Table 2). From 1992–2017, the mean annual growth rate for Short-eared Owls was 1.075 (95% CI = 1.006–1.148).

Snowy Owl (*Bubo scandiacus*)

The population index for Snowy Owls was 742 (95% CI = 153–443), 976 (95% CI = 593–1358), 123 (95% CI = 19–227), and 69 (95% CI = 0–149) in 2014, 2015, 2016, and 2017, respectively (Fig. 34), with a long-term (1986–2017) mean annual index 944 total birds (95% CI = 537–1,351; Table 2). From 1986–2017, the mean annual growth rate for Snowy Owls was 1.008 (95% CI = 0.959–1.060).

DISCUSSION

This report describes results of spatially comprehensive aerial breeding population survey data for all common waterbirds (excluding shorebirds; due to inconsistent surveying), owls, eagles, and ravens on the ACP of Alaska, collected by USFWS from 1986–2017; including 2014–2017 survey data not previously reported. To our knowledge, this survey data represents the only broad-scale, long-term systematic monitoring of waterbirds in the Arctic of North America. Although the long-standing, continental-scale aerial Waterfowl Breeding Population and Habitat Survey (WBPHS) samples most of Alaska's primary waterfowl production areas, it has never included the rich wetlands of the Arctic Coastal Plain of Alaska or the high-Arctic of Canada. Further, while several targeted monitoring programs for specific species or limited areas of the ACP have been conducted; to our knowledge the ACP Survey represents the most comprehensive ACP-wide aerial survey of waterbirds.

Our data from 1986–2017 indicated that Yellow-billed Loon, Tundra Swan, Greater White-fronted Goose, Snow Goose, Pacific Black Brant, King and Common Eiders, White-winged Scoter, Red-breasted Merganser, Golden Eagle, Glaucous and Sabine's Gulls, Arctic Tern, and Short-eared Owl have all significantly increased during this period (growth rates > 1 with 95% confidence intervals that do not overlap 1), while Long-tailed Ducks and Black Scoters have significantly declined. Several other species show mean annual growth rates that reflect possible increase or decline, but lack adequate sample sizes, or are too variable to estimate growth with sufficient precision.

Though observer bias is a factor in all aerial surveys, the experience level and stability of the 2014–2017 ACP Aerial Survey crew, as well as the left-seat pilot-observers for all surveys 1986-2017, was extremely high. From 2014–2017, the same two observers (Wilson/Larned) collected all survey data, with Larned having collected one half of all data from 1992–2017. Despite the remarkable stability of crews during the history of the ACP survey, perception and availability bias are still largely unaccounted for, potentially affecting confidence in our measures of population abundance, and thereby, trend. Though we do not provide detection adjusted population estimates for 1986–2017, in 2015, we initiated a study examining observer detection of eiders and other waterbirds on the ACP (Wilson et al. 2017), and have continued to collect detection data as part of our operational surveys since 2016. We hope to provide detection-adjusted population estimates, upon completion of our updated population analysis program (in progress). In addition to incorporating detection adjusted abundance estimates in future reports, we also plan to refine analyses using state-space models that weight annual estimates according to within-year variance in order to improve estimates of trend.

The analysis and implementation of a multi-species, aerial monitoring program such as the ACP Survey is challenging due to the inherent variability of the natural ecosystem, the varied natural histories of 30+ species, and the logistical difficulties of conducting aerial surveys in the Arctic. Moreover, it is difficult to achieve adequate within-year sampling of such a large spatial area within a short annual phenologic window. Surveys of this type are further complicated by several waterfowl species that exist in extremely low densities and/or breed irregularly (such as Steller's eiders), making precision in monitoring difficult to achieve. Collection of such a long-term dataset has been made possible by integrating improvements in sample design along the way. The sample design used in this survey was originally developed in 1986 to target breeding ducks, and later augmented (North Slope Eider Survey: 1992–2006) to better include coastal areas and earlier nesting species, such as eiders. Though the redesigned survey (2007–present) amalgamated these two designs and provided a good temporal, spatial, and inferential compromise, the changing distributions and abundances of many waterfowl species, as well as the rapid and wide-spread landscape changes in the Arctic, may warrant reevaluation of the current stratification and overall survey design. Nonetheless, this ACP Survey provides the largest, longest-running, and most comprehensive dataset of waterbird distribution and abundance for the Arctic Coastal Plain, and perhaps all the Arctic.

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Arctic Coastal Plain Aerial Survey Crew 2014–2017. Bill Larned (right-front seat observer) and Heather Wilson (left-front seat observer/pilot).

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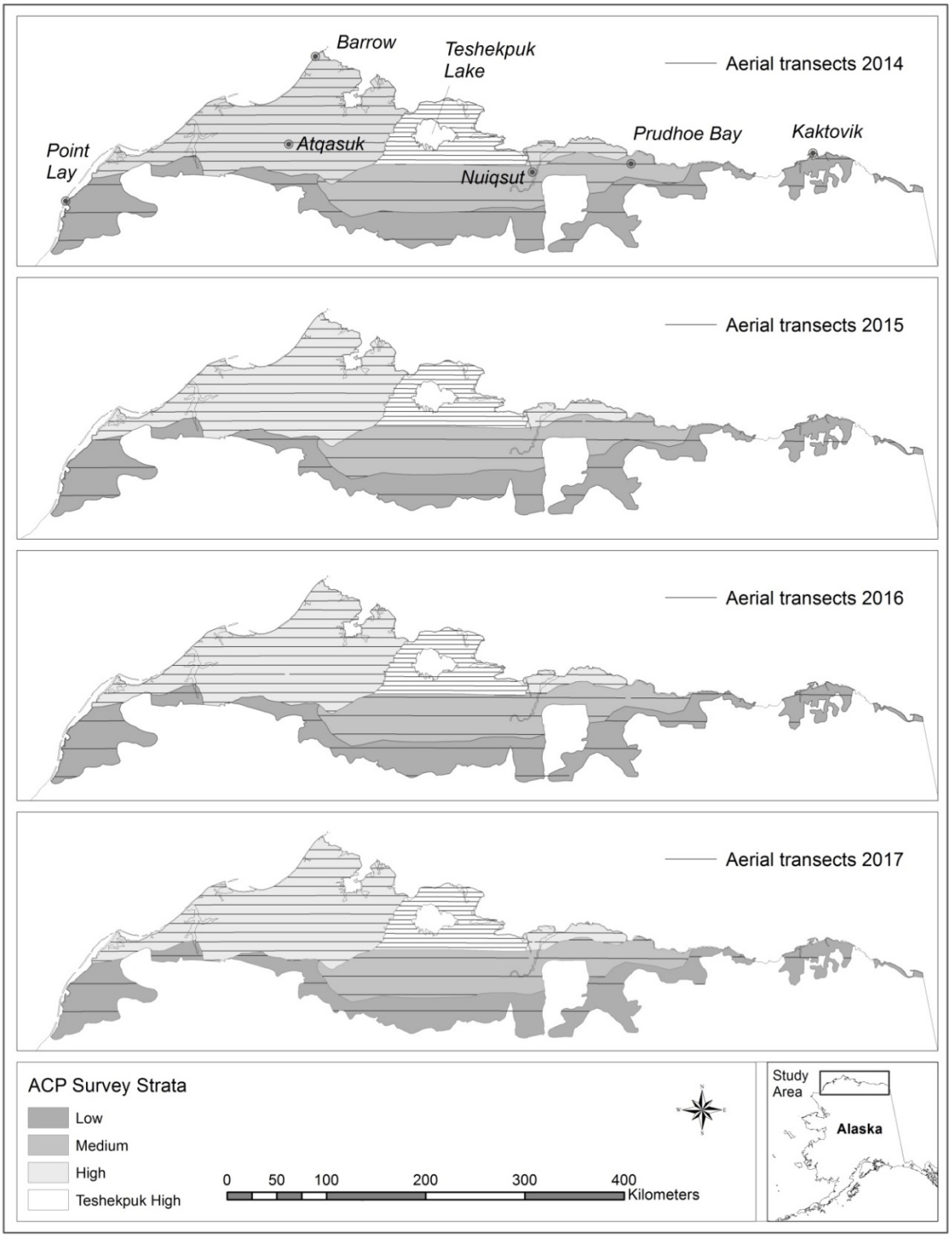


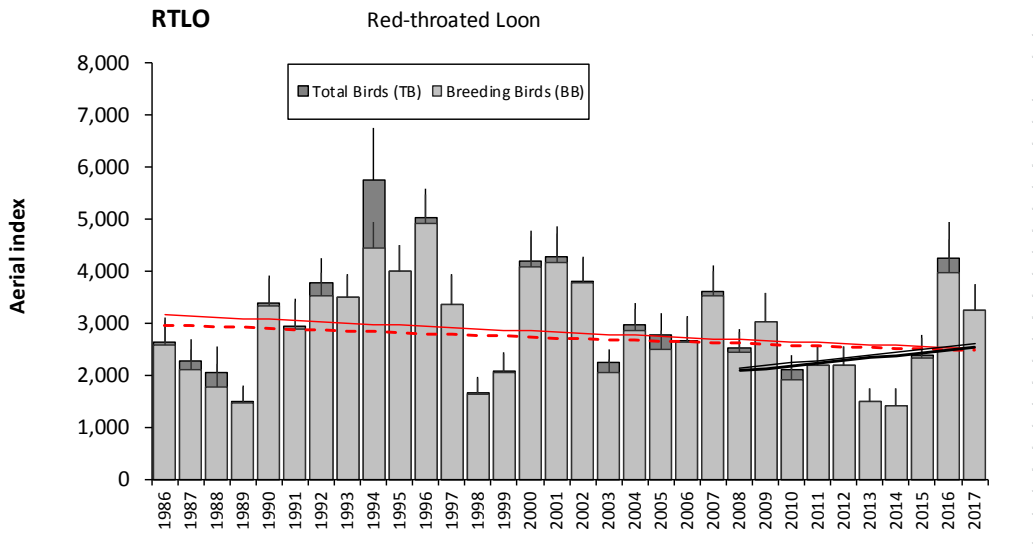
Figure 1. Arctic Coastal Plain Breeding Waterbird Survey design, Alaska (2014–2017); total study area is 57,336 km^2, showing the 4-year rotating panel of systematic strip-transects within four density-based strata (Larned et al. 2012, Stehn et al. 2013). Inter-transect distances for each strata with all four years combined were as follows: 2.4 km (High), 4.8 km (Medium), 7.2 km (Low), and 1.2 km (Teshekpuk High). Changes among years are most apparent in the Low and Medium density strata.

Table 1. Arctic Coastal Plain Survey dates and crews (1986–2017). The original Arctic Coastal Plain Breeding Pair Survey ("Original ACP", 1986-2006; Mallek 2007) had broad geographic coverage, but was timed later (late June to early July) than the North Slope Eider Survey ("NSE", 1992–2006; Larned et al. 2006), which covered only the northern and coastal areas of the ACP, but was timed earlier (early-mid June). The current "ACP" Breeding Pair Survey combined the timing of the NSE survey with the geographic coverage of the original ACP survey (Stehn et al. 2013), and has been flown since 2007.

Year	Survey	Dates of Data Collection	Pilot Left-front Observer	Right-front Observer	Aircraft
1986	Original ACP	1-7 July	R. King	S. Cane	C185 Amphib
1987	Original ACP	30 June - 9 July	R. King	S. Cane	C185 Amphib
1988	Original ACP	30 June - 13 July	R. King	M. McWhorter	C185 Amphib
1989	Original ACP	28 June - 6 July	R. King	B. Gradin	C185 Amphib
1990	Original ACP	21-27 June	R. King	A. Brackney	C185 Amphib
1991	Original ACP	22-30 June	R. King	A. Brackney	C185 Amphib
1992	Original ACP	27 June - 10 July	R. King	A. Brackney	C206 Amphib
1993	Original ACP	22-28 June	R. King	A. Brackney	C185 Amphib
1994	Original ACP	28 June - 2 July	R. King	A. Brackney	C185 Amphib
1995	Original ACP	28 June - 4 July	R. King	A. Brackney	C185 Amphib
1996	Original ACP	23-30 June	R. King	A. Brackney	C206 Amphib
1997	Original ACP	28 June - 3 July	R. King	C. Dau	C206 Amphib
1998	Original ACP	25-30 June	R. King/C. Dau	R. King/C. Dau	C206 Amphib
1999	Original ACP	2-4 July	R. King/C. Dau	E. Mallek/E. Taylor	C185/C206 Amphib
2000	Original ACP	29 June - 6 July	E. Mallek	D. Marks	C206 Amphib
2001	Original ACP	23-27 June	E. Mallek	D. Marks	C206 Amphib
2002	Original ACP	20-24 June	E. Mallek	D. Marks	C206 Amphib
2003	Original ACP	24-27 June	E. Mallek	D. Marks	C206 Amphib
2004	Original ACP	23-27 June	E. Mallek	D. Marks	C206 Amphib
2005	Original ACP	24-27 June	E. Mallek	D. Marks	C206 Amphib
2006	Original ACP	23-28 June	E. Mallek	D. Marks	C206 Amphib
1992	NSE	20-29 June	W. Larned	G. Balogh	C185 Amphib
1993	NSE	9-18 June	W. Larned	G. Balogh	C206 Amphib
1994	NSE	12-19 June	W. Larned	G. Balogh	C206 Amphib
1995	NSE	9-18 June	W. Larned	G. Balogh	C206 Amphib
1996	NSE	7-16 June	W. Larned	G. Balogh	C206 Amphib
1997	NSE	11-20 June	W. Larned/T. Tiplady	W. Larned/T. Tiplady	C206 Amphib
1998	NSE	7-15 June	W. Larned/T. Tiplady	W. Larned/T. Tiplady	C206 Amphib
1999	NSE	11-17 June	W. Larned/T. Tiplady	W. Larned/T. Tiplady	C206 Amphib
2000	NSE	11-18 June	W. Larned	J. Fischer	C206 Amphib
2001	NSE	11-17 June	W. Larned	J. Fischer	C206 Amphib
2002	NSE	9-14 June	W. Larned	A. Brackney	C206 Amphib
2003	NSE	9-18 June	W. Larned/E. Mallek	A. Brackney/D. Marks	C206 Amphib
2004	NSE	11-17 June	W. Larned	A. Brackney	C206 Amphib
2005	NSE	10-19 June	W. Larned	T. Moran	C206 Amphib
2006	NSE	10-16 June	W. Larned	D. Fronczak	C206 Amphib
2007	ACP	14-19 June	W. Larned	R. MacDonald	C206 Amphib
2008	ACP	8-16 June	W. Larned	R. MacDonald	C206 Amphib
2009	ACP	7-15 June	W. Larned	R. MacDonald	C206 Amphib
2010	ACP	11-22 June	W. Larned/K. Bollinger	W. Schock	C206 Amphib
2011	ACP	10-19 June	W. Larned	W. Schock	Kodiak Amphib
2012	ACP	12-18 June	H. Wilson/ W. Larned	H. Wilson/W. Larned	Kodiak Amphib
2013	ACP	10-17 June	H. Wilson	W. Larned	C206 Amphib
2014	ACP	10-20 June	H. Wilson	W. Larned	C206 Amphib
2015	ACP	8-14 June	H. Wilson	W. Larned	C206 Amphib
2016	ACP	6-13 June	H. Wilson	W. Larned	C206 Amphib
2017	ACP	11-19 June	H. Wilson	W. Larned	C206 Amphib

Table 2. Mean population indices, coefficient of variation (CV), long-term and most recent 10-year growth rates and associated 95% confidence intervals (CI) for bird species in early to mid-June on Arctic Coastal Plain wetlands in Alaska. Variance estimates used were based on within-year sampling error among transects as stratified by four physiographic regions. Significant growth rates are highlighted green for positive trend, pink for negative. For total and indicated total bird formulas (S=Single male, Pr = Pair, and Fl = Flock). Estimates are not corrected for incomplete detection.

Species	Total & Indicated Bird Formulas	Years	n years	Long-term Average	Long-term CV	Long-term Growth rate	Long-term Growth 95% CI	Last 10 yrs Growth rate	Last 10 yrs 95% CI
Red-throated Loon	S + 2*Pr + Fl	1986-2017	32	2,985	0.352	0.994	0.980-1.007	1.022	0.947-1.102
Pacific Loon	S + 2*Pr + Fl	1986-2017	32	32,561	0.175	1.003	0.997-1.010	0.986	0.942-1.033
Yellow-billed Loon	S + 2*Pr + Fl	1986-2017	32	2,006	0.214	**1.013**	1.002-1.024	0.964	0.907-1.025
Red-necked Grebe	S + 2*Pr + Fl	1986-2017	32	125	1.358	0.969	0.925-1.015	0.854	0.698-1.045
Tundra Swan	S + 2*Pr + Fl	1986-2017	32	10,258	0.440	**1.045**	1.038-1.051	1.021	0.996-1.047
Gr. White-fronted Goose	2 * (S + Pr) + Fl	1986-2017	32	153,372	0.592	**1.047**	1.036-1.058	1.056	0.992-1.124
Snow Goose	S + 2*Pr + Fl	1986-2017	32	13,078	1.493	**1.242**	1.193-1.293	**1.181**	1.056-1.321
Taverner's Cackling Goose	2 * (S + Pr) + Fl	1986-2017	32	10,909	0.574	1.018	0.993-1.043	1.023	0.899-1.165
Black Brant	2 * (S + Pr) + Fl	1986-2017	32	8,634	0.683	**1.084**	1.062-1.105	**1.061**	1.005-1.120
Mallard	2 * (S + Pr) + Fl	1986-2017	32	472	0.995	0.991	0.941-1.043	1.025	0.779-1.348
Northern Pintail	2 * (S + Pr) + Fl	1986-2017	32	66,630	0.287	1.004	0.992-1.016	1.038	0.978-1.101
Am. Wigeon	2 * (S + Pr) + Fl	1986-2017	32	672	0.774	1.015	0.976-1.056	1.098	0.886-1.361
Northern shoveler	2 * (S + Pr) + Fl	1986-2017	32	435	1.183	1.001	0.948-1.057	0.947	0.686-1.307
Am. Green-winged Teal	2 * (S + Pr) + Fl	1986-2017	32	659	0.944	0.986	0.948-1.024	1.044	0.886-1.229
Scaup spp.	S + 2*Pr + Fl	1986-2017	32	15,831	0.336	1.011	0.998-1.024	0.933	0.869-1.002
Long-tailed Duck	2 * (S + Pr) + Fl	1986-2017	32	51,151	0.191	**0.991**	0.985-0.998	0.972	0.938-1.007
King Eider	2 * (S + Pr) + Fl	1986-2017	32	16,349	0.290	**1.025**	1.016-1.034	0.993	0.967-1.020
Common Eider	2 * (S + Pr) + Fl	1986-2017	32	609	1.356	**1.058**	1.018-1.100	1.141	0.907-1.436
Spectacled Eider	2 * (S + Pr) + Fl	1992-2017	26	6,956	0.245	0.988	0.977-1.000	0.976	0.935-1.019
Steller's Eider	2 * (S + Pr) + Fl	1989-2017	29	199	1.137	0.969	0.913-1.028	1.184	0.897-1.565
Surf Scoter	2 * (S + Pr) + Fl	1986-2017	32	98	1.443	1.022	0.979-1.067	1.210	0.931-1.573
Black Scoter	2 * (S + Pr) + Fl	1986-2017	32	276	1.004	**0.947**	0.903-0.993	0.823	0.607-1.114
White-winged Scoter	2 * (S + Pr) + Fl	1986-2017	32	4,357	1.480	**1.140**	1.107-1.175	1.064	0.894-1.267
Red-breasted Merganser	2 * (S + Pr) + Fl	1986-2017	32	981	0.686	**1.063**	1.047-1.078	1.034	0.962-1.111
Golden Eagle	S + 2*Pr + Fl	1986-2017	32	136	0.915	**1.068**	1.040-1.097	0.996	0.869-1.142
Sandhill Crane	2 * (S + Pr) + Fl	1986-2017	32	308	1.249	**1.071**	1.042-1.100	**1.022**	0.858-1.217
Jaeger spp.	S + 2*Pr + Fl	1986-2017	32	8,651	0.277	1.000	0.990-1.011	0.973	0.940-1.008
Glaucous Gull	S + 2*Pr + Fl	1992-2017	26	20,681	0.443	**1.034**	1.021-1.048	**1.097**	1.040-1.158
Sabine's Gull	S + 2*Pr + Fl	1992-2017	26	10,241	0.379	**1.042**	1.028-1.056	1.007	0.972-1.044
Arctic Tern	S + 2*Pr + Fl	1992-2017	26	19,202	0.184	**1.019**	1.012-1.026	0.998	0.974-1.023
Common Raven	S + 2*Pr + Fl	1992-2017	32	305	0.705	1.011	0.969-1.055	0.906	0.785-1.045
Short-eared Owl	S + 2*Pr + Fl	1992-2017	32	332	1.551	**1.075**	1.006-1.148	0.988	0.721-1.354
Snowy Owl	S + 2*Pr + Fl	1986-2017	32	944	1.246	1.008	0.959-1.060	0.874	0.656-1.165



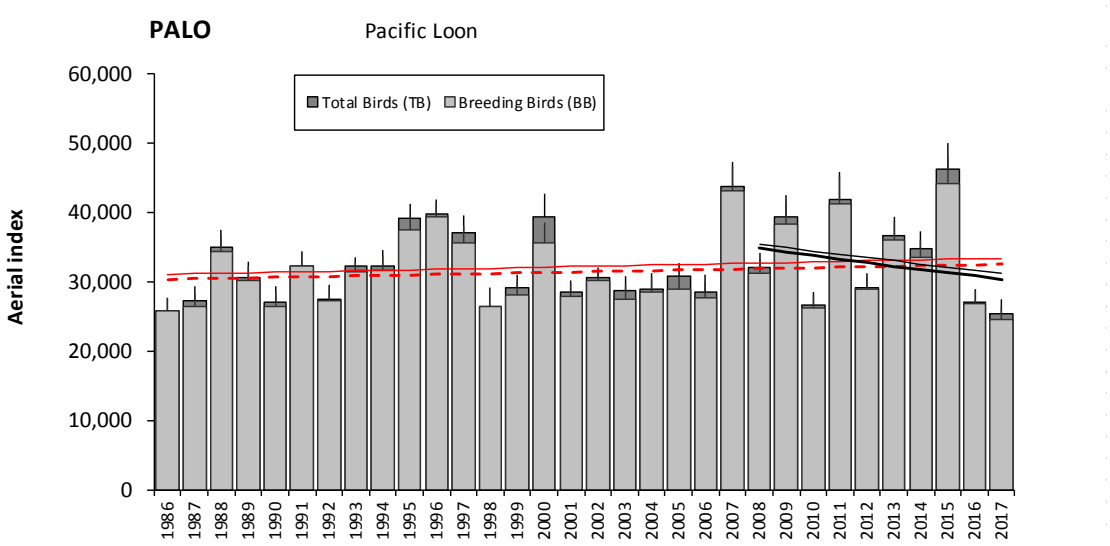
Year	Breeding Birds (BB)	SE Breeding Birds	Total Birds (TB)	SE Total Birds
1986	**2,592**	461	**2,636**	471
1987	**2,113**	392	**2,282**	415
1988	**1,783**	432	**2,067**	485
1989	**1,472**	305	**1,497**	311
1990	**3,333**	521	**3,389**	532
1991	**2,903**	519	**2,952**	530
1992	**3,531**	436	**3,789**	473
1993	**3,495**	437	**3,503**	438
1994	**4,448**	509	**5,752**	1001
1995	**4,002**	492	**4,014**	494
1996	**4,935**	552	**5,032**	567
1997	**3,362**	562	**3,374**	567
1998	**1,655**	302	**1,665**	305
1999	**2,063**	369	**2,075**	373
2000	**4,103**	572	**4,213**	582
2001	**4,181**	553	**4,288**	569
2002	**3,787**	481	**3,808**	486
2003	**2,060**	247	**2,248**	250
2004	**2,876**	401	**2,965**	418
2005	**2,509**	360	**2,774**	431
* **2006**	**2,655**	455	**2,680**	462
2007	**3,522**	486	**3,619**	490
2008	**2,459**	380	**2,530**	374
2009	**3,046**	546	**3,046**	546
2010	**1,913**	269	**2,107**	299
2011	**2,209**	354	**2,209**	354
2012	**2,200**	353	**2,200**	353
2013	**1,497**	271	**1,497**	271
2014	**1,408**	334	**1,408**	334
2015	**2,332**	391	**2,404**	392
2016	**3,969**	663	**4,244**	702
2017	**3,256**	489	**3,256**	489

All Year Index (1986-2017)	Breeding Birds (BB)	Total Birds (TB)
number of years =	32	32
average index =	**2,865**	**2,985**
SE average index =	169	186
95% CI index =	(2,534-3,195)	(2,621-3,349)
ave. annual growth =	**0.995**	**0.994**
95% CI annual growth =	(0.982-1.008)	(0.980-1.007)

10-Yr Index (2008-2017)	BB	TB
number of years =	10	10
average index =	**2,429**	**2,490**
SE average index =	252	268
95% CI index =	(1,934-2,923)	(1,965-3,015)
ave. annual growth =	**1.022**	**1.022**
95% CI annual growth =	(0.950-1.100)	(0.947-1.102)

Note:
Breeding Birds (BB) = Singles + 2 x (pairs)
Total Birds (TB) = Singles + (2 x pairs) + flocks

Figure 2. Summary of annual population indices for Red-throated Loons (*Gavia stellata*) on the Arctic Coastal Plain, Alaska, 1986–2017. Average annual growth rates were estimated using log-linear regression, with standard errors (SE) calculated from residual errors around the regression line. Long-term growth rates are depicted in red (solid line = total birds [TB], dotted line = breeding birds [BB]), while 10-year growth rates are depicted in black (bold = TB, non-bold = BB). *Estimates from 1986 to 2006 are adjusted to account for survey timing and geographic extent of current (2007–2017) survey design (study area = 57,336 km^2).



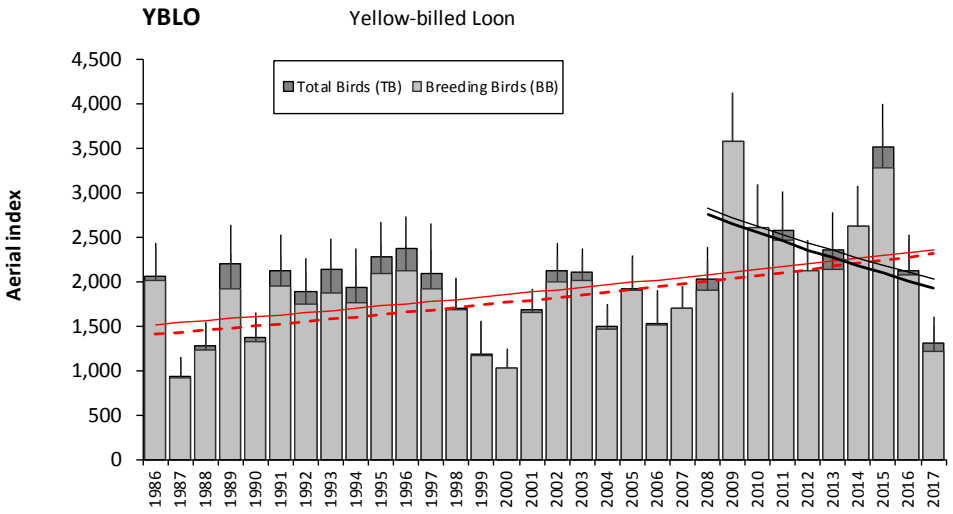
	Year	Breeding Birds (BB)	SE Breeding Birds	Total Birds (TB)	SE Total Birds
	1986	**25,924**	1,837	**25,948**	1,835
	1987	**26,502**	1,982	**27,409**	2,077
	1988	**34,433**	2,498	**35,013**	2,584
	1989	**30,316**	2,045	**30,770**	2,123
	1990	**26,526**	2,009	**27,145**	2,280
	1991	**32,396**	2,137	**32,320**	2,137
	1992	**27,339**	2,035	**27,506**	2,100
	1993	**31,483**	1,395	**32,242**	1,435
	1994	**31,780**	2,097	**32,417**	2,163
	1995	**37,610**	2,124	**39,302**	2,088
	1996	**39,452**	2,054	**39,751**	2,114
	1997	**35,731**	2,380	**37,167**	2,517
	1998	**26,549**	2,668	**26,541**	2,652
	1999	**28,220**	1,920	**29,134**	1,971
	2000	**35,642**	2,980	**39,378**	3,403
	2001	**28,052**	1,753	**28,529**	1,766
	2002	**30,251**	1,616	**30,591**	1,605
	2003	**27,539**	1,999	**28,901**	2,074
	2004	**28,527**	2,344	**29,036**	2,332
	2005	**29,025**	1,759	**30,845**	2,014
*	2006	**27,769**	2,364	**28,638**	2,496
	2007	**43,118**	3,597	**43,773**	3,599
	2008	**31,330**	2,098	**32,070**	2,225
	2009	**38,415**	3,100	**39,405**	3,252
	2010	**26,365**	1,769	**26,704**	1,875
	2011	**41,335**	4,002	**41,958**	4,000
	2012	**28,985**	1,994	**29,316**	1,971
	2013	**36,061**	2,775	**36,635**	2,844
	2014	**33,675**	2,478	**34,778**	2,593
	2015	**44,232**	3,705	**46,218**	3,803
	2016	**26,884**	1,819	**27,090**	1,817
	2017	**24,598**	2,008	**25,425**	2,083

All Year Index (1986-2017)	Breeding Birds (BB)	Total Birds (TB)
number of years =	32	32
average index =	**31,752**	**32,561**
SE average index =	955	1,007
95% CI index =	(29,880-33,624)	(30,587-34,535)
ave. annual growth =	**1.003**	**1.003**
95% CI annual growth =	(0.997-1.009)	(0.997-1.010)

10-Yr Index (2008-2017)	BB	TB
number of years =	10	10
average index =	**33,188**	**33,960**
SE average index =	2,122	2,235
95% CI index =	(29,028-37,347)	(29,579-38,340)
ave. annual growth =	**0.985**	**0.986**
95% CI annual growth =	(0.942-1.030)	(0.942-1.033)

Note:
Breeding Birds (BB) = Singles + 2 x (pairs)
Total Birds (TB) = Singles + (2 x pairs) + flocks

Figure 3. Summary of annual population indices for Pacific Loons (*Gavia pacifica*) on the Arctic Coastal Plain, Alaska, 1986–2017. Average annual growth rates were estimated using log-linear regression, with standard errors (SE) calculated from residual errors around the regression line. Long-term growth rates are depicted in red (solid line = total birds [TB], dotted line = breeding birds [BB]), while 10-year growth rates are depicted in black (bold = TB, non-bold = BB). *Estimates from 1986 to 2006 are adjusted to account for survey timing and geographic extent of current (2007–2017) survey design (study area = 57,336 km^2).



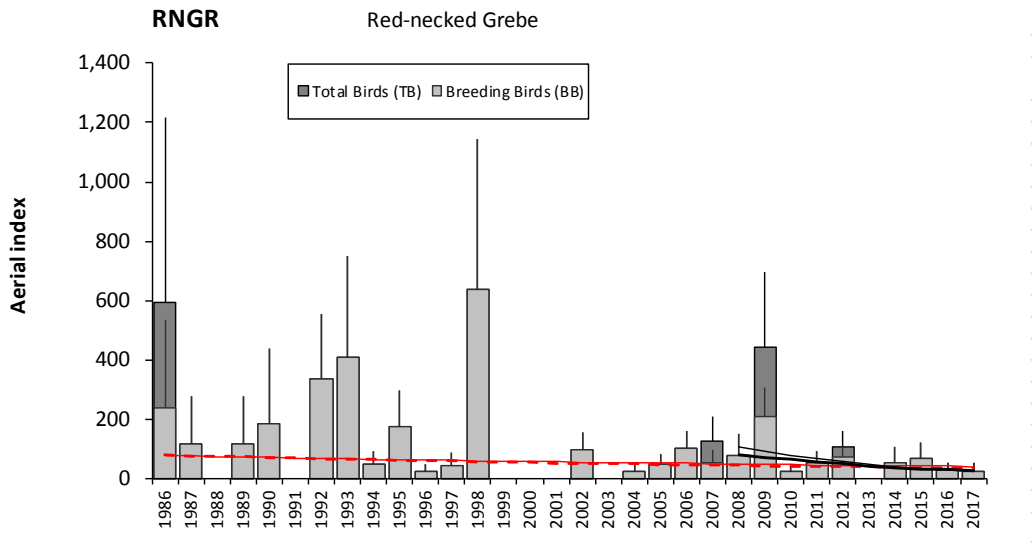
	Year	Breeding Birds (BB)	SE Breeding Birds	Total Birds (TB)	SE Total Birds
	1986	**2,015**	364	**2,070**	375
	1987	**921**	214	**946**	221
	1988	**1,243**	269	**1,277**	277
	1989	**1,929**	387	**2,204**	444
	1990	**1,338**	276	**1,375**	285
	1991	**1,957**	348	**2,127**	411
	1992	**1,759**	355	**1,894**	374
	1993	**1,886**	290	**2,151**	332
	1994	**1,772**	408	**1,944**	430
	1995	**2,096**	352	**2,285**	387
	1996	**2,127**	279	**2,378**	365
	1997	**1,925**	444	**2,093**	573
	1998	**1,687**	341	**1,709**	348
	1999	**1,176**	370	**1,192**	378
	2000	**1,030**	206	**1,040**	208
	2001	**1,667**	237	**1,684**	239
	2002	**2,002**	300	**2,126**	315
	2003	**2,023**	267	**2,120**	266
	2004	**1,476**	250	**1,496**	254
	2005	**1,907**	359	**1,929**	365
*	2006	**1,526**	359	**1,541**	363
	2007	**1,709**	255	**1,709**	255
	2008	**1,915**	320	**2,037**	353
	2009	**3,584**	548	**3,584**	548
	2010	**2,618**	487	**2,618**	487
	2011	**2,478**	440	**2,588**	439
	2012	**2,122**	353	**2,122**	353
	2013	**2,146**	331	**2,367**	422
	2014	**2,624**	453	**2,624**	453
	2015	**3,281**	454	**3,521**	478
	2016	**2,080**	405	**2,121**	408
	2017	**1,228**	277	**1,311**	299

All Year Index (1986-2017)	Breeding Birds (BB)	Total Birds (TB)
number of years =	32	32
average index =	**1,914**	**2,006**
SE average index =	102	107
95% CI index =	(1,714-2,114)	(1,797-2,215)
ave. annual growth =	**1.014**	**1.013**
95% CI annual growth =	(1.004-1.025)	(1.002-1.024)

10-Yr Index (2008-2017)	BB	TB
number of years =	10	10
average index =	**2,408**	**2,489**
SE average index =	214	216
95% CI index =	(1,988-2,828)	(2,067-2,912)
ave. annual growth =	**0.961**	**0.964**
95% CI annual growth =	(0.903-1.024)	(0.907-1.025)

Note:
Breeding Birds (BB) = Singles + 2 x (pairs)
Total Birds (TB) = Singles + (2 x pairs) + flocks

Figure 4. Summary of annual population indices for Yellow-billed Loons (*Gavia adamsii*) on the Arctic Coastal Plain, Alaska, 1986–2017. Average annual growth rates were estimated using log-linear regression, with standard errors (SE) calculated from residual errors around the regression line. Long-term growth rates are depicted in red (solid line = total birds [TB], dotted line = breeding birds [BB]), while 10-year growth rates are depicted in black (bold = TB, non-bold = BB). *Estimates from 1986 to 2006 are adjusted to account for survey timing and geographic extent of current (2007–2017) survey design (study area = 57,336 km^2).



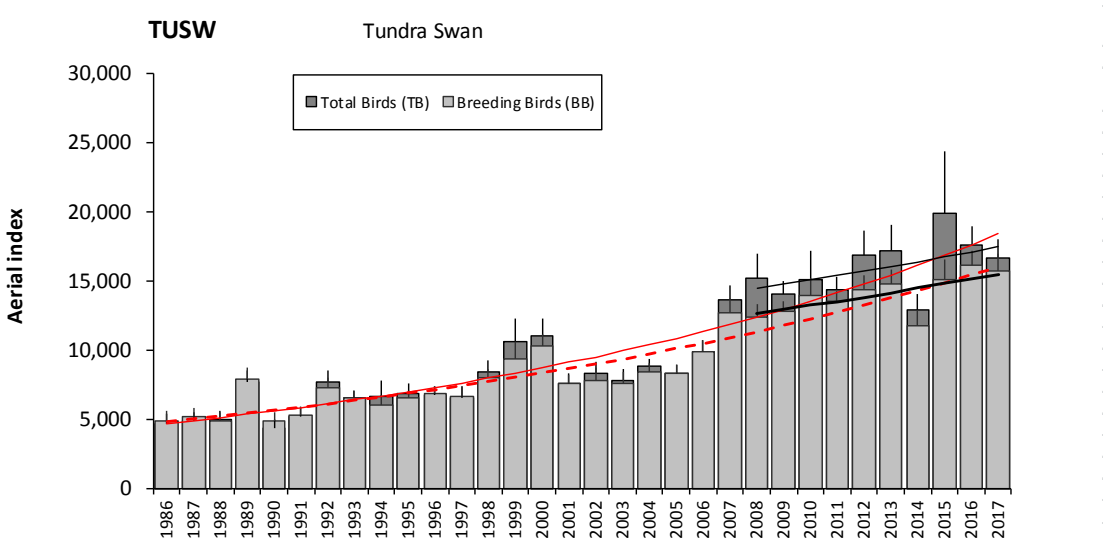
	Year	Breeding Birds (BB)	SE Breeding Birds	Total Birds (TB)	SE Total Birds
	1986	**237**	297	**592**	626
	1987	**118**	161	**118**	161
	1988	**0**	0	**0**	0
	1989	**118**	161	**118**	161
	1990	**188**	253	**188**	253
	1991	**0**	0	**0**	0
	1992	**334**	219	**334**	219
	1993	**411**	338	**411**	338
	1994	**48**	48	**48**	48
	1995	**176**	122	**176**	122
	1996	**25**	25	**25**	25
	1997	**47**	41	**47**	41
	1998	**640**	502	**640**	502
	1999	**0**	0	**0**	0
	2000	**0**	0	**0**	0
	2001	**0**	0	**0**	0
	2002	**99**	57	**99**	57
	2003	**0**	0	**0**	0
	2004	**25**	24	**25**	24
	2005	**49**	35	**49**	35
*	**2006**	**102**	61	**102**	61
	2007	**53**	43	**126**	84
	2008	**81**	72	**81**	72
	2009	**209**	98	**442**	254
	2010	**24**	24	**24**	24
	2011	**53**	41	**53**	41
	2012	**72**	38	**108**	51
	2013	**0**	0	**0**	0
	2014	**55**	50	**55**	50
	2015	**71**	50	**71**	50
	2016	**28**	27	**28**	27
	2017	**27**	27	**27**	27

All Year Index (1986-2017)	Breeding Birds (BB)	Total Birds (TB)
number of years =	32	32
average index =	**103**	**125**
SE average index =	25	30
95% CI index =	(54-151)	(65-184)
ave. annual growth =	**0.968**	**0.969**
95% CI annual growth =	(0.928-1.011)	(0.925-1.015)

10-Yr Index (2008-2017)	BB	TB
number of years =	10	10
average index =	**62**	**89**
SE average index =	18	40
95% CI index =	(26-98)	(10-168)
ave. annual growth =	**0.884**	**0.854**
95% CI annual growth =	(0.751-1.041)	(0.698-1.045)

Note:
Breeding Birds (BB) = Singles + 2 x (pairs)
Total Birds (TB) = Singles + (2 x pairs) + flocks

Figure 5. Summary of annual population indices for Red-necked Grebes (*Podiceps grisegena*) on the Arctic Coastal Plain, Alaska, 1986–2017. Average annual growth rates were estimated using log-linear regression, with standard errors (SE) calculated from residual errors around the regression line. Long-term growth rates are depicted in red (solid line = total birds [TB], dotted line = breeding birds [BB]), while 10-year growth rates are depicted in black (bold = TB, non-bold = BB). *Estimates from 1986 to 2006 are adjusted to account for survey timing and geographic extent of current (2007–2017) survey design (study area = 57,336 km^2).



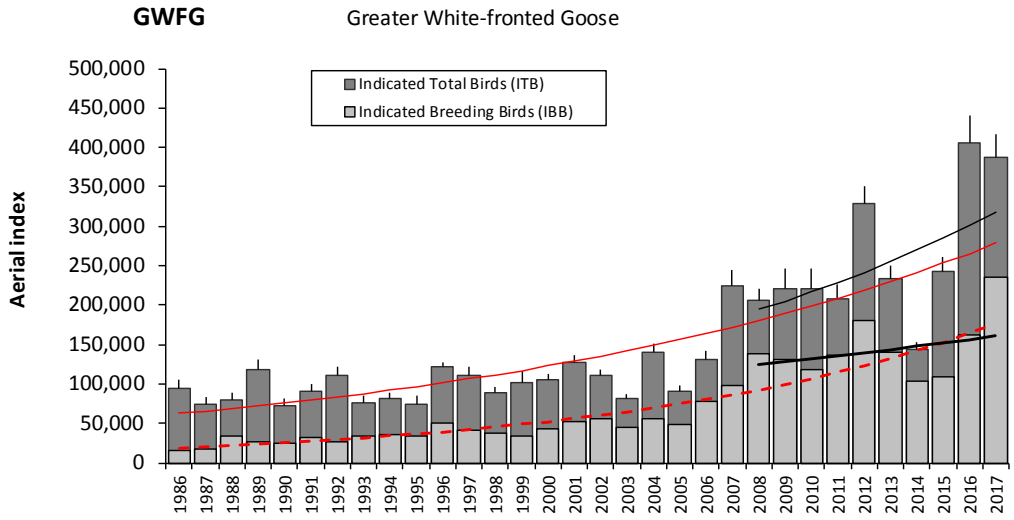
	Year	Breeding Birds (BB)	SE Breeding Birds	Total Birds (TB)	SE Total Birds
	1986	**4,910**	693	**4,690**	727
	1987	**5,199**	654	**4,905**	627
	1988	**4,913**	584	**5,003**	642
	1989	**7,915**	857	**7,682**	923
	1990	**4,916**	577	**4,439**	554
	1991	**5,280**	637	**5,205**	666
	1992	**7,310**	716	**7,726**	856
	1993	**6,554**	572	**6,574**	579
	1994	**6,018**	742	**6,692**	1,143
	1995	**6,567**	506	**6,880**	723
	1996	**6,852**	615	**6,812**	611
	1997	**6,647**	803	**6,607**	848
	1998	**7,995**	705	**8,450**	867
	1999	**9,381**	1,264	**10,625**	1,675
	2000	**10,331**	853	**11,070**	1,272
	2001	**7,580**	672	**7,666**	729
	2002	**7,882**	907	**8,356**	882
	2003	**7,598**	850	**7,808**	839
	2004	**8,483**	579	**8,869**	550
	2005	**8,361**	656	**8,346**	670
*	**2006**	**9,905**	871	**9,924**	877
	2007	**12,713**	1,024	**13,704**	1,042
	2008	**12,466**	889	**15,201**	1,812
	2009	**12,867**	662	**14,120**	936
	2010	**14,002**	1,281	**15,135**	2,097
	2011	**13,551**	790	**14,423**	914
	2012	**14,373**	1,025	**16,894**	1,825
	2013	**14,771**	1,091	**17,185**	1,907
	2014	**11,837**	1,056	**12,965**	1,084
	2015	**15,155**	1,486	**19,921**	4,537
	2016	**16,155**	1,054	**17,637**	1,299
	2017	**15,740**	1,215	**16,735**	1,359

All Year Index (1986-2017)	**Breeding Birds (BB)**	**Total Birds (TB)**
number of years =	32	32
average index =	**9,507**	**10,258**
SE average index =	640	797
95% CI index =	(8,253-10,761)	(8,696-11,820)
ave. annual growth =	**1.039**	**1.045**
95% CI annual growth =	(1.034-1.044)	(1.038-1.051)

10-Yr Index (2008-2017)	**BB**	**TB**
number of years =	10	10
average index =	**14,092**	**16,022**
SE average index =	449	645
95% CI index =	(13,211-14,972)	(14,758-17,285)
ave. annual growth =	**1.023**	**1.021**
95% CI annual growth =	(1.005-1.041)	(0.996-1.047)

Note:
Breeding Birds (BB) = Singles + 2 x (pairs)
Total Birds (TB) = Singles + (2 x pairs) + flocks

Figure 6. Summary of annual population indices for Tundra Swans (*Cygnus columbianus*) on the Arctic Coastal Plain, Alaska, 1986–2017. Average annual growth rates were estimated using log-linear regression, with standard errors (SE) calculated from residual errors around the regression line. Long-term growth rates are depicted in red (solid line = total birds [TB], dotted line = breeding birds [BB]), while 10-year growth rates are depicted in black (bold = TB, non-bold = BB). *Estimates from 1986 to 2006 are adjusted to account for survey timing and geographic extent of current (2007–2017) survey design (study area = 57,336 km^2).



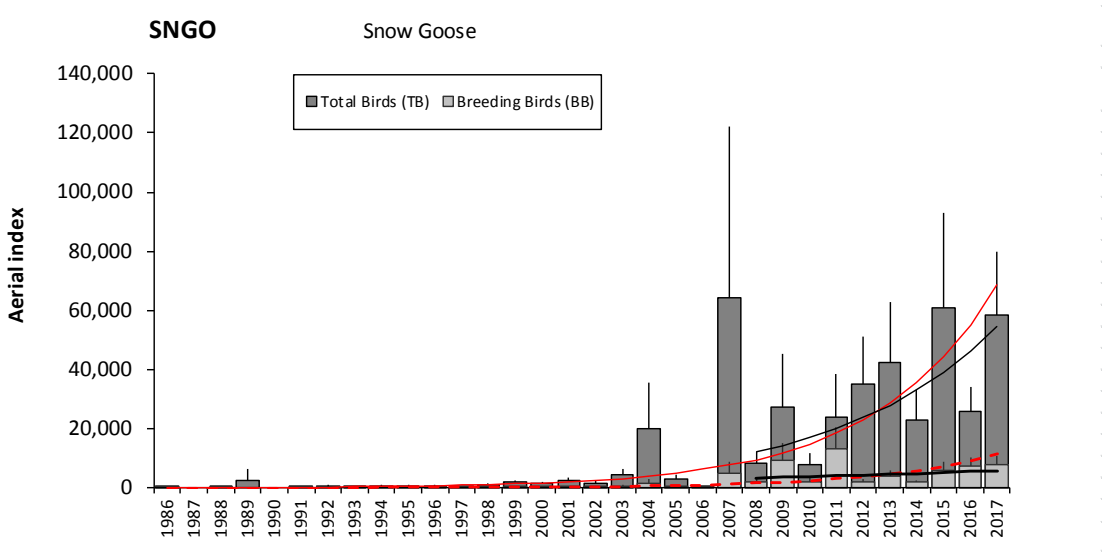
	Year	Indicated Breeding Birds (IBB)	SE Breeding Birds	Indicated Total Birds (ITB)	SE Indicated Total
	1986	**14,920**	2,045	**93,644**	12,467
	1987	**17,918**	2,318	**73,312**	9,981
	1988	**33,715**	3,670	**79,870**	9,585
	1989	**26,530**	2,898	**117,604**	14,150
	1990	**24,325**	2,752	**72,028**	10,383
	1991	**32,444**	3,389	**90,392**	10,007
	1992	**26,457**	2,580	**111,589**	10,739
	1993	**34,241**	2,717	**76,649**	7,684
	1994	**36,571**	2,413	**82,239**	7,030
	1995	**34,487**	2,375	**74,674**	10,054
	1996	**50,373**	3,644	**121,048**	6,400
	1997	**41,986**	3,690	**111,241**	11,253
	1998	**36,864**	3,025	**89,417**	7,293
	1999	**34,516**	2,726	**101,021**	16,021
	2000	**42,552**	3,085	**104,580**	7,711
	2001	**52,045**	3,124	**127,154**	8,512
	2002	**56,194**	4,332	**109,947**	8,415
	2003	**45,097**	3,301	**81,525**	5,841
	2004	**55,150**	3,736	**140,612**	9,824
	2005	**49,404**	3,328	**91,039**	6,446
*	**2006**	**78,113**	5,219	**131,683**	10,123
	2007	**98,618**	8,732	**225,227**	19,004
	2008	**137,897**	10,394	**205,832**	14,865
	2009	**130,675**	12,785	**220,650**	26,481
	2010	**117,688**	8,179	**220,917**	25,675
	2011	**137,215**	11,233	**208,644**	17,228
	2012	**180,939**	11,819	**329,567**	20,932
	2013	**139,803**	9,906	**233,467**	15,652
	2014	**104,217**	5,629	**144,271**	8,544
	2015	**108,960**	7,555	**243,561**	17,632
	2016	**161,812**	12,896	**406,515**	34,839
	2017	**234,708**	15,523	**387,991**	29,231

All Year Index (1986-2017)	**Indicated Breeding Birds (IBB)**	**Indicated Total Birds (ITB)**
number of years =	32	32
average index =	**74,264**	**153,372**
SE average index =	9,780	16,042
95% CI index =	(48,458-82,810)	(121,931-184,814)
ave. annual growth =	**1.076**	**1.047**
95% CI annual growth =	(1.066-1.085)	(1.036-1.058)

10-Yr Index (2008-2017)	**IBB**	**ITB**
number of years =	10	10
average index =	**145,391**	**260,142**
SE average index =	12,325	27,019
95% CI index =	(121,234-169,548)	(207,184-313,099)
ave. annual growth =	**1.030**	**1.056**
95% CI annual growth =	(0.977-1.085)	(0.992-1.124)

Note:
Indicated Breeding Birds (IBB) = 2 x (singles + pairs)
Indicated Total Birds (ITB) = 2 x (singles + pairs) + flocks

Figure 7. Summary of annual population indices for Greater White-fronted Geese (*Anser albifrons*) on the Arctic Coastal Plain, Alaska, 1986–2017. Average annual growth rates were estimated using log-linear regression, with standard errors (SE) calculated from residual errors around the regression line. Long-term growth rates are depicted in red (solid line = indicated total birds [ITB], dotted line = indicated breeding birds [IBB]), while 10-year growth rates are depicted in black (bold = ITB, non-bold = IBB). *Estimates from 1986 to 2006 are adjusted to account for survey timing and geographic extent of current (2007–2017) survey design (study area = 57,336 km^2).



	Year	Breeding Birds (BB)	SE Breeding Birds	Total Birds (TB)	SE Total Birds
	1986	**22**	27	**127**	138
	1987	**0**	0	**0**	0
	1988	**23**	29	**224**	273
	1989	**0**	0	**2,665**	3,664
	1990	**0**	0	**0**	0
	1991	**44**	54	**62**	83
	1992	**90**	62	**625**	525
	1993	**94**	65	**309**	172
	1994	**24**	24	**663**	465
	1995	**437**	193	**569**	233
	1996	**200**	109	**578**	290
	1997	**221**	107	**306**	135
	1998	**235**	100	**971**	613
	1999	**153**	68	**1,788**	894
	2000	**378**	114	**1,583**	535
	2001	**232**	81	**2,303**	1,266
	2002	**173**	115	**1,585**	734
	2003	**630**	255	**4,317**	2,111
	2004	**1,665**	1,323	**20,139**	15,319
	2005	**314**	197	**3,163**	1,513
*	**2006**	**241**	104	**405**	170
	2007	**4,783**	4,239	**64,120**	58,163
	2008	**2,011**	1,309	**8,282**	3,707
	2009	**9,247**	5,909	**27,154**	17,952
	2010	**2,160**	1,093	**7,929**	3,573
	2011	**12,974**	7,582	**23,662**	14,869
	2012	**2,243**	892	**34,926**	16,228
	2013	**3,991**	2,069	**42,277**	20,361
	2014	**1,916**	643	**22,811**	10,514
	2015	**6,097**	2,683	**60,837**	32,050
	2016	**7,137**	2,968	**25,845**	8,208
	2017	**7,732**	2,938	**58,265**	21,355

All Year Index (1986-2017)	**Breeding Birds (BB)**	**Total Birds (TB)**
number of years =	32	32
average index =	**2,046**	**13,078**
SE average index =	575	3,451
95% CI index =	(919-3,173)	(6,313-19,842)
ave. annual growth =	**1.240**	**1.242**
95% CI annual growth =	(1.202-1.279)	(1.193-1.293)

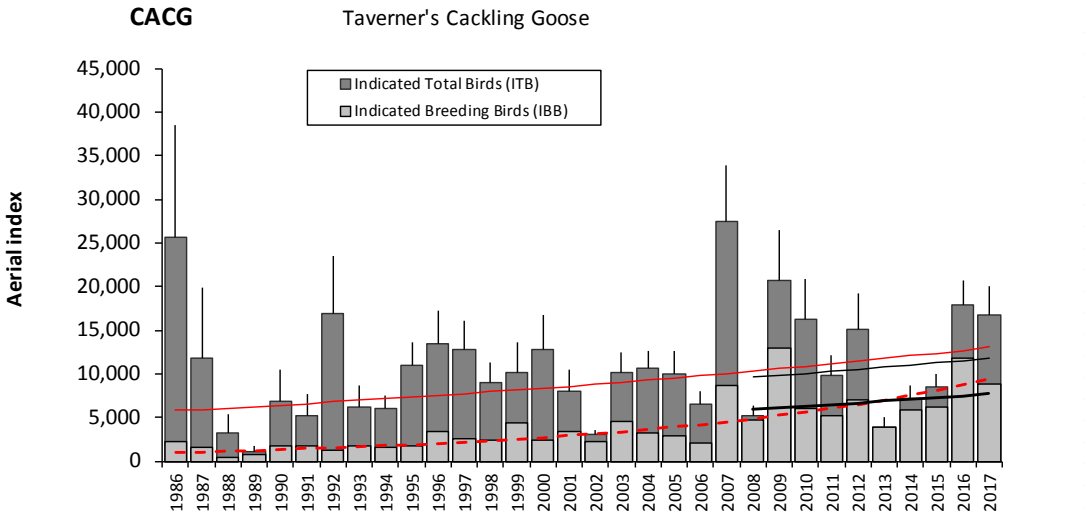
10-Yr Index (2008-2017)	**BB**	**TB**
number of years =	10	10
average index =	**5,551**	**31,199**
SE average index =	1,188	5,760
95% CI index =	(3,223-7,879)	(19,908-42,489)
ave. annual growth =	**1.065**	**1.181**
95% CI annual growth =	(0.908-1.248)	(1.056-1.321)

Note:

Breeding Birds (BB) = Singles + 2 x (pairs)

Total Birds (TB) = Singles + (2 x pairs) + flocks

Figure 8. Summary of annual population indices for Snow Geese (*Chen caerulescens*) on the Arctic Coastal Plain, Alaska, 1986–2017. Average annual growth rates were estimated using log-linear regression, with standard errors (SE) calculated from residual errors around the regression line. Long-term growth rates are depicted in red (solid line = total birds [TB], dotted line = breeding birds [BB]), while 10-year growth rates are depicted in black (bold = TB, non-bold = BB). *Estimates from 1986 to 2006 are adjusted to account for survey timing and geographic extent of current (2007–2017) survey design (study area = 57,336 km^2).



	Year	Indicated Breeding Birds (IBB)	SE Breeding Birds	Indicated Total Birds (ITB)	SE Indicated Total
	1986	**2,242**	474	**25,689**	12,728
	1987	**1,562**	383	**11,734**	8,176
	1988	**489**	209	**3,220**	2,060
	1989	**703**	230	**1,134**	525
	1990	**1,716**	404	**6,893**	3,501
	1991	**1,782**	435	**5,135**	2,579
	1992	**1,261**	284	**16,941**	6,548
	1993	**1,685**	489	**6,178**	2,495
	1994	**1,606**	309	**5,979**	1,530
	1995	**1,756**	369	**10,913**	2,690
	1996	**3,320**	816	**13,397**	3,842
	1997	**2,536**	822	**12,701**	3,410
	1998	**2,464**	537	**9,043**	2,246
	1999	**4,347**	881	**10,218**	3,443
	2000	**2,455**	397	**12,795**	3,888
	2001	**3,460**	774	**8,058**	2,394
	2002	**2,264**	385	**3,044**	444
	2003	**4,504**	681	**10,188**	2,210
	2004	**3,154**	494	**10,653**	1,917
	2005	**2,946**	508	**10,048**	2,635
*	**2006**	**2,087**	410	**6,505**	1,524
	2007	**8,572**	2,117	**27,402**	6,551
	2008	**4,672**	983	**5,259**	1,062
	2009	**12,925**	2,381	**20,718**	5,657
	2010	**6,030**	1,114	**16,264**	4,565
	2011	**5,155**	1,202	**9,859**	2,335
	2012	**7,087**	1,888	**15,028**	4,114
	2013	**3,910**	1,174	**3,910**	1,174
	2014	**5,836**	1,306	**7,110**	1,494
	2015	**6,150**	1,053	**8,432**	1,488
	2016	**11,837**	1,672	**17,927**	2,685
	2017	**8,780**	1,929	**16,719**	3,278

All Year Index (1986-2017)	**Indicated Breeding Birds (IBB)**	**Indicated Total Birds (ITB)**
number of years =	32	32
average index =	**4,041**	**10,909**
SE average index =	541	1,106
95% CI index =	(2,391-4,154)	(8,741-13,077)
ave. annual growth =	**1.071**	**1.018**
95% CI annual growth =	(1.054-1.087)	(0.993-1.043)

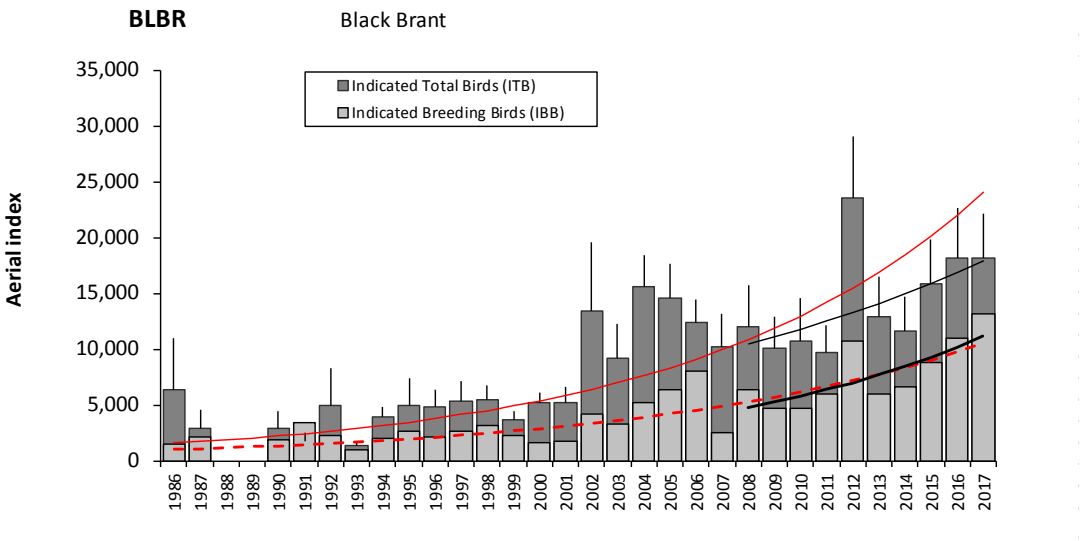
10-Yr Index (2008-2017)	**IBB**	**ITB**
number of years =	10	10
average index =	**7,238**	**12,123**
SE average index =	957	1,864
95% CI index =	(5,362-9,115)	(8,469-15,776)
ave. annual growth =	**1.030**	**1.023**
95% CI annual growth =	(0.945-1.123)	(0.899-1.165)

Note:

Indicated Breeding Birds (IBB) = 2 x (singles + pairs)

Indicated Total Birds (ITB) = 2 x (singles + pairs) + flocks

Figure 9. Summary of annual population indices for Taverner's Cackling Goose (*Branta hutchinisii taverneri*) on the Arctic Coastal Plain, Alaska, 1986–2017. Average annual growth rates were estimated using log-linear regression, with standard errors (SE) calculated from residual errors around the regression line. Long-term growth rates are depicted in red (solid line = indicated total birds [ITB], dotted line = indicated breeding birds [IBB]), while 10-year growth rates are depicted in black (bold = ITB, non-bold = IBB). *Estimates from 1986 to 2006 are adjusted to account for survey timing and geographic extent of current (2007–2017) survey design (study area = 57,336 km^2).



	Year	Indicated Breeding Birds (IBB)	SE Breeding Birds	Indicated Total Birds (ITB)	SE Indicated Total
	1986	**1,529**	594	**6,297**	4,712
	1987	**2,176**	747	**2,938**	1,556
	1988	**0**	0	**0**	0
	1989	**0**	0	**0**	0
	1990	**1,861**	830	**2,875**	1,574
	1991	**3,408**	1,498	**1,737**	708
	1992	**2,206**	795	**4,977**	3,239
	1993	**943**	281	**1,324**	455
	1994	**2,012**	437	**3,914**	921
	1995	**2,653**	1,183	**4,975**	2,337
	1996	**2,057**	562	**4,751**	1,555
	1997	**2,603**	762	**5,352**	1,770
	1998	**3,190**	664	**5,405**	1,316
	1999	**2,239**	512	**3,697**	746
	2000	**1,559**	294	**5,210**	897
	2001	**1,729**	425	**5,149**	1,491
	2002	**4,218**	699	**13,368**	6,210
	2003	**3,247**	688	**9,159**	3,104
	2004	**5,246**	789	**15,569**	2,813
	2005	**6,321**	929	**14,558**	3,013
*	**2006**	**8,010**	1,230	**12,380**	2,037
	2007	**2,481**	962	**10,131**	3,028
	2008	**6,347**	1,652	**11,930**	3,720
	2009	**4,635**	1,233	**10,095**	2,808
	2010	**4,737**	982	**10,720**	3,892
	2011	**5,919**	1,485	**9,684**	2,483
	2012	**10,663**	2,284	**23,548**	5,550
	2013	**5,928**	1,567	**12,862**	3,586
	2014	**6,623**	1,187	**11,610**	3,119
	2015	**8,810**	1,921	**15,777**	4,052
	2016	**10,946**	2,347	**18,095**	4,485
	2017	**13,136**	2,706	**18,192**	3,888

All Year Index (1986-2017)	**Indicated Breeding Birds (IBB)**	**Indicated Total Birds (ITB)**
number of years =	32	32
average index =	**4,295**	**8,634**
SE average index =	575	1,042
95% CI index =	(2,445-4,296)	(6,592-10,675)
ave. annual growth =	**1.077**	**1.084**
95% CI annual growth =	(1.058-1.095)	(1.062-1.105)

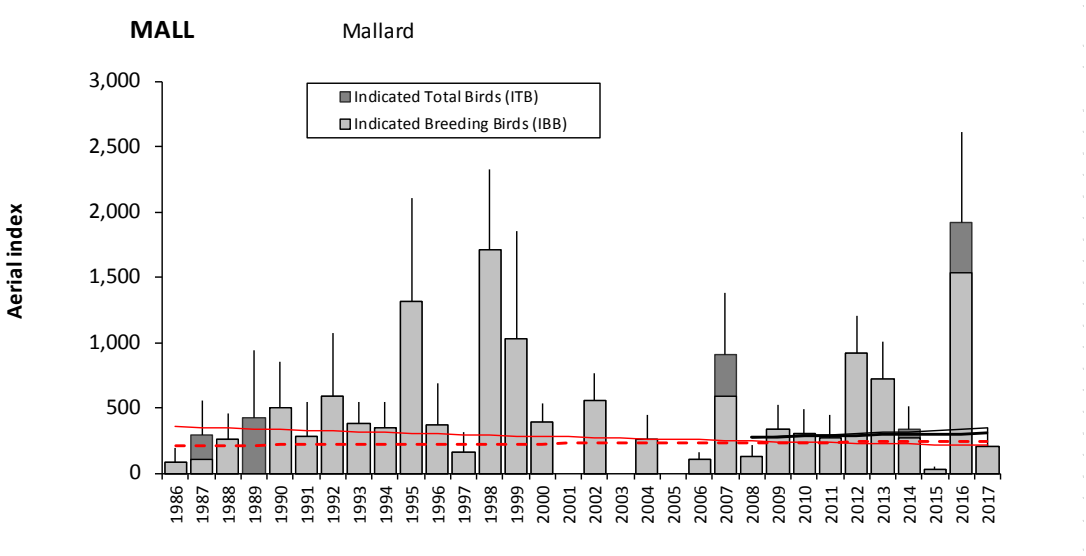
10-Yr Index (2008-2017)	**IBB**	**ITB**
number of years =	10	10
average index =	**7,774**	**14,251**
SE average index =	928	1,430
95% CI index =	(5,955-9,593)	(11,449-17,054)
ave. annual growth =	**1.098**	**1.061**
95% CI annual growth =	(1.042-1.157)	(1.005-1.120)

Note:

Indicated Breeding Birds (IBB) = 2 x (singles + pairs)

Indicated Total Birds (ITB) = 2 x (singles + pairs) + flocks

Figure 10. Summary of annual population indices for Pacific Black Brant (*Branta bernicla nigricans*) on the Arctic Coastal Plain, Alaska, 1986–2017. Average annual growth rates were estimated using log-linear regression, with standard errors (SE) calculated from residual errors around the regression line. Long-term growth rates are depicted in red (solid line = indicated total birds [ITB], dotted line = indicated breeding birds [IBB]), while 10-year growth rates are depicted in black (bold = ITB, non-bold = IBB). *Estimates from 1986 to 2006 are adjusted to account for survey timing and geographic extent of current (2007–2017) survey design (study area = 57,336 km^2).



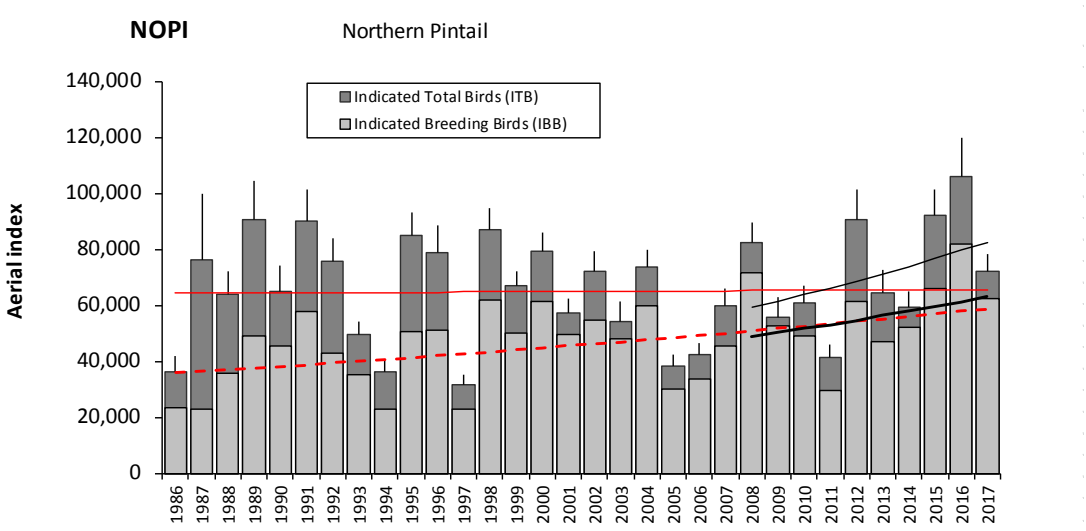
	Year	Indicated Breeding Birds (IBB)	SE Breeding Birds	Indicated Total Birds (ITB)	SE Indicated Total
	1986	**85**	106	**85**	106
	1987	**108**	129	**296**	264
	1988	**262**	195	**262**	195
	1989	**0**	0	**427**	511
	1990	**496**	351	**496**	351
	1991	**281**	264	**281**	264
	1992	**592**	485	**592**	485
	1993	**380**	158	**380**	158
	1994	**341**	202	**341**	202
	1995	**1,309**	800	**1,309**	800
	1996	**371**	314	**371**	314
	1997	**164**	145	**164**	145
	1998	**1,710**	609	**1,710**	609
	1999	**1,029**	826	**1,029**	826
	2000	**389**	148	**389**	148
	2001	**0**	0	**0**	0
	2002	**550**	216	**550**	216
	2003	**0**	0	**0**	0
	2004	**257**	189	**257**	189
	2005	**0**	0	**0**	0
*	**2006**	**102**	58	**102**	58
	2007	**584**	358	**904**	470
	2008	**128**	85	**128**	85
	2009	**330**	194	**330**	194
	2010	**301**	191	**301**	191
	2011	**269**	179	**269**	179
	2012	**918**	287	**918**	287
	2013	**723**	277	**723**	277
	2014	**265**	156	**340**	173
	2015	**23**	22	**23**	22
	2016	**1,537**	602	**1,923**	686
	2017	**202**	145	**202**	145

All Year Index (1986-2017)	Indicated Breeding Birds (IBB)	Indicated Total Birds (ITB)
number of years =	32	32
average index =	**428**	**472**
SE average index =	78	83
95% CI index =	(179-366)	(309-635)
ave. annual growth =	**1.010**	**0.991**
95% CI annual growth =	(0.956-1.066)	(0.941-1.043)

10-Yr Index (2008-2017)	IBB	ITB
number of years =	10	10
average index =	**470**	**516**
SE average index =	146	178
95% CI index =	(183-756)	(167-865)
ave. annual growth =	**1.011**	**1.025**
95% CI annual growth =	(0.775-1.319)	(0.779-1.348)

Note:
Indicated Breeding Birds (IBB) = 2 x (singles + pairs)
Indicated Total Birds (ITB) = 2 x (singles + pairs) + flocks

Figure 11. Summary of annual population indices for Mallards (*Anas platyrhynchos*) on the Arctic Coastal Plain, Alaska, 1986–2017. Average annual growth rates were estimated using log-linear regression, with standard errors (SE) calculated from residual errors around the regression line. Long-term growth rates are depicted in red (solid line = indicated total birds [ITB], dotted line = indicated breeding birds [IBB]), while 10-year growth rates are depicted in black (bold = ITB, non-bold = IBB). *Estimates from 1986 to 2006 are adjusted to account for survey timing and geographic extent of current (2007–2017) survey design (study area = 57,336 km^2).



	Year	Indicated Breeding Birds (IBB)	SE Breeding Birds	Indicated Total Birds (ITB)	SE Indicated Total
	1986	**23,533**	2,565	**36,279**	5,413
	1987	**23,020**	3,131	**75,983**	23,725
	1988	**35,544**	3,386	**63,794**	8,004
	1989	**48,769**	6,078	**90,413**	14,121
	1990	**45,195**	5,465	**64,894**	9,222
	1991	**57,581**	5,749	**90,253**	11,069
	1992	**42,946**	4,158	**75,558**	8,111
	1993	**34,913**	2,524	**49,411**	4,899
	1994	**22,975**	2,175	**36,060**	4,364
	1995	**50,509**	3,909	**85,039**	7,930
	1996	**51,047**	4,234	**78,644**	9,927
	1997	**22,605**	2,428	**31,737**	3,637
	1998	**61,970**	4,733	**87,104**	7,457
	1999	**49,959**	3,260	**66,674**	5,259
	2000	**61,117**	3,561	**79,357**	6,366
	2001	**49,639**	3,600	**57,333**	4,911
	2002	**54,846**	4,544	**71,946**	7,036
	2003	**47,941**	4,819	**54,275**	6,931
	2004	**59,749**	4,924	**73,690**	6,074
	2005	**29,911**	2,868	**38,364**	3,706
*	**2006**	**33,801**	3,143	**42,102**	4,273
	2007	**45,132**	3,839	**59,796**	6,120
	2008	**71,652**	5,391	**82,224**	7,207
	2009	**52,587**	6,480	**55,715**	7,094
	2010	**49,018**	4,257	**60,800**	5,868
	2011	**29,384**	2,546	**41,221**	4,463
	2012	**61,485**	5,401	**90,269**	10,914
	2013	**46,887**	3,496	**64,276**	8,387
	2014	**51,817**	4,718	**59,377**	5,465
	2015	**65,774**	5,523	**92,056**	9,028
	2016	**81,733**	9,577	**105,673**	14,056
	2017	**62,312**	5,126	**71,852**	6,551

All Year Index (1986-2017)	**Indicated Breeding Birds (IBB)**	**Indicated Total Birds (ITB)**
number of years =	32	32
average index =	**47,667**	**66,630**
SE average index =	2,625	3,384
95% CI index =	(25,328-31,300)	(59,998-73,262)
ave. annual growth =	**1.019**	**1.004**
95% CI annual growth =	(1.007-1.030)	(0.992-1.016)

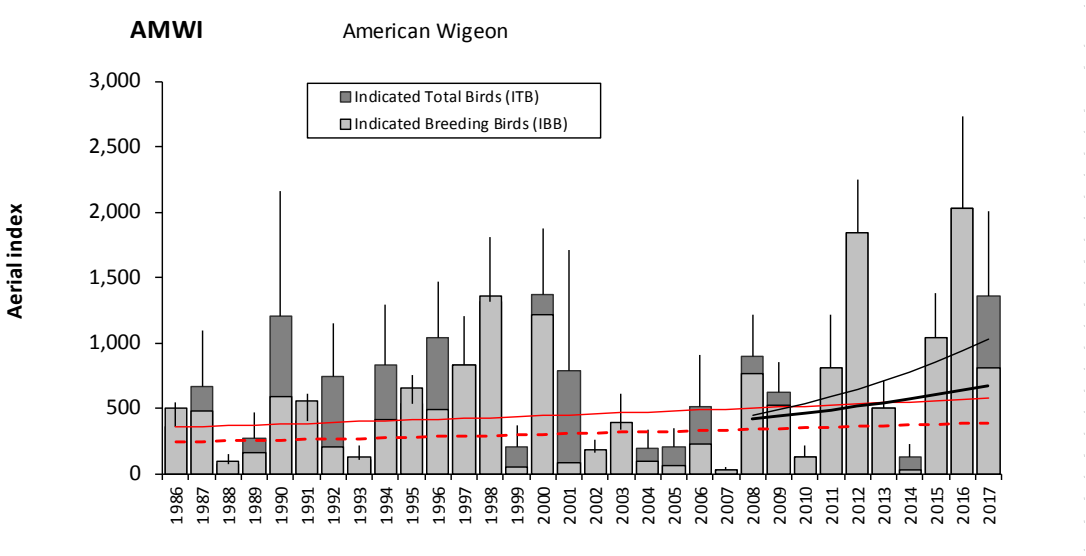
10-Yr Index (2008-2017)	**IBB**	**ITB**
number of years =	10	10
average index =	**57,265**	**72,346**
SE average index =	4,626	6,263
95% CI index =	(48,198-66,332)	(60,071-84,621)
ave. annual growth =	**1.029**	**1.038**
95% CI annual growth =	(0.967-1.095)	(0.978-1.101)

Note:

Indicated Breeding Birds (IBB) = 2 x (singles + pairs)

Indicated Total Birds (ITB) = 2 x (singles + pairs) + flocks

Figure 12. Summary of annual population indices for Northern Pintail (*Anas acuta*) on the Arctic Coastal Plain, Alaska, 1986–2017. Average annual growth rates were estimated using log-linear regression, with standard errors (SE) calculated from residual errors around the regression line. Long-term growth rates are depicted in red (solid line = indicated total birds [ITB], dotted line = indicated breeding birds [IBB]), while 10-year growth rates are depicted in black (bold = ITB, non-bold = IBB). *Estimates from 1986 to 2006 are adjusted to account for survey timing and geographic extent of current (2007–2017) survey design (study area = 57,336 km^2).



	Year	Indicated Breeding Birds (IBB)	SE Breeding Birds	Indicated Total Birds (ITB)	SE Indicated Total
	1986	**501**	235	**360**	181
	1987	**473**	259	**663**	428
	1988	**94**	103	**68**	78
	1989	**164**	135	**265**	206
	1990	**588**	324	**1,200**	960
	1991	**557**	280	**400**	216
	1992	**208**	110	**743**	405
	1993	**126**	143	**104**	111
	1994	**409**	343	**834**	456
	1995	**653**	262	**534**	224
	1996	**492**	148	**1,035**	436
	1997	**832**	363	**834**	368
	1998	**1,360**	532	**1,316**	495
	1999	**52**	43	**207**	156
	2000	**1,219**	546	**1,368**	509
	2001	**79**	70	**788**	921
	2002	**181**	118	**158**	101
	2003	**395**	340	**339**	269
	2004	**90**	81	**196**	138
	2005	**57**	33	**205**	145
*	**2006**	**224**	104	**512**	394
	2007	**24**	22	**24**	22
	2008	**759**	297	**900**	317
	2009	**521**	217	**620**	231
	2010	**131**	85	**131**	85
	2011	**806**	411	**806**	411
	2012	**1,837**	411	**1,837**	411
	2013	**500**	206	**500**	206
	2014	**25**	25	**125**	105
	2015	**1,042**	338	**1,042**	338
	2016	**2,025**	706	**2,025**	706
	2017	**805**	350	**1,358**	646

All Year Index (1986-2017)	Indicated Breeding Birds (IBB)	Indicated Total Birds (ITB)
number of years =	32	32
average index =	**539**	**672**
SE average index =	90	92
95% CI index =	(306-582)	(491-852)
ave. annual growth =	**1.011**	**1.015**
95% CI annual growth =	(0.966-1.058)	(0.976-1.056)

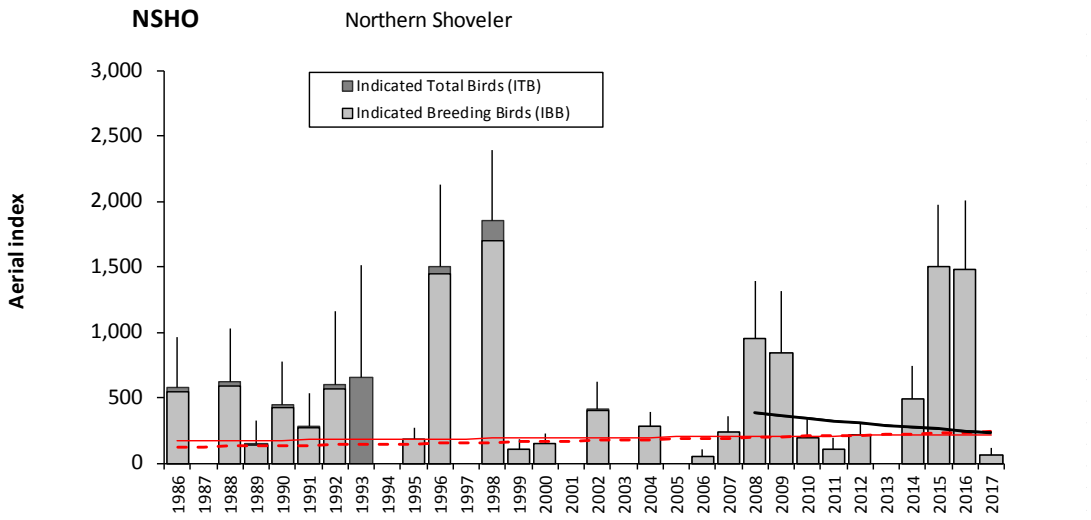
10-Yr Index (2008-2017)	IBB	ITB
number of years =	10	10
average index =	**845**	**935**
SE average index =	206	206
95% CI index =	(441-1,250)	(532-1,337)
ave. annual growth =	**1.054**	**1.098**
95% CI annual growth =	(0.782-1.421)	(0.886-1.361)

Note:

Indicated Breeding Birds (IBB) = 2 x (singles + pairs)

Indicated Total Birds (ITB) = 2 x (singles + pairs) + flocks

Figure 13. Summary of annual population indices for American Wigeon (*Anas americana*) on the Arctic Coastal Plain, Alaska, 1986–2017. Average annual growth rates were estimated using log-linear regression, with standard errors (SE) calculated from residual errors around the regression line. Long-term growth rates are depicted in red (solid line = indicated total birds [ITB], dotted line = indicated breeding birds [IBB]), while 10-year growth rates are depicted in black (bold = ITB, non-bold = IBB). *Estimates from 1986 to 2006 are adjusted to account for survey timing and geographic extent of current (2007–2017) survey design (study area = 57,336 km^2).



	Year	Indicated Breeding Birds (IBB)	SE Breeding Birds	Indicated Total Birds (ITB)	SE Indicated Total
	1986	**543**	356	**577**	381
	1987	**0**	0	**0**	0
	1988	**587**	377	**624**	404
	1989	**137**	162	**146**	173
	1990	**418**	305	**445**	326
	1991	**267**	229	**284**	245
	1992	**563**	525	**599**	561
	1993	**0**	0	**650**	862
	1994	**0**	0	**0**	0
	1995	**181**	89	**181**	89
	1996	**1,445**	591	**1,497**	628
	1997	**0**	0	**0**	0
	1998	**1,701**	497	**1,852**	537
	1999	**103**	79	**103**	79
	2000	**153**	76	**153**	76
	2001	**0**	0	**0**	0
	2002	**398**	208	**407**	219
	2003	**0**	0	**0**	0
	2004	**282**	109	**282**	109
	2005	**0**	0	**0**	0
*	**2006**	**51**	53	**51**	53
	2007	**242**	112	**242**	112
	2008	**953**	433	**953**	433
	2009	**841**	475	**841**	475
	2010	**195**	145	**195**	145
	2011	**106**	82	**106**	82
	2012	**215**	100	**215**	100
	2013	**0**	0	**0**	0
	2014	**484**	255	**484**	255
	2015	**1,504**	472	**1,504**	472
	2016	**1,481**	521	**1,481**	521
	2017	**55**	55	**55**	55

All Year Index (1986-2017)	**Indicated Breeding Birds (IBB)**	**Indicated Total Birds (ITB)**
number of years =	32	32
average index =	**403**	**435**
SE average index =	88	91
95% CI index =	(176-432)	(257-613)
ave. annual growth =	**1.013**	**1.001**
95% CI annual growth =	(0.959-1.070)	(0.948-1.057)

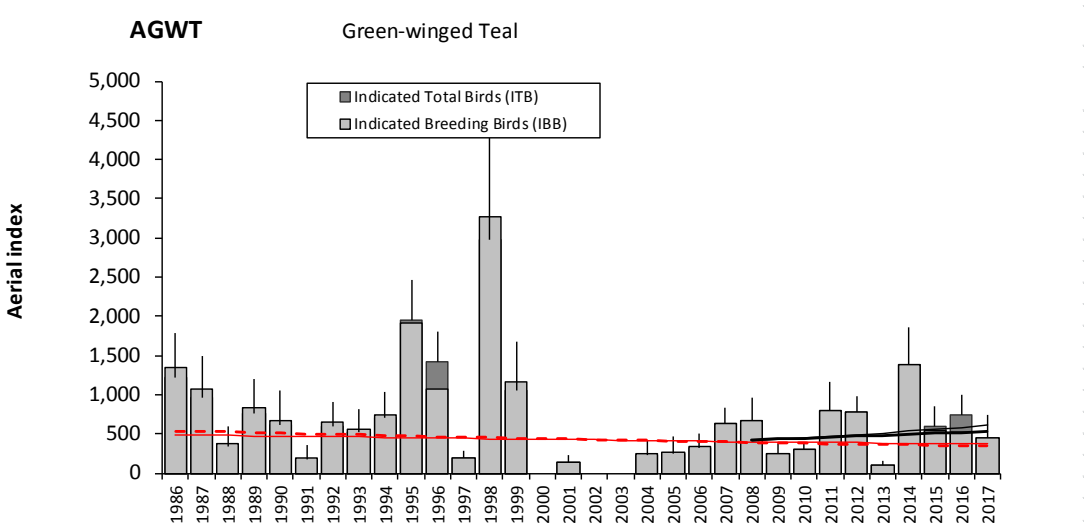
10-Yr Index (2008-2017)	**IBB**	**ITB**
number of years =	10	10
average index =	**583**	**583**
SE average index =	183	183
95% CI index =	(226-941)	(226-941)
ave. annual growth =	**0.947**	**0.947**
95% CI annual growth =	(0.686-1.307)	(0.686-1.307)

Note:

Indicated Breeding Birds (IBB) = 2 x (singles + pairs)

Indicated Total Birds (ITB) = 2 x (singles + pairs) + flocks

Figure 14. Summary of annual population indices for Northern Shoveler (*Anas clypeata*) on the Arctic Coastal Plain, Alaska, 1986–2017. Average annual growth rates were estimated using log-linear regression, with standard errors (SE) calculated from residual errors around the regression line. Long-term growth rates are depicted in red (solid line = indicated total birds [ITB], dotted line = indicated breeding birds [IBB]), while 10-year growth rates are depicted in black (bold = ITB, non-bold = IBB). *Estimates from 1986 to 2006 are adjusted to account for survey timing and geographic extent of current (2007–2017) survey design (study area = 57,336 km^2).



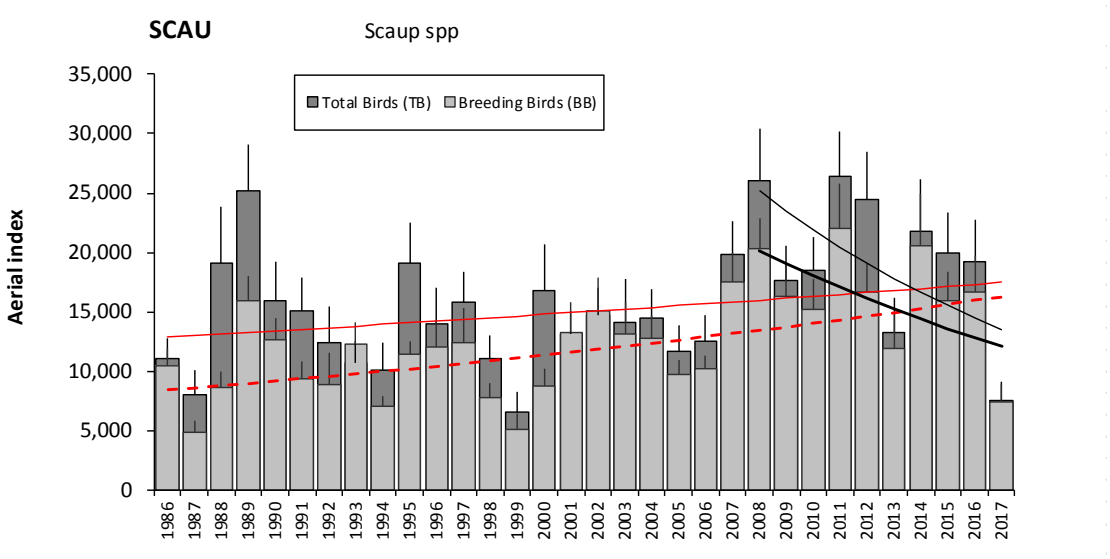
	Year	Indicated Breeding Birds (IBB)	SE Breeding Birds	Indicated Total Birds (ITB)	SE Indicated Total
	1986	**1,348**	616	**1,211**	568
	1987	**1,064**	578	**956**	532
	1988	**372**	286	**335**	261
	1989	**840**	476	**755**	437
	1990	**674**	485	**606**	447
	1991	**188**	212	**169**	194
	1992	**657**	347	**591**	317
	1993	**553**	305	**531**	285
	1994	**750**	346	**708**	321
	1995	**1,908**	513	**1,954**	505
	1996	**1,067**	368	**1,414**	391
	1997	**195**	84	**195**	84
	1998	**3,274**	1,436	**2,975**	1,328
	1999	**1,160**	665	**1,057**	615
	2000	**0**	0	**0**	0
	2001	**146**	77	**146**	77
	2002	**0**	0	**0**	0
	2003	**0**	0	**0**	0
	2004	**242**	198	**222**	182
	2005	**267**	246	**248**	226
*	**2006**	**347**	190	**327**	177
	2007	**627**	215	**627**	215
	2008	**666**	291	**666**	291
	2009	**251**	129	**251**	129
	2010	**308**	88	**308**	88
	2011	**798**	367	**798**	367
	2012	**771**	210	**771**	210
	2013	**109**	53	**109**	53
	2014	**1,384**	471	**1,384**	471
	2015	**536**	255	**594**	261
	2016	**522**	156	**742**	263
	2017	**453**	285	**453**	285

All Year Index (1986-2017)	Indicated Breeding Birds (IBB)	Indicated Total Birds (ITB)
number of years =	32	32
average index =	**671**	**659**
SE average index =	116	110
95% CI index =	(302-647)	(444-875)
ave. annual growth =	**0.980**	**0.986**
95% CI annual growth =	(0.944-1.019)	(0.948-1.024)

10-Yr Index (2008-2017)	IBB	ITB
number of years =	10	10
average index =	**580**	**608**
SE average index =	114	114
95% CI index =	(357-803)	(383-832)
ave. annual growth =	**1.025**	**1.044**
95% CI annual growth =	(0.872-1.205)	(0.886-1.229)

Note:
Indicated Breeding Birds (IBB) = 2 x (singles + pairs)
Indicated Total Birds (ITB) = 2 x (singles + pairs) + flocks

Figure 15. Summary of annual population indices for American Green-winged Teal (*Anas crecca*) on the Arctic Coastal Plain, Alaska, 1986–2017. Average annual growth rates were estimated using log-linear regression, with standard errors (SE) calculated from residual errors around the regression line. Long-term growth rates are depicted in red (solid line = indicated total birds [ITB], dotted line = indicated breeding birds [IBB]), while 10-year growth rates are depicted in black (bold = ITB, non-bold = IBB). *Estimates from 1986 to 2006 are adjusted to account for survey timing and geographic extent of current (2007–2017) survey design (study area = 57,336 km^2).



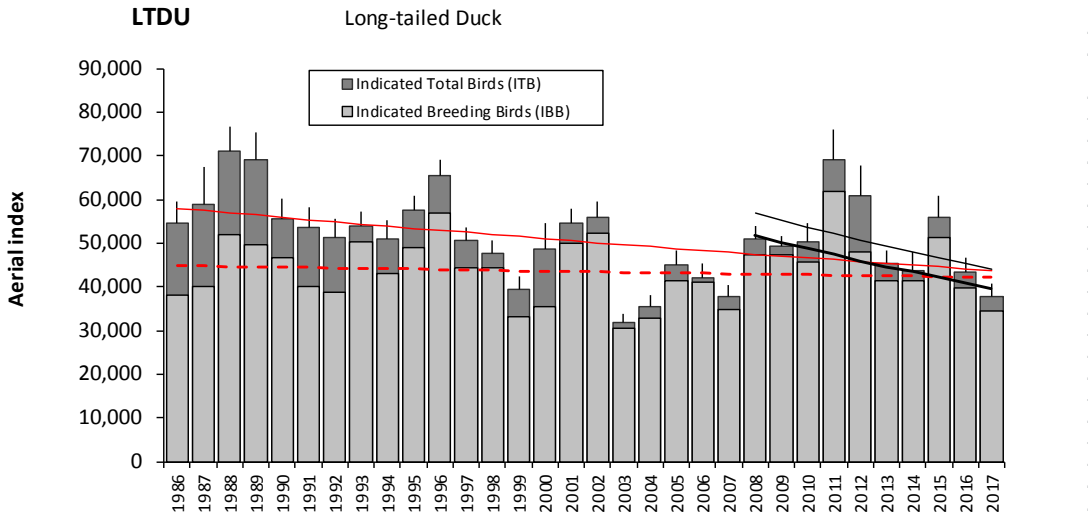
	Year	Breeding Birds (BB)	SE Breeding Birds	Total Birds (TB)	SE Total Birds
	1986	**10,422**	1,534	**11,025**	1,772
	1987	**4,855**	967	**8,014**	2,080
	1988	**8,695**	1,298	**19,104**	4,790
	1989	**15,962**	2,081	**25,230**	3,874
	1990	**12,620**	1,823	**15,948**	3,296
	1991	**9,352**	1,442	**15,149**	2,790
	1992	**8,897**	2,646	**12,464**	2,986
	1993	**12,313**	1,851	**10,739**	1,846
	1994	**7,081**	878	**10,078**	2,289
	1995	**11,474**	1,115	**19,168**	3,361
	1996	**12,108**	2,205	**13,982**	3,083
	1997	**12,482**	2,832	**15,767**	2,611
	1998	**7,835**	1,130	**11,057**	2,002
	1999	**5,132**	1,274	**6,544**	1,684
	2000	**8,768**	1,426	**16,839**	3,856
	2001	**13,262**	2,505	**13,102**	2,028
	2002	**15,065**	2,823	**14,752**	2,315
	2003	**13,174**	2,596	**14,147**	3,669
	2004	**12,845**	1,875	**14,496**	2,379
	2005	**9,722**	1,275	**11,745**	2,131
*	2006	**10,176**	1,198	**12,578**	2,114
	2007	**17,508**	2,502	**19,842**	2,778
	2008	**20,291**	2,638	**26,094**	4,291
	2009	**16,355**	2,601	**17,665**	2,913
	2010	**15,227**	2,504	**18,499**	2,812
	2011	**21,979**	3,801	**26,367**	3,841
	2012	**16,709**	2,433	**24,490**	3,951
	2013	**11,931**	2,744	**13,256**	2,902
	2014	**20,577**	4,338	**21,796**	4,423
	2015	**15,988**	2,397	**19,915**	3,497
	2016	**16,643**	3,119	**19,195**	3,609
	2017	**7,375**	1,529	**7,541**	1,538

All Year Index (1986-2017)	Breeding Birds (BB)	Total Birds (TB)
number of years =	32	32
average index =	**12,588**	**15,831**
SE average index =	771	940
95% CI index =	(11,077-14,100)	(13,989-17,673)
ave. annual growth =	**1.020**	**1.011**
95% CI annual growth =	(1.008-1.033)	(0.998-1.024)

10-Yr Index (2008-2017)	BB	TB
number of years =	10	10
average index =	**16,308**	**19,482**
SE average index =	1,361	1,848
95% CI index =	(13,640-18,976)	(15,859-23,104)
ave. annual growth =	**0.945**	**0.933**
95% CI annual growth =	(0.889-1.005)	(0.869-1.002)

Note:
Breeding Birds (BB) = Singles + 2 x (pairs)
Total Birds (TB) = Singles + (2 x pairs) + flocks

Figure 16. Summary of annual population indices for Scaup Species (*Aythya affinis and A. marila*) on the Arctic Coastal Plain, Alaska, 1986–2017. Average annual growth rates were estimated using log-linear regression, with standard errors (SE) calculated from residual errors around the regression line. Long-term growth rates are depicted in red (solid line = total birds [TB], dotted line = breeding birds [BB]), while 10-year growth rates are depicted in black (bold = TB, non-bold = BB). *Estimates from 1986 to 2006 are adjusted to account for survey timing and geographic extent of current (2007–2017) survey design (study area = 57,336 km^2).



	Year	Indicated Breeding Birds (IBB)	SE Breeding Birds	Indicated Total Birds (ITB)	SE Indicated Total
	1986	**38,186**	2,792	**54,594**	4,916
	1987	**39,982**	3,456	**58,909**	8,429
	1988	**51,990**	3,685	**71,169**	5,601
	1989	**49,538**	3,338	**69,155**	6,198
	1990	**46,758**	3,525	**55,509**	4,753
	1991	**39,938**	3,035	**53,659**	4,466
	1992	**38,827**	3,022	**51,245**	4,440
	1993	**50,180**	2,969	**53,886**	3,204
	1994	**42,965**	2,702	**50,938**	4,154
	1995	**48,956**	2,731	**57,454**	3,459
	1996	**56,733**	3,319	**65,282**	3,802
	1997	**44,243**	2,741	**50,572**	2,897
	1998	**44,329**	2,637	**47,786**	2,957
	1999	**33,205**	2,336	**39,258**	3,260
	2000	**35,406**	2,257	**48,718**	5,844
	2001	**49,851**	3,507	**54,455**	3,529
	2002	**52,135**	3,417	**55,871**	3,706
	2003	**30,613**	2,101	**31,784**	2,141
	2004	**32,935**	2,898	**35,296**	2,811
	2005	**41,459**	2,740	**45,008**	3,128
*	**2006**	**40,950**	3,150	**42,139**	3,255
	2007	**34,852**	2,412	**37,595**	2,639
	2008	**47,256**	2,766	**50,919**	2,981
	2009	**47,195**	2,440	**49,142**	2,567
	2010	**45,673**	3,773	**50,332**	4,103
	2011	**61,740**	5,371	**69,146**	6,875
	2012	**47,915**	4,006	**60,748**	7,135
	2013	**41,490**	2,718	**45,467**	2,947
	2014	**41,471**	4,179	**43,799**	4,267
	2015	**51,222**	4,509	**55,751**	4,928
	2016	**39,754**	2,854	**43,376**	3,149
	2017	**34,432**	2,551	**37,855**	2,852

All Year Index (1986-2017)	**Indicated Breeding Birds (IBB)**	**Indicated Total Birds (ITB)**
number of years =	32	32
average index =	**43,818**	**51,151**
SE average index =	1,286	1,726
95% CI index =	(31,649-35,596)	(47,767-54,534)
ave. annual growth =	**0.999**	**0.991**
95% CI annual growth =	(0.993-1.005)	(0.985-0.998)

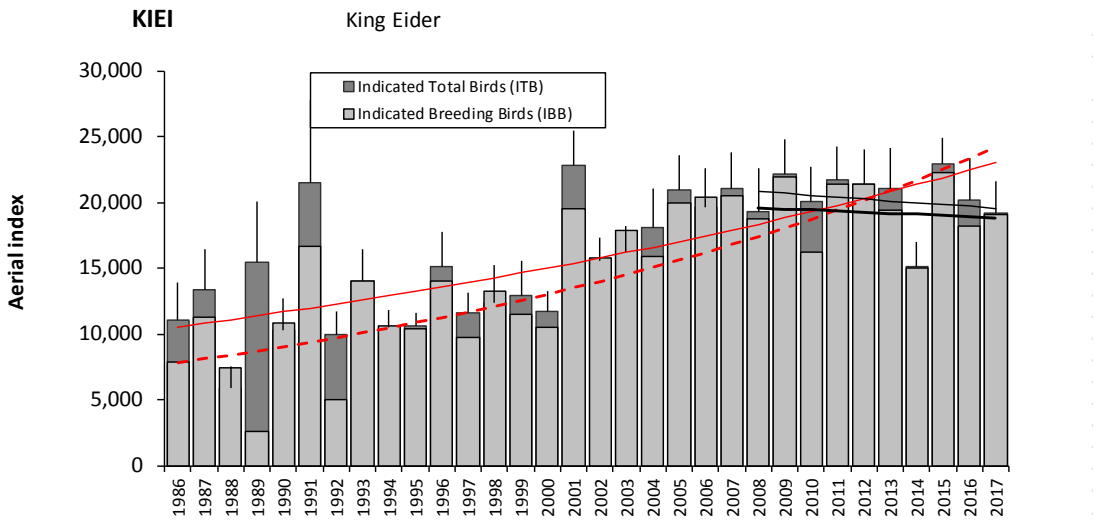
10-Yr Index (2008-2017)	**IBB**	**ITB**
number of years =	10	10
average index =	**45,815**	**50,654**
SE average index =	2,346	2,912
95% CI index =	(41,218-50,412)	(44,947-56,360)
ave. annual growth =	**0.971**	**0.972**
95% CI annual growth =	(0.942-1.001)	(0.938-1.007)

Note:

Indicated Breeding Birds (IBB) = 2 x (singles + pairs)

Indicated Total Birds (ITB) = 2 x (singles + pairs) + flocks

Figure 17. Summary of annual population indices for Long-tailed Duck (*Clangula hyemalis*) on the Arctic Coastal Plain, Alaska, 1986–2017. Average annual growth rates were estimated using log-linear regression, with standard errors (SE) calculated from residual errors around the regression line. Long-term growth rates are depicted in red (solid line = indicated total birds [ITB], dotted line = indicated breeding birds [IBB]), while 10-year growth rates are depicted in black (bold = ITB, non-bold = IBB). *Estimates from 1986 to 2006 are adjusted to account for survey timing and geographic extent of current (2007–2017) survey design (study area = 57,336 km^2).



Year	Indicated Breeding Birds (IBB)	SE Breeding Birds	Indicated Total Birds (ITB)	SE Indicated Total
1986	**7,867**	1,911	**11,029**	2,855
1987	**11,260**	2,621	**13,365**	3,074
1988	**7,415**	2,214	**5,841**	1,710
1989	**2,568**	1,131	**15,453**	4,590
1990	**10,791**	2,572	**10,248**	2,472
1991	**16,669**	3,274	**21,498**	6,258
1992	**5,020**	1,066	**9,980**	1,771
1993	**14,024**	1,941	**13,959**	2,463
1994	**10,600**	1,496	**10,527**	1,328
1995	**10,384**	1,057	**10,587**	1,055
1996	**14,033**	1,707	**15,144**	2,650
1997	**9,763**	1,201	**11,550**	1,568
1998	**13,205**	3,460	**12,415**	2,765
1999	**11,519**	1,898	**12,920**	2,600
2000	**10,531**	1,206	**11,656**	1,628
2001	**19,535**	2,170	**22,758**	2,728
2002	**15,715**	1,795	**15,525**	1,758
2003	**17,855**	2,373	**16,180**	1,963
2004	**15,893**	2,232	**18,074**	2,952
2005	**19,989**	3,349	**20,883**	2,718
* **2006**	**20,402**	3,186	**19,611**	2,975
2007	**20,510**	2,589	**21,063**	2,725
2008	**18,731**	3,215	**19,236**	3,327
2009	**21,927**	2,611	**22,149**	2,630
2010	**16,172**	1,687	**20,053**	2,668
2011	**21,366**	2,509	**21,704**	2,559
2012	**21,406**	2,657	**21,406**	2,657
2013	**19,395**	2,521	**21,013**	3,078
2014	**14,947**	1,858	**15,136**	1,863
2015	**22,249**	2,006	**22,904**	2,021
2016	**18,210**	2,722	**20,116**	3,240
2017	**19,090**	2,459	**19,171**	2,472

All Year Index (1986-2017)	Indicated Breeding Birds (IBB)	Indicated Total Birds (ITB)
number of years =	32	32
average index =	**14,970**	**16,349**
SE average index =	931	837
95% CI index =	(10,721-13,725)	(14,707-17,990)
ave. annual growth =	**1.037**	**1.025**
95% CI annual growth =	(1.024-1.050)	(1.016-1.034)

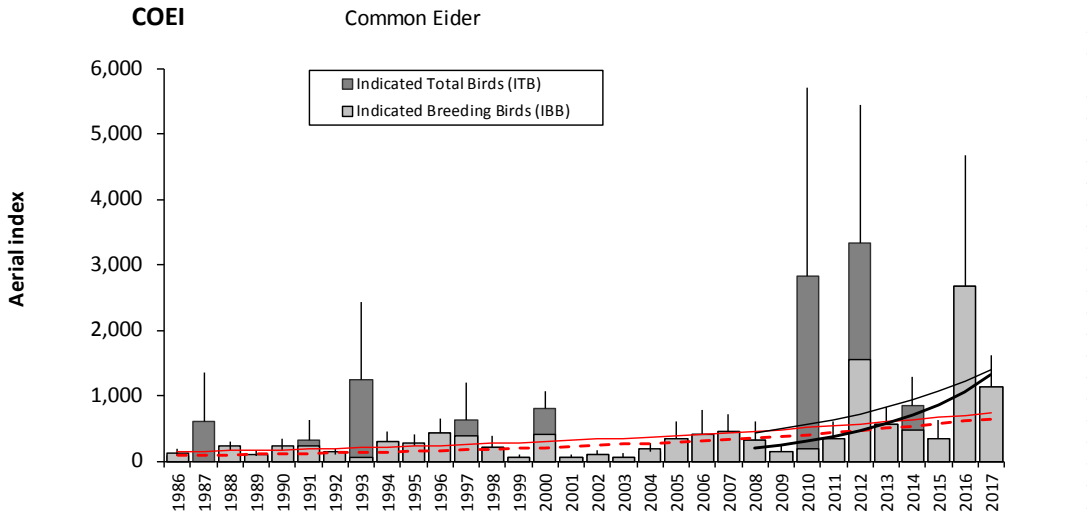
10-Yr Index (2008-2017)	IBB	ITB
number of years =	10	10
average index =	**19,349**	**20,289**
SE average index =	779	692
95% CI index =	(17,823-20,876)	(18,933-21,645)
ave. annual growth =	**0.996**	**0.993**
95% CI annual growth =	(0.966-1.026)	(0.967-1.020)

Note:

Indicated Breeding Birds (IBB) = 2 x (singles + pairs)

Indicated Total Birds (ITB) = 2 x (singles + pairs) + flocks

Figure 18. Summary of annual population indices for King Eiders (*Somateria spectabilis*) on the Arctic Coastal Plain, Alaska, 1986–2017. Average annual growth rates were estimated using log-linear regression, with standard errors (SE) calculated from residual errors around the regression line. Long-term growth rates are depicted in red (solid line = indicated total birds [ITB], dotted line = indicated breeding birds [IBB]), while 10-year growth rates are depicted in black (bold = ITB, non-bold = IBB). *Estimates from 1986 to 2006 are adjusted to account for survey timing and geographic extent of current (2007–2017) survey design (study area = 57,336 km^2).



	Year	Indicated Breeding Birds (IBB)	SE Breeding Birds	Indicated Total Birds (ITB)	SE Indicated Total
	1986	**118**	137	**85**	105
	1987	**0**	0	**598**	761
	1988	**225**	180	**163**	138
	1989	**107**	118	**78**	91
	1990	**235**	209	**171**	162
	1991	**227**	264	**329**	307
	1992	**144**	102	**104**	81
	1993	**48**	48	**1,242**	1,197
	1994	**286**	160	**286**	160
	1995	**268**	210	**233**	183
	1996	**435**	222	**435**	222
	1997	**391**	324	**635**	556
	1998	**208**	174	**208**	174
	1999	**52**	50	**52**	50
	2000	**417**	217	**798**	275
	2001	**49**	43	**49**	43
	2002	**99**	72	**99**	72
	2003	**53**	59	**53**	59
	2004	**180**	171	**144**	134
	2005	**344**	256	**344**	256
*	**2006**	**406**	368	**406**	368
	2007	**452**	258	**452**	258
	2008	**330**	286	**330**	286
	2009	**144**	111	**144**	111
	2010	**191**	195	**2,818**	2,877
	2011	**344**	263	**344**	263
	2012	**1,545**	804	**3,334**	2,109
	2013	**565**	265	**565**	265
	2014	**472**	219	**850**	439
	2015	**335**	286	**335**	286
	2016	**2,666**	2,000	**2,666**	2,000
	2017	**1,132**	491	**1,132**	491

All Year Index (1986-2017)	**Indicated Breeding Birds (IBB)**	**Indicated Total Birds (ITB)**
number of years =	32	32
average index =	**390**	**609**
SE average index =	92	146
95% CI index =	(170-506)	(324-894)
ave. annual growth =	**1.067**	**1.058**
95% CI annual growth =	(1.034-1.101)	(1.018-1.100)

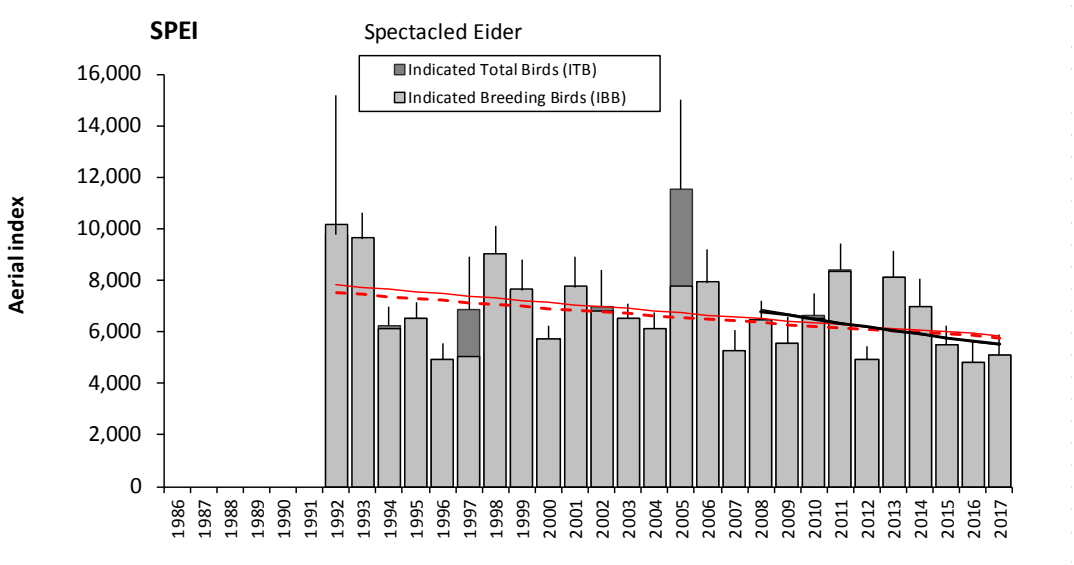
10-Yr Index (2008-2017)	**IBB**	**ITB**
number of years =	10	10
average index =	**772**	**1,252**
SE average index =	253	383
95% CI index =	(277-1,268)	(502-2,002)
ave. annual growth =	**1.231**	**1.141**
95% CI annual growth =	(1.054-1.438)	(0.907-1.436)

Note:

Indicated Breeding Birds (IBB) = 2 x (singles + pairs)

Indicated Total Birds (ITB) = 2 x (singles + pairs) + flocks

Figure 19. Summary of annual population indices for Common Eiders (*Somateria mollisima*) on the Arctic Coastal Plain, Alaska, 1986–2017. Average annual growth rates were estimated using log-linear regression, with standard errors (SE) calculated from residual errors around the regression line. Long-term growth rates are depicted in red (solid line = indicated total birds [ITB], dotted line = indicated breeding birds [IBB]), while 10-year growth rates are depicted in black (bold = ITB, non-bold = IBB). *Estimates from 1986 to 2006 are adjusted to account for survey timing and geographic extent of current (2007–2017) survey design (study area = 57,336 km^2).



	Year	Indicated Breeding Birds (IBB)	SE Breeding Birds	Indicated Total Birds (ITB)	SE Indicated Total
	1986				
	1987				
	1988				
	1989				
	1990				
	1991				
	1992	**10,149**	5,722	**9,774**	5,412
	1993	**9,650**	1,015	**9,615**	999
	1994	**6,125**	705	**6,244**	710
	1995	**6,505**	667	**6,505**	667
	1996	**4,935**	633	**4,935**	633
	1997	**5,050**	508	**6,835**	2,089
	1998	**9,030**	1,082	**9,030**	1,082
	1999	**7,664**	1,237	**7,600**	1,185
	2000	**5,740**	501	**5,740**	501
	2001	**7,763**	1,221	**7,727**	1,182
	2002	**6,808**	1,416	**6,994**	1,420
	2003	**6,515**	601	**6,515**	601
	2004	**6,140**	601	**6,140**	601
	2005	**7,796**	1,010	**11,551**	3,478
*	**2006**	**7,941**	1,330	**7,904**	1,302
	2007	**5,287**	765	**5,287**	765
	2008	**6,445**	758	**6,445**	758
	2009	**5,525**	1,075	**5,525**	1,075
	2010	**6,500**	839	**6,637**	856
	2011	**8,348**	971	**8,419**	980
	2012	**4,902**	550	**4,902**	550
	2013	**8,098**	1,044	**8,098**	1,044
	2014	**6,986**	1,051	**6,986**	1,051
	2015	**5,496**	744	**5,496**	744
	2016	**4,833**	794	**4,833**	794
	2017	**5,122**	760	**5,122**	760

All Year Index (1992-2017)	**Indicated Breeding Birds (IBB)**	**Indicated Total Birds (ITB)**
number of years =	26	26
average index =	**6,744**	**6,956**
SE average index =	297	334
95% CI index =	(6,163-7,326)	(6,302-7,610)
ave. annual growth =	**0.990**	**0.988**
95% CI annual growth =	(0.979-1.000)	(0.977-1.000)

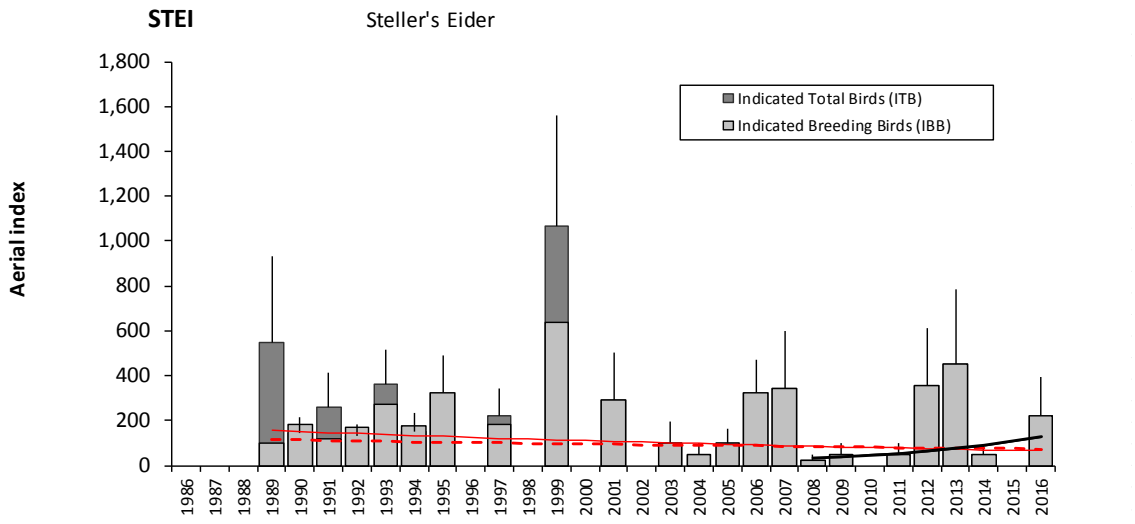
10-Yr Index (2008-2017)	**IBB**	**ITB**
number of years =	10	10
average index =	**6,226**	**6,246**
SE average index =	403	409
95% CI index =	(5,435-7,016)	(5,445-7,048)
ave. annual growth =	**0.977**	**0.976**
95% CI annual growth =	(0.936-1.019)	(0.935-1.019)

Note:

Indicated Breeding Birds (IBB) = 2 x (singles + pairs)

Indicated Total Birds (ITB) = 2 x (singles + pairs) + flocks

Figure 20. Summary of annual population indices for Spectacled Eiders (*Somateria fischeri*) on the Arctic Coastal Plain, Alaska, 1992–2017. Average annual growth rates were estimated using log-linear regression, with standard errors (SE) calculated from residual errors around the regression line. Long-term growth rates are depicted in red (solid line = indicated total birds [ITB], dotted line = indicated breeding birds [IBB]), while 10-year growth rates are depicted in black (bold = ITB, non-bold = IBB). *Estimates from 1992 to 2006 are adjusted to account for survey timing and geographic extent of current (2007–2017) survey design (study area = 57,336 km^2).



	Year	Indicated Breeding Birds (IBB)	SE Breeding Birds	Indicated Total Birds (ITB)	SE Indicated Total
	1986				
	1987				
	1988				
	1989	**98**	65	**546**	388
	1990	**182**	89	**141**	71
	1991	**119**	75	**262**	151
	1992	**170**	62	**132**	50
	1993	**274**	132	**359**	159
	1994	**178**	98	**149**	83
	1995	**326**	166	**326**	166
	1996	**0**	0	**0**	0
	1997	**185**	120	**220**	121
	1998	**0**	0	**0**	0
	1999	**635**	405	**1,065**	495
	2000	**0**	0	**0**	0
	2001	**292**	212	**292**	212
	2002	**0**	0	**0**	0
	2003	**98**	98	**98**	98
	2004	**50**	52	**50**	52
	2005	**98**	68	**98**	68
*	**2006**	**326**	146	**326**	146
	2007	**340**	256	**340**	256
	2008	**25**	25	**25**	25
	2009	**48**	50	**48**	50
	2010	**0**	0	**0**	0
	2011	**49**	49	**49**	49
	2012	**358**	256	**358**	256
	2013	**452**	333	**452**	333
	2014	**47**	48	**47**	48
	2015	**0**	0	**0**	0
	2016	**220**	175	**220**	175
	2017	**168**	125	**168**	125

All Year Index (1989-2017)	Indicated Breeding Birds (IBB)	Indicated Total Birds (ITB)
number of years =	29	29
average index =	**163**	**199**
SE average index =	30	42
95% CI index =	(106-221)	(116-282)
ave. annual growth =	**0.984**	**0.969**
95% CI annual growth =	(0.930-1.041)	(0.913-1.028)

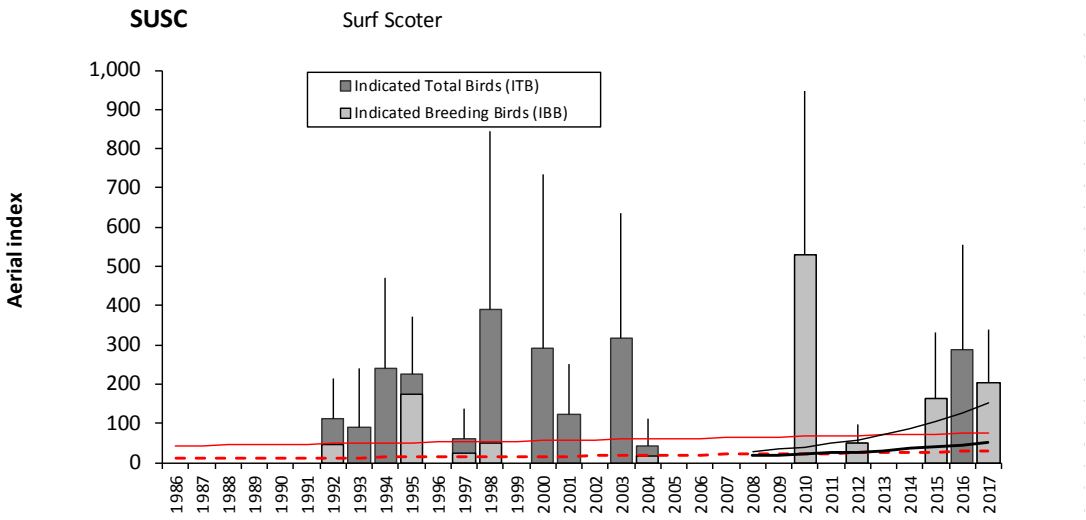
10-Yr Index (2008-2017)	IBB	ITB
number of years =	10	10
average index =	**137**	**137**
SE average index =	51	51
95% CI index =	(38-236)	(38-236)
ave. annual growth =	**1.184**	**1.184**
95% CI annual growth =	(0.897-1.565)	(0.897-1.565)

Note:

Indicated Breeding Birds (IBB) = 2 x (singles + pairs)

Indicated Total Birds (ITB) = 2 x (singles + pairs) + flocks

Figure 21. Summary of annual population indices for Steller's Eiders (*Polysticta stelleri*) on the Arctic Coastal Plain, Alaska, 1989–2017. Average annual growth rates were estimated using log-linear regression, with standard errors (SE) calculated from residual errors around the regression line. Long-term growth rates are depicted in red (solid line = indicated total birds [ITB], dotted line = indicated breeding birds [IBB]), while 10-year growth rates are depicted in black (bold = ITB, non-bold = IBB). *Estimates from 1989 to 2006 are adjusted to account for survey timing and geographic extent of current (2007–2017) survey design (study area = 57,336 km^2).



	Year	Indicated Breeding Birds (IBB)	SE Breeding Birds	Indicated Total Birds (ITB)	SE Indicated Total
	1986	**0**	0	**0**	0
	1987	**0**	0	**0**	0
	1988	**0**	0	**0**	0
	1989	**0**	0	**0**	0
	1990	**0**	0	**0**	0
	1991	**0**	0	**0**	0
	1992	**45**	52	**111**	102
	1993	**0**	0	**89**	152
	1994	**0**	0	**238**	233
	1995	**175**	116	**226**	147
	1996	**0**	0	**0**	0
	1997	**25**	38	**62**	76
	1998	**48**	78	**390**	454
	1999	**0**	0	**0**	0
	2000	**0**	0	**291**	444
	2001	**0**	0	**122**	130
	2002	**0**	0	**0**	0
	2003	**0**	0	**316**	319
	2004	**18**	34	**44**	69
	2005	**0**	0	**0**	0
*	**2006**	**0**	0	**0**	0
	2007	**0**	0	**0**	0
	2008	**0**	0	**0**	0
	2009	**0**	0	**0**	0
	2010	**531**	417	**531**	417
	2011	**0**	0	**0**	0
	2012	**48**	49	**48**	49
	2013	**0**	0	**0**	0
	2014	**0**	0	**0**	0
	2015	**164**	168	**164**	168
	2016	**0**	0	**289**	265
	2017	**202**	137	**202**	137

All Year Index (1986-2017)	**Indicated Breeding Birds (IBB)**	**Indicated Total Birds (ITB)**
number of years =	32	32
average index =	**39**	**98**
SE average index =	18	25
95% CI index =	(6-54)	(49-146)
ave. annual growth =	**1.036**	**1.022**
95% CI annual growth =	(0.993-1.080)	(0.979-1.067)

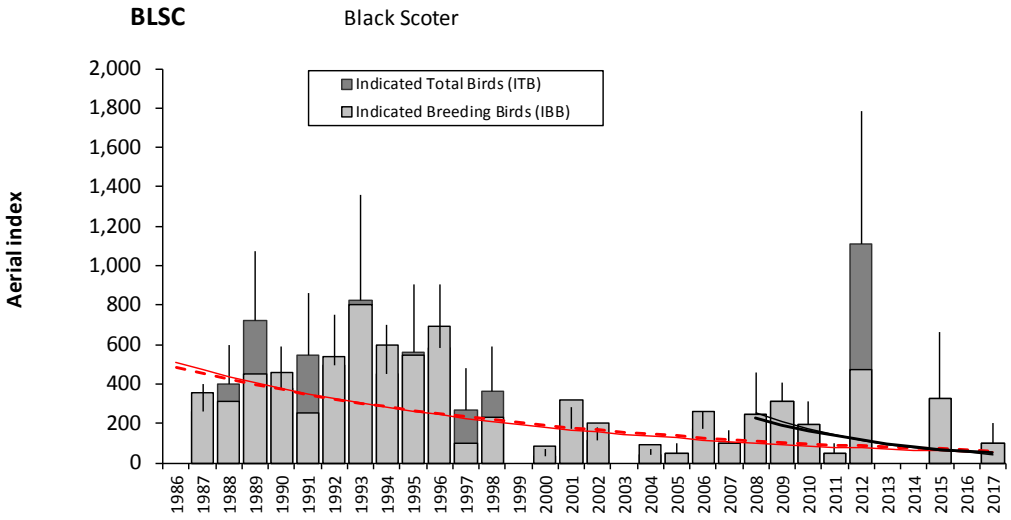
10-Yr Index (2008-2017)	**IBB**	**ITB**
number of years =	10	10
average index =	**94**	**123**
SE average index =	54	56
95% CI index =	-(11-200)	(13-233)
ave. annual growth =	**1.132**	**1.210**
95% CI annual growth =	(0.789-1.626)	(0.931-1.573)

Note:

Indicated Breeding Birds (IBB) = 2 x (singles + pairs)

Indicated Total Birds (ITB) = 2 x (singles + pairs) + flocks

Figure 22. Summary of annual population indices for Surf Scoters (*Melanitta perspicillata*) on the Arctic Coastal Plain, Alaska, 1986–2017. Average annual growth rates were estimated using log-linear regression, with standard errors (SE) calculated from residual errors around the regression line. Long-term growth rates are depicted in red (solid line = indicated total birds [ITB], dotted line = indicated breeding birds [IBB]), while 10-year growth rates are depicted in black (bold = ITB, non-bold = IBB). *Estimates from 1986 to 2006 are adjusted to account for survey timing and geographic extent of current (2007–2017) survey design (study area = 57,336 km^2).



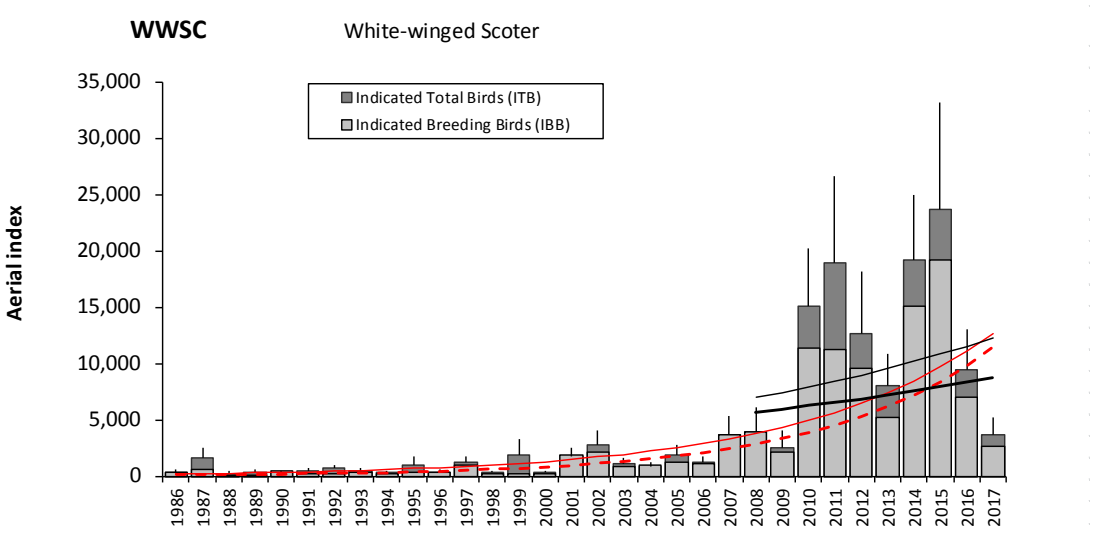
	Year	Indicated Breeding Birds (IBB)	SE Breeding Birds	Indicated Total Birds (ITB)	SE Indicated Total
	1986	**0**	0	**0**	0
	1987	**357**	170	**258**	141
	1988	**314**	134	**396**	203
	1989	**451**	226	**722**	353
	1990	**459**	258	**376**	213
	1991	**250**	137	**548**	312
	1992	**537**	249	**497**	257
	1993	**799**	399	**821**	540
	1994	**598**	314	**448**	249
	1995	**546**	305	**557**	347
	1996	**691**	317	**586**	318
	1997	**98**	111	**265**	218
	1998	**232**	102	**360**	232
	1999	**0**	0	**0**	0
	2000	**82**	72	**36**	35
	2001	**321**	216	**171**	109
	2002	**201**	100	**116**	67
	2003	**0**	0	**0**	0
	2004	**90**	65	**39**	32
	2005	**49**	51	**49**	51
*	**2006**	**260**	138	**171**	92
	2007	**97**	70	**97**	70
	2008	**242**	216	**242**	216
	2009	**311**	95	**311**	95
	2010	**191**	120	**191**	120
	2011	**49**	47	**49**	47
	2012	**475**	216	**1,107**	675
	2013	**0**	0	**0**	0
	2014	**0**	0	**0**	0
	2015	**328**	338	**328**	338
	2016	**0**	0	**0**	0
	2017	**101**	98	**101**	98

All Year Index (1986-2017)	**Indicated Breeding Birds (IBB)**	**Indicated Total Birds (ITB)**
number of years =	32	32
average index =	**254**	**276**
SE average index =	39	49
95% CI index =	(158-318)	(181-372)
ave. annual growth =	**0.952**	**0.947**
95% CI annual growth =	(0.914-0.991)	(0.903-0.993)

10-Yr Index (2008-2017)	**IBB**	**ITB**
number of years =	10	10
average index =	**170**	**233**
SE average index =	53	105
95% CI index =	(67-273)	(27-439)
ave. annual growth =	**0.844**	**0.823**
95% CI annual growth =	(0.660-1.079)	(0.607-1.114)

Note:
Indicated Breeding Birds (IBB) = 2 x (singles + pairs)
Indicated Total Birds (ITB) = 2 x (singles + pairs) + flocks

Figure 23. Summary of annual population indices for Black Scoters (*Melanitta nigra*) on the Arctic Coastal Plain, Alaska, 1986–2017. Average annual growth rates were estimated using log-linear regression, with standard errors (SE) calculated from residual errors around the regression line. Long-term growth rates are depicted in red (solid line = indicated total birds [ITB], dotted line = indicated breeding birds [IBB]), while 10-year growth rates are depicted in black (bold = ITB, non-bold = IBB). *Estimates from 1986 to 2006 are adjusted to account for survey timing and geographic extent of current (2007–2017) survey design (study area = 57,336 km^2).



Year	Indicated Breeding Birds (IBB)	SE Breeding Birds	Indicated Total Birds (ITB)	SE Indicated Total
1986	**363**	164	**357**	166
1987	**538**	279	**1,615**	933
1988	**73**	60	**200**	198
1989	**123**	112	**306**	220
1990	**395**	226	**281**	160
1991	**183**	143	**420**	294
1992	**241**	134	**665**	338
1993	**318**	314	**439**	286
1994	**135**	88	**298**	180
1995	**339**	190	**979**	690
1996	**317**	293	**354**	266
1997	**1,009**	394	**1,211**	473
1998	**208**	106	**280**	167
1999	**217**	107	**1,822**	1,387
2000	**222**	123	**280**	160
2001	**1,893**	878	**1,730**	811
2002	**2,176**	979	**2,750**	1,305
2003	**897**	457	**1,150**	493
2004	**1,003**	530	**788**	418
2005	**1,179**	659	**1,800**	987
* **2006**	**1,034**	481	**1,163**	548
2007	**3,619**	1,644	**3,619**	1,644
2008	**3,949**	2,132	**3,949**	2,132
2009	**2,078**	1,170	**2,544**	1,498
2010	**11,373**	3,115	**15,115**	5,125
2011	**11,269**	4,232	**18,864**	7,787
2012	**9,613**	4,461	**12,609**	5,490
2013	**5,246**	2,301	**7,999**	2,866
2014	**15,012**	3,911	**19,162**	5,795
2015	**19,171**	7,423	**23,602**	9,552
2016	**7,024**	2,091	**9,414**	3,569
2017	**2,681**	959	**3,658**	1,562

All Year Index (1986-2017)	Indicated Breeding Birds (IBB)	Indicated Total Birds (ITB)
number of years =	32	32
average index =	**3,247**	**4,357**
SE average index =	861	1,140
95% CI index =	(1,479-4,561)	(2,123-6,591)
ave. annual growth =	**1.160**	**1.140**
95% CI annual growth =	(1.125-1.195)	(1.107-1.175)

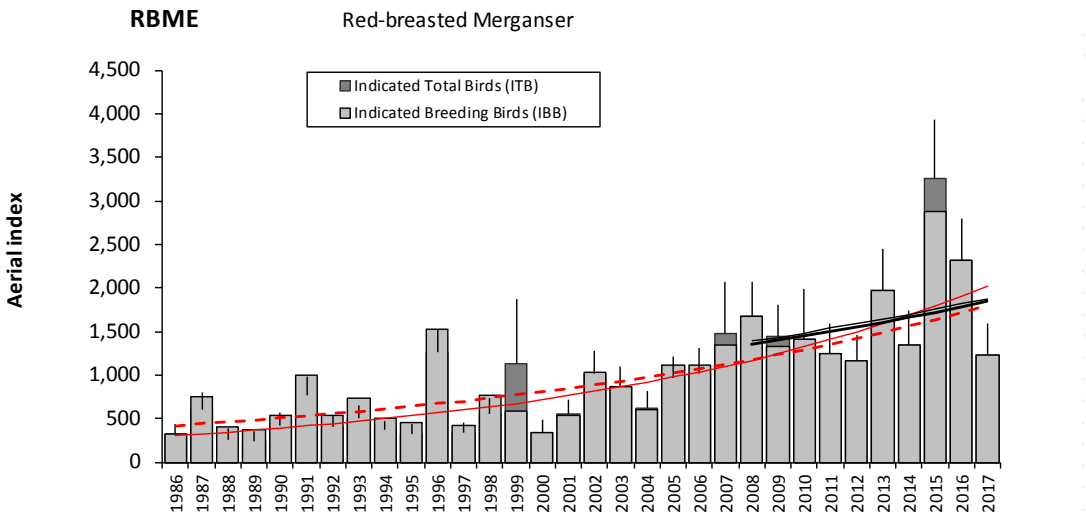
10-Yr Index (2008-2017)	IBB	ITB
number of years =	10	10
average index =	**8,741**	**11,692**
SE average index =	1,768	2,330
95% CI index =	(5,276-12,207)	(7,124-16,259)
ave. annual growth =	**1.049**	**1.064**
95% CI annual growth =	(0.888-1.239)	(0.894-1.267)

Note:

Indicated Breeding Birds (IBB) = 2 x (singles + pairs)

Indicated Total Birds (ITB) = 2 x (singles + pairs) + flocks

Figure 24. Summary of annual population indices for White-winged Scoters (*Melanitta fusca*) on the Arctic Coastal Plain, Alaska, 1986–2017. Average annual growth rates were estimated using log-linear regression, with standard errors (SE) calculated from residual errors around the regression line. Long-term growth rates are depicted in red (solid line = indicated total birds [ITB], dotted line = indicated breeding birds [IBB]), while 10-year growth rates are depicted in black (bold = ITB, non-bold = IBB). *Estimates from 1986 to 2006 are adjusted to account for survey timing and geographic extent of current (2007–2017) survey design (study area = 57,336 km^2).



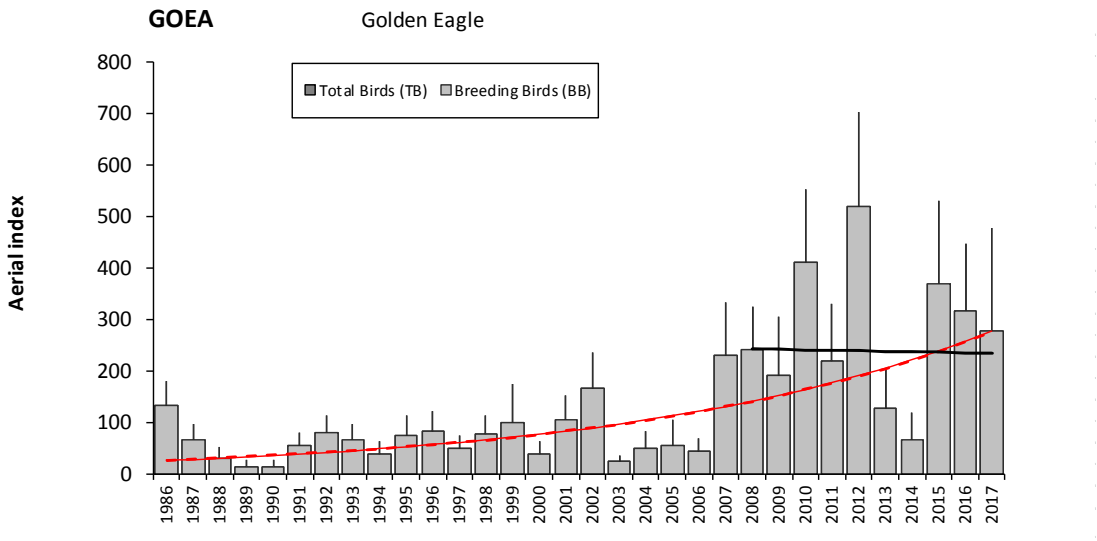
	Year	Indicated Breeding Birds (IBB)	SE Breeding Birds	Indicated Total Birds (ITB)	SE Indicated Total
	1986	**329**	131	**321**	120
	1987	**749**	265	**606**	200
	1988	**402**	185	**264**	123
	1989	**374**	155	**245**	103
	1990	**540**	180	**426**	145
	1991	**1,003**	275	**760**	220
	1992	**530**	153	**411**	121
	1993	**727**	197	**510**	142
	1994	**502**	144	**364**	110
	1995	**449**	136	**326**	103
	1996	**1,519**	302	**1,266**	258
	1997	**417**	145	**340**	118
	1998	**760**	279	**545**	193
	1999	**584**	190	**1,137**	733
	2000	**342**	138	**342**	138
	2001	**528**	173	**554**	159
	2002	**1,034**	202	**1,006**	266
	2003	**865**	224	**869**	233
	2004	**608**	182	**624**	184
	2005	**1,114**	277	**961**	246
*	**2006**	**1,113**	282	**1,019**	295
	2007	**1,347**	568	**1,468**	599
	2008	**1,669**	399	**1,669**	399
	2009	**1,320**	339	**1,443**	360
	2010	**1,404**	590	**1,404**	590
	2011	**1,240**	349	**1,240**	349
	2012	**1,156**	301	**1,156**	301
	2013	**1,972**	481	**1,972**	481
	2014	**1,344**	389	**1,344**	389
	2015	**2,882**	568	**3,248**	681
	2016	**2,323**	476	**2,323**	476
	2017	**1,228**	365	**1,228**	365

All Year Index (1986-2017)	**Indicated Breeding Birds (IBB)**	**Indicated Total Birds (ITB)**
number of years =	32	32
average index =	**1,012**	**981**
SE average index =	107	119
95% CI index =	(683-998)	(747-1,215)
ave. annual growth =	**1.050**	**1.063**
95% CI annual growth =	(1.035-1.064)	(1.047-1.078)

10-Yr Index (2008-2017)	**IBB**	**ITB**
number of years =	10	10
average index =	**1,654**	**1,703**
SE average index =	180	207
95% CI index =	(1,300-2,007)	(1,296-2,109)
ave. annual growth =	**1.034**	**1.034**
95% CI annual growth =	(0.968-1.105)	(0.962-1.111)

Note:
Indicated Breeding Birds (IBB) = 2 x (singles + pairs)
Indicated Total Birds (ITB) = 2 x (singles + pairs) + flocks

Figure 25. Summary of annual population indices for Red-breasted Mergansers (*Mergus serrator*) on the Arctic Coastal Plain, Alaska, 1986–2017. Average annual growth rates were estimated using log-linear regression, with standard errors (SE) calculated from residual errors around the regression line. Long-term growth rates are depicted in red (solid line = indicated total birds [ITB], dotted line = indicated breeding birds [IBB]), while 10-year growth rates are depicted in black (bold = ITB, non-bold = IBB). *Estimates from 1986 to 2006 are adjusted to account for survey timing and geographic extent of current (2007–2017) survey design (study area = 57,336 km^2).



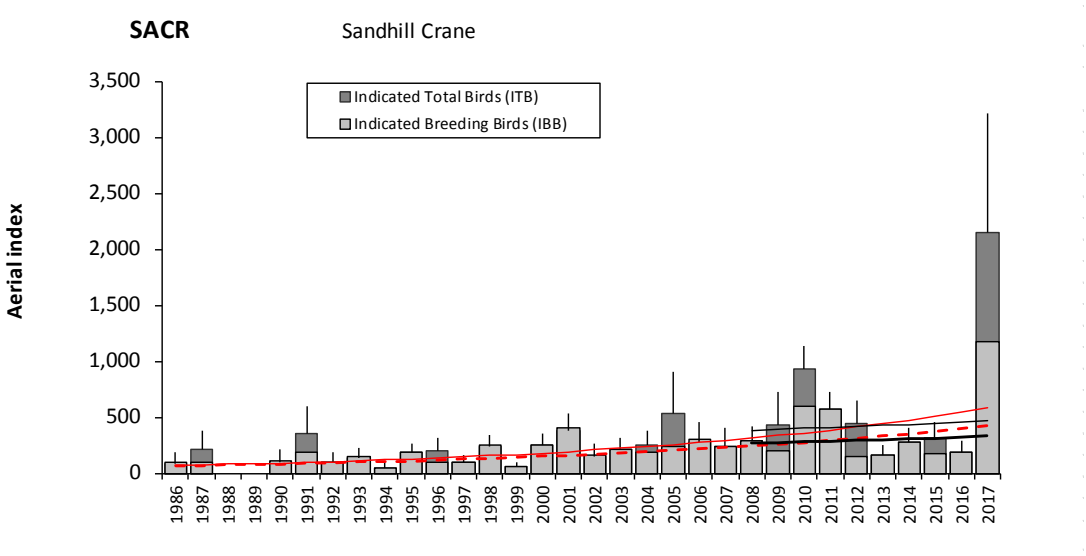
Year	Breeding Birds (BB)	SE Breeding Birds	Total Birds (TB)	SE Total Birds
1986	**134**	48	**134**	48
1987	**68**	29	**68**	29
1988	**32**	21	**32**	21
1989	**16**	13	**16**	13
1990	**15**	12	**15**	12
1991	**56**	26	**56**	26
1992	**82**	32	**82**	32
1993	**68**	29	**68**	29
1994	**38**	26	**38**	26
1995	**77**	37	**77**	37
1996	**83**	39	**83**	39
1997	**49**	28	**49**	28
1998	**77**	36	**77**	36
1999	**100**	75	**100**	75
2000	**39**	26	**39**	26
2001	**107**	46	**107**	46
2002	**168**	70	**168**	70
2003	**24**	13	**24**	13
2004	**50**	34	**50**	34
2005	**56**	51	**56**	51
* 2006	**44**	26	**44**	26
2007	**230**	103	**230**	103
2008	**241**	84	**241**	84
2009	**192**	115	**192**	115
2010	**411**	143	**411**	143
2011	**220**	113	**220**	113
2012	**522**	183	**522**	183
2013	**130**	75	**130**	75
2014	**68**	52	**68**	52
2015	**371**	161	**371**	161
2016	**317**	130	**317**	130
2017	**278**	201	**278**	201

All Year Index (1986-2017)	Breeding Birds (BB)	Total Birds (TB)
number of years =	32	32
average index =	**136**	**136**
SE average index =	22	22
95% CI index =	(92-180)	(92-180)
ave. annual growth =	**1.068**	**1.068**
95% CI annual growth =	(1.040-1.097)	(1.040-1.097)

10-Yr Index (2008-2017)	BB	TB
number of years =	10	10
average index =	**275**	**275**
SE average index =	43	43
95% CI index =	(191-359)	(191-359)
ave. annual growth =	**0.996**	**0.996**
95% CI annual growth =	(0.869-1.142)	(0.869-1.142)

Note:
Breeding Birds (BB) = Singles + 2 x (pairs)
Total Birds (TB) = Singles + (2 x pairs) + flocks

Figure 26. Summary of annual population indices for Golden Eagle (*Aquila chrysaetos*) on the Arctic Coastal Plain, Alaska, 1986–2017. Average annual growth rates were estimated using log-linear regression, with standard errors (SE) calculated from residual errors around the regression line. Long-term growth rates are depicted in red (solid line = indicated total birds ITB], dotted line = indicated breeding birds [BB]), while 10-year growth rates are depicted in black (bold = TB, non-bold = BB). *Estimates from 1986 to 2006 are adjusted to account for survey timing and geographic extent of current (2007–2017) survey design (study area = 57,336 km^2).



	Year	Indicated Breeding Birds (IBB)	SE Breeding Birds	Indicated Total Birds (ITB)	SE Indicated Total
	1986	**98**	104	**89**	96
	1987	**98**	104	**212**	163
	1988	**0**	0	**0**	0
	1989	**0**	0	**0**	0
	1990	**112**	120	**102**	110
	1991	**191**	145	**355**	241
	1992	**101**	108	**92**	99
	1993	**141**	103	**133**	97
	1994	**48**	48	**48**	48
	1995	**186**	78	**186**	78
	1996	**99**	70	**200**	118
	1997	**96**	63	**96**	63
	1998	**246**	111	**236**	106
	1999	**52**	48	**52**	48
	2000	**247**	106	**247**	106
	2001	**403**	156	**384**	147
	2002	**156**	118	**147**	110
	2003	**217**	115	**206**	109
	2004	**182**	119	**248**	130
	2005	**242**	94	**526**	372
*	**2006**	**299**	196	**280**	181
	2007	**233**	175	**233**	175
	2008	**294**	117	**294**	117
	2009	**193**	91	**434**	297
	2010	**598**	209	**935**	198
	2011	**576**	154	**576**	154
	2012	**143**	108	**436**	211
	2013	**162**	90	**162**	90
	2014	**280**	128	**280**	128
	2015	**167**	108	**310**	148
	2016	**192**	98	**192**	98
	2017	**1,173**	446	**2,150**	1,060

All Year Index (1986-2017)	**Indicated Breeding Birds (IBB)**	**Indicated Total Birds (ITB)**
number of years =	32	32
average index =	**226**	**308**
SE average index =	39	68
95% CI index =	(110-223)	(174-441)
ave. annual growth =	**1.061**	**1.071**
95% CI annual growth =	(1.036-1.086)	(1.042-1.100)

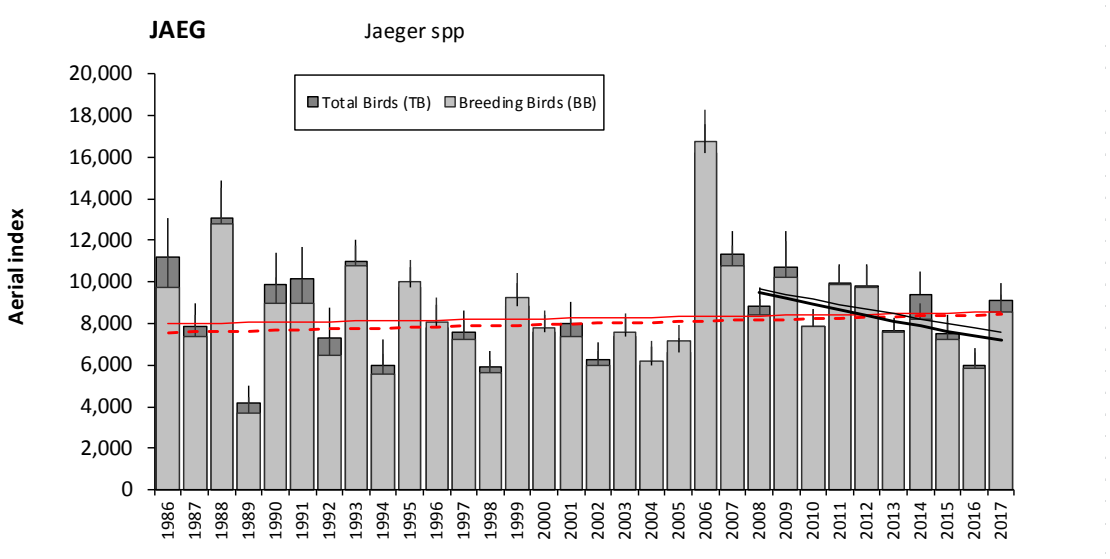
10-Yr Index (2008-2017)	**IBB**	**ITB**
number of years =	10	10
average index =	**378**	**577**
SE average index =	103	189
95% CI index =	(176-579)	(207-947)
ave. annual growth =	**1.024**	**1.022**
95% CI annual growth =	(0.873-1.202)	(0.858-1.217)

Note:

Indicated Breeding Birds (IBB) = 2 x (singles + pairs)

Indicated Total Birds (ITB) = 2 x (singles + pairs) + flocks

Figure 27. Summary of annual population indices for Sandhill Crane (*Grus canadensis*) on the Arctic Coastal Plain, Alaska, 1986–2017. Average annual growth rates were estimated using log-linear regression, with standard errors (SE) calculated from residual errors around the regression line. Long-term growth rates are depicted in red (solid line = indicated total birds [ITB], dotted line = indicated breeding birds [IBB]), while 10-year growth rates are depicted in black (bold = ITB, non-bold = IBB). *Estimates from 1986 to 2006 are adjusted to account for survey timing and geographic extent of current (2007–2017) survey design (study area = 57,336 km^2).



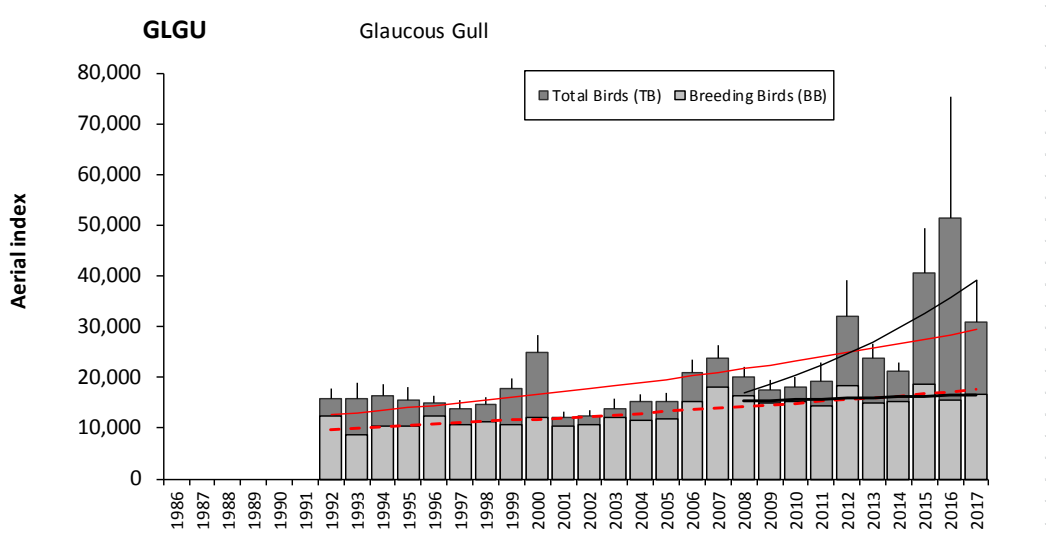
	Year	Breeding Birds (BB)	SE Breeding Birds	Total Birds (TB)	SE Total Birds
	1986	**9,716**	1,521	**11,211**	1,864
	1987	**7,362**	1,036	**7,877**	1,095
	1988	**12,800**	1,708	**13,082**	1,819
	1989	**3,683**	760	**4,166**	819
	1990	**8,946**	1,274	**9,862**	1,579
	1991	**9,007**	1,170	**10,169**	1,522
	1992	**6,470**	808	**7,328**	1,457
	1993	**10,752**	1,014	**11,001**	1,052
	1994	**5,602**	913	**6,013**	1,197
	1995	**10,032**	1,018	**9,745**	944
	1996	**8,074**	1,211	**7,825**	1,078
	1997	**7,247**	924	**7,617**	985
	1998	**5,611**	658	**5,903**	776
	1999	**9,222**	1,210	**8,869**	1,088
	2000	**7,774**	884	**7,579**	815
	2001	**7,358**	883	**8,015**	1,005
	2002	**5,969**	743	**6,238**	843
	2003	**7,587**	871	**7,354**	901
	2004	**6,226**	965	**6,002**	883
	2005	**7,139**	781	**6,630**	689
*	**2006**	**16,735**	1,534	**16,209**	1,369
	2007	**10,763**	971	**11,324**	1,151
	2008	**8,439**	746	**8,829**	888
	2009	**10,224**	1,769	**10,689**	1,727
	2010	**7,883**	803	**7,883**	803
	2011	**9,903**	882	**9,938**	883
	2012	**9,771**	1,044	**9,807**	1,043
	2013	**7,554**	587	**7,687**	578
	2014	**8,239**	752	**9,377**	1,138
	2015	**7,223**	908	**7,517**	901
	2016	**5,819**	819	**5,997**	833
	2017	**8,582**	843	**9,096**	868

All Year Index (1986-2017)	**Breeding Birds (BB)**	**Total Birds (TB)**
number of years =	32	32
average index =	**8,366**	**8,651**
SE average index =	427	423
95% CI index =	(7,530-9,202)	(7,822-9,481)
ave. annual growth =	**1.002**	**1.000**
95% CI annual growth =	(0.991-1.013)	(0.990-1.011)

10-Yr Index (2008-2017)	**BB**	**TB**
number of years =	10	10
average index =	**8,364**	**8,682**
SE average index =	429	444
95% CI index =	(7,523-9,204)	(7,812-9,552)
ave. annual growth =	**0.970**	**0.973**
95% CI annual growth =	(0.939-1.002)	(0.940-1.008)

Note:
Breeding Birds (BB) = Singles + 2 x (pairs)
Total Birds (TB) = Singles + (2 x pairs) + flocks

Figure 28. Summary of annual population indices for Jaeger Species (*Stercorarius pomarinus, S. parasiticus, and S. longicauda*) on the Arctic Coastal Plain, Alaska, 1986–2017. Average annual growth rates were estimated using log-linear regression, with standard errors (SE) calculated from residual errors around the regression line. Long-term growth rates are depicted in red (solid line = total birds [TB], dotted line = breeding birds [BB]), while 10-year growth rates are depicted in black (bold = TB, non-bold = BB). *Estimates from 1986 to 2006 are adjusted to account for survey timing and geographic extent of current (2007–2017) survey design (study area = 57,336 km^2).



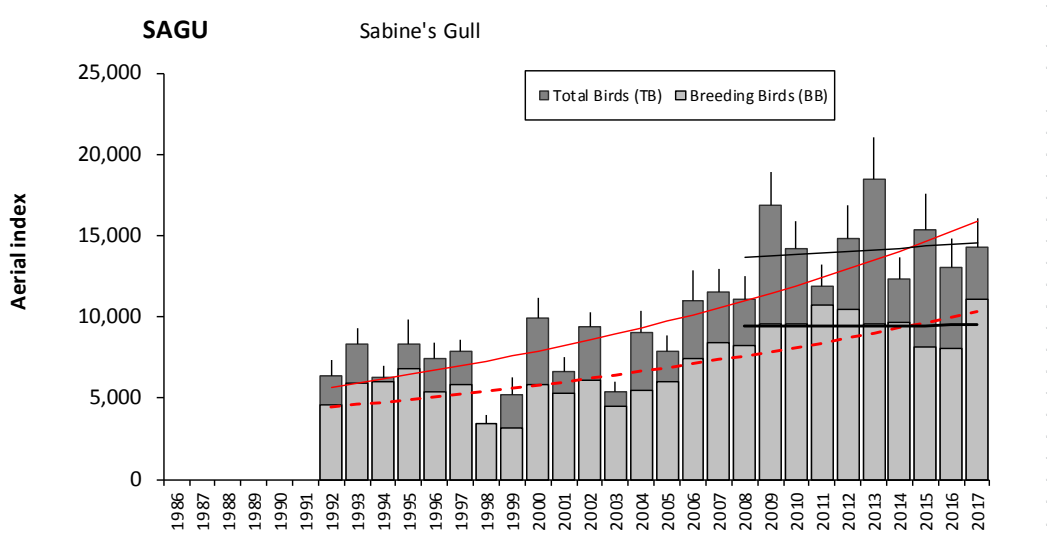
Year	Breeding Birds (BB)	SE Breeding Birds	Total Birds (TB)	SE Total Birds
1986				
1987				
1988				
1989				
1990				
1991				
1992	**12,388**	773	**15,933**	1,787
1993	**8,577**	640	**15,770**	3,163
1994	**10,328**	653	**16,256**	2,523
1995	**10,264**	745	**15,614**	2,588
1996	**12,318**	919	**14,855**	1,493
1997	**10,642**	1,003	**13,670**	1,798
1998	**11,367**	963	**14,531**	1,670
1999	**10,588**	1,064	**17,699**	2,014
2000	**12,018**	854	**24,973**	3,409
2001	**10,261**	704	**12,028**	1,253
2002	**10,642**	931	**12,309**	1,181
2003	**12,020**	1,159	**13,865**	1,795
2004	**11,428**	797	**15,173**	1,406
2005	**11,881**	886	**15,211**	1,633
* **2006**	**15,361**	1,110	**21,004**	2,427
2007	**18,212**	1,140	**23,897**	2,534
2008	**16,309**	1,471	**20,117**	1,876
2009	**14,819**	1,066	**17,629**	1,782
2010	**15,188**	1,177	**18,166**	1,781
2011	**14,313**	1,367	**19,232**	3,706
2012	**18,286**	1,396	**32,002**	7,240
2013	**14,928**	995	**23,763**	2,891
2014	**15,243**	1,145	**21,258**	1,746
2015	**18,698**	1,389	**40,626**	8,847
2016	**15,384**	1,165	**51,272**	23,938
2017	**16,739**	1,218	**30,844**	8,411

All Year Index (1992-2017)	Breeding Birds (BB)	Total Birds (TB)
number of years =	26	26
average index =	**13,392**	**20,681**
SE average index =	563	1,795
95% CI index =	(12,289-14,496)	(17,162-24,200)
ave. annual growth =	**1.023**	**1.034**
95% CI annual growth =	(1.017-1.030)	(1.021-1.048)

10-Yr Index (2008-2017)	BB	TB
number of years =	10	10
average index =	**15,991**	**27,491**
SE average index =	473	3,542
95% CI index =	(15,063-16,918)	(20,548-34,434)
ave. annual growth =	**1.009**	**1.097**
95% CI annual growth =	(0.990-1.029)	(1.040-1.158)

Note:
Breeding Birds (BB) = Singles + 2 x (pairs)
Total Birds (TB) = Singles + (2 x pairs) + flocks

Figure 29. Summary of annual population indices for Glaucous Gulls (*Larus hyperboreus*) on the Arctic Coastal Plain, Alaska, 1992–2017. Average annual growth rates were estimated using log-linear regression, with standard errors (SE) calculated from residual errors around the regression line. Long-term growth rates are depicted in red (solid line = total birds [TB], dotted line = breeding birds [BB]), while 10-year growth rates are depicted in black (bold = TB, non-bold = BB). *Estimates from 1992 to 2006 are adjusted to account for survey timing and geographic extent of current (2007–2017) survey design (study area = 57,336 km^2).



	Year	Breeding Birds (BB)	SE Breeding Birds	Total Birds (TB)	SE Total Birds
	1986				
	1987				
	1988				
	1989				
	1990				
	1991				
	1992	**4,554**	749	**6,335**	979
	1993	**5,938**	640	**8,287**	1,040
	1994	**6,004**	699	**6,257**	705
	1995	**6,815**	905	**8,312**	1,506
	1996	**5,357**	639	**7,441**	982
	1997	**5,848**	558	**7,848**	720
	1998	**3,417**	573	**3,460**	507
	1999	**3,172**	644	**5,237**	1,057
	2000	**5,862**	718	**9,920**	1,219
	2001	**5,274**	561	**6,592**	890
	2002	**6,084**	576	**9,354**	931
	2003	**4,511**	505	**5,424**	625
	2004	**5,505**	697	**9,053**	1,302
	2005	**5,975**	775	**7,872**	963
*	**2006**	**7,406**	835	**10,980**	1,859
	2007	**8,449**	1,053	**11,542**	1,442
	2008	**8,255**	1,000	**11,100**	1,436
	2009	**9,582**	884	**16,900**	1,983
	2010	**9,580**	1,090	**14,177**	1,661
	2011	**10,710**	1,194	**11,878**	1,343
	2012	**10,492**	1,070	**14,839**	1,977
	2013	**9,539**	1,232	**18,436**	2,649
	2014	**9,658**	958	**12,282**	1,371
	2015	**8,128**	769	**15,391**	2,177
	2016	**8,046**	830	**13,073**	1,745
	2017	**11,035**	1,219	**14,270**	1,791

All Year Index (1992-2017)	Breeding Birds (BB)	Total Birds (TB)
number of years =	26	26
average index =	**7,123**	**10,241**
SE average index =	446	761
95% CI index =	(6,249-7,997)	(8,749-11,732)
ave. annual growth =	**1.034**	**1.042**
95% CI annual growth =	(1.022-1.046)	(1.028-1.056)

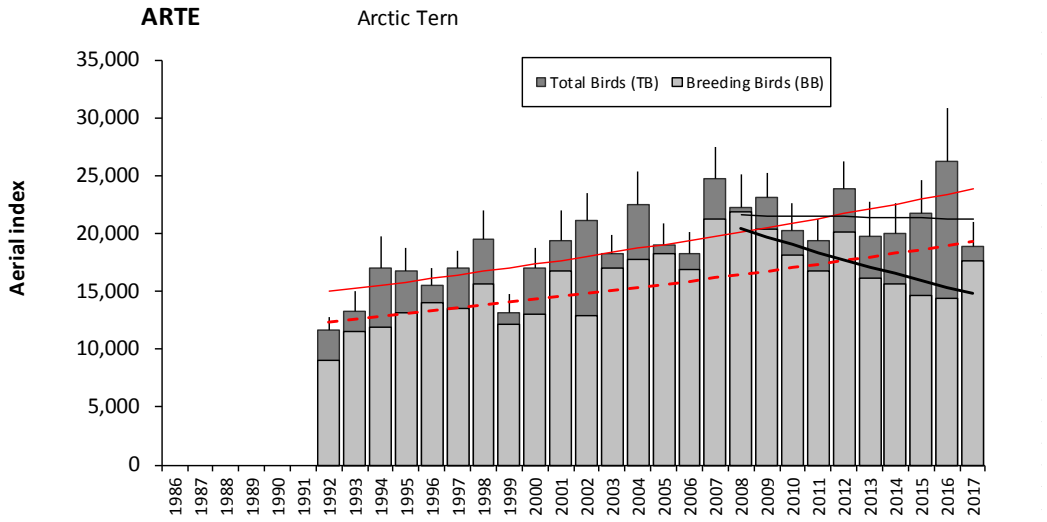
10-Yr Index (2008-2017)	BB	TB
number of years =	10	10
average index =	**9,502**	**14,235**
SE average index =	340	723
95% CI index =	(8,837-10,168)	(12,818-15,651)
ave. annual growth =	**1.001**	**1.007**
95% CI annual growth =	(0.975-1.028)	(0.972-1.044)

Note:

Breeding Birds (BB) = Singles + 2 x (pairs)

Total Birds (TB) = Singles + (2 x pairs) + flocks

Figure 30. Summary of annual population indices for Sabine's Gulls (*Xema sabini*) on the Arctic Coastal Plain, Alaska, 1992–2017. Average annual growth rates were estimated using log-linear regression, with standard errors (SE) calculated from residual errors around the regression line. Long-term growth rates are depicted in red (solid line = total birds [TB], dotted line = breeding birds [BB]), while 10-year growth rates are depicted in black (bold = TB, non-bold = BB). *Estimates from 1992 to 2006 are adjusted to account for survey timing and geographic extent of current (2007–2017) survey design (study area = 57,336 km^2).



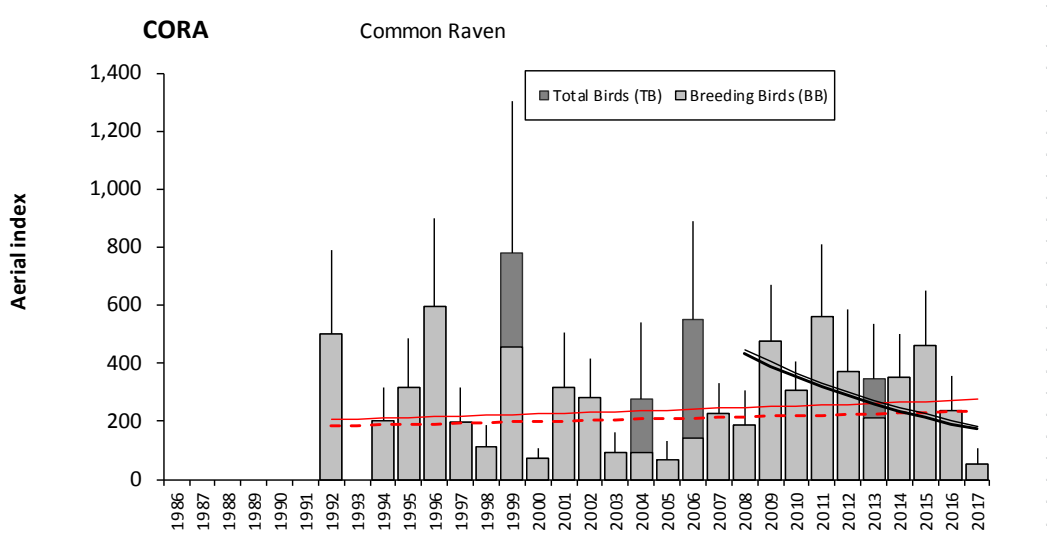
	Year	Breeding Birds (BB)	SE Breeding Birds	Total Birds (TB)	SE Total Birds
	1986				
	1987				
	1988				
	1989				
	1990				
	1991				
	1992	**9,068**	838	**11,598**	1,208
	1993	**11,461**	1,140	**13,279**	1,706
	1994	**11,922**	1,256	**16,952**	2,783
	1995	**13,107**	958	**16,753**	1,942
	1996	**14,026**	1,095	**15,568**	1,453
	1997	**13,502**	1,571	**17,037**	1,466
	1998	**15,654**	1,843	**19,527**	2,510
	1999	**12,115**	1,539	**13,114**	1,620
	2000	**13,033**	1,035	**17,036**	1,722
	2001	**16,733**	1,309	**19,426**	2,522
	2002	**12,845**	1,124	**21,108**	2,374
	2003	**16,942**	1,487	**18,211**	1,685
	2004	**17,731**	1,395	**22,492**	2,805
	2005	**18,228**	1,289	**18,991**	1,897
*	**2006**	**16,911**	1,879	**18,246**	1,878
	2007	**21,203**	2,110	**24,689**	2,769
	2008	**21,822**	2,740	**22,243**	2,841
	2009	**20,324**	2,049	**23,049**	2,198
	2010	**18,124**	2,174	**20,215**	2,359
	2011	**16,796**	2,014	**19,315**	1,974
	2012	**20,076**	2,145	**23,858**	2,370
	2013	**16,077**	2,275	**19,692**	3,097
	2014	**15,690**	1,758	**20,016**	2,634
	2015	**14,660**	1,755	**21,741**	2,802
	2016	**14,422**	1,465	**26,191**	4,592
	2017	**17,613**	1,857	**18,913**	2,054

All Year Index (1992-2017)	**Breeding Birds (BB)**	**Total Birds (TB)**
number of years =	26	26
average index =	**15,772**	**19,202**
SE average index =	626	694
95% CI index =	(14,545-17,000)	(17,842-20,563)
ave. annual growth =	**1.018**	**1.019**
95% CI annual growth =	(1.009-1.026)	(1.012-1.026)

10-Yr Index (2008-2017)	**BB**	**TB**
number of years =	10	10
average index =	**17,560**	**21,523**
SE average index =	796	739
95% CI index =	(16,001-19,120)	(20,075-22,972)
ave. annual growth =	**0.965**	**0.998**
95% CI annual growth =	(0.945-0.986)	(0.974-1.023)

Note:
Breeding Birds (BB) = Singles + 2 x (pairs)
Total Birds (TB) = Singles + (2 x pairs) + flocks

Figure 31. Summary of annual population indices for Arctic Tern (*Sterna paradisaea*) on the Arctic Coastal Plain, Alaska, 1992–2017. Average annual growth rates were estimated using log-linear regression, with standard errors (SE) calculated from residual errors around the regression line. Long-term growth rates are depicted in red (solid line = total birds [TB], dotted line = breeding birds [BB]), while 10-year growth rates are depicted in black (bold = TB, non-bold = BB). *Estimates from 1992 to 2006 are adjusted to account for survey timing and geographic extent of current (2007–2017) survey design (study area = 57,336 km^2).



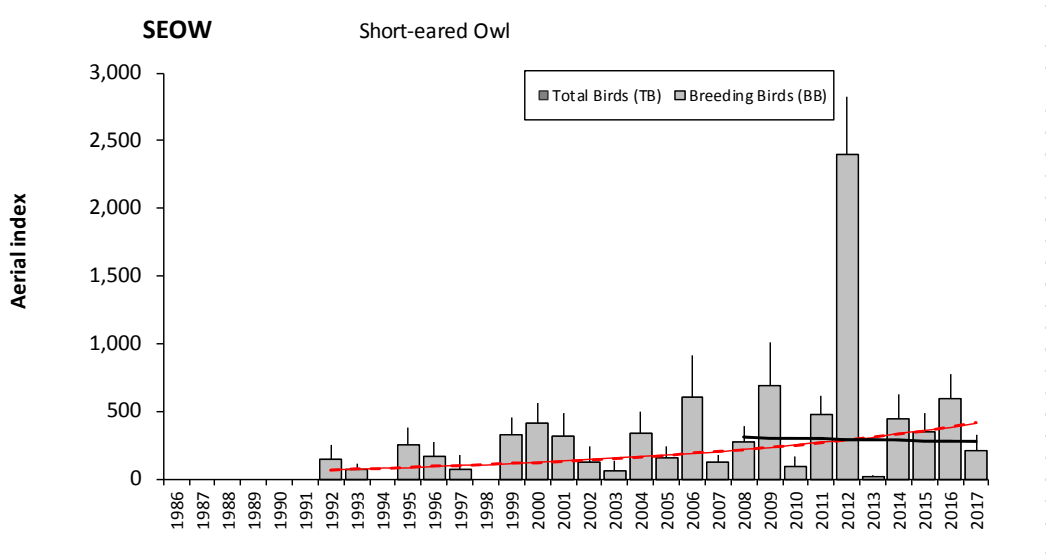
	Year	Breeding Birds (BB)	SE Breeding Birds	Total Birds (TB)	SE Total Birds
	1986				
	1987				
	1988				
	1989				
	1990				
	1991				
	1992	**499**	291	**499**	291
	1993	**0**	0	**0**	0
	1994	**202**	114	**202**	114
	1995	**318**	169	**318**	169
	1996	**594**	303	**594**	303
	1997	**198**	120	**198**	120
	1998	**113**	77	**113**	77
	1999	**455**	223	**779**	523
	2000	**73**	35	**73**	35
	2001	**316**	190	**316**	190
	2002	**279**	135	**279**	135
	2003	**92**	70	**92**	70
	2004	**91**	54	**275**	264
	2005	**68**	61	**68**	61
*	**2006**	**142**	99	**549**	341
	2007	**225**	107	**225**	107
	2008	**189**	118	**189**	118
	2009	**476**	197	**476**	197
	2010	**309**	95	**309**	95
	2011	**562**	248	**562**	248
	2012	**371**	216	**371**	216
	2013	**212**	113	**344**	189
	2014	**353**	149	**353**	149
	2015	**461**	189	**461**	189
	2016	**234**	123	**234**	123
	2017	**51**	54	**51**	54

All Year Index (1992-2017)	Breeding Birds (BB)	Total Birds (TB)
number of years =	26	26
average index =	**265**	**305**
SE average index =	33	38
95% CI index =	(200-329)	(231-379)
ave. annual growth =	**1.010**	**1.011**
95% CI annual growth =	(0.969-1.052)	(0.969-1.055)

10-Yr Index (2008-2017)	BB	TB
number of years =	10	10
average index =	**322**	**335**
SE average index =	49	47
95% CI index =	(226-418)	(242-428)
ave. annual growth =	**0.903**	**0.906**
95% CI annual growth =	(0.783-1.042)	(0.785-1.045)

Note:
Breeding Birds (BB) = Singles + 2 x (pairs)
Total Birds (TB) = Singles + (2 x pairs) + flocks

Figure 32. Summary of annual population indices for Common Raven (*Corvus corax*) on the Arctic Coastal Plain, Alaska, 1992–2017. Average annual growth rates were estimated using log-linear regression, with standard errors (SE) calculated from residual errors around the regression line. Long-term growth rates are depicted in red (solid line = total birds [TB], dotted line = breeding birds [BB]), while 10-year growth rates are depicted in black (bold = TB, non-bold = BB). *Estimates from1992 to 2006 are adjusted to account for survey timing and geographic extent of current (2007–2017) survey design (study area = 57,336 km^2).



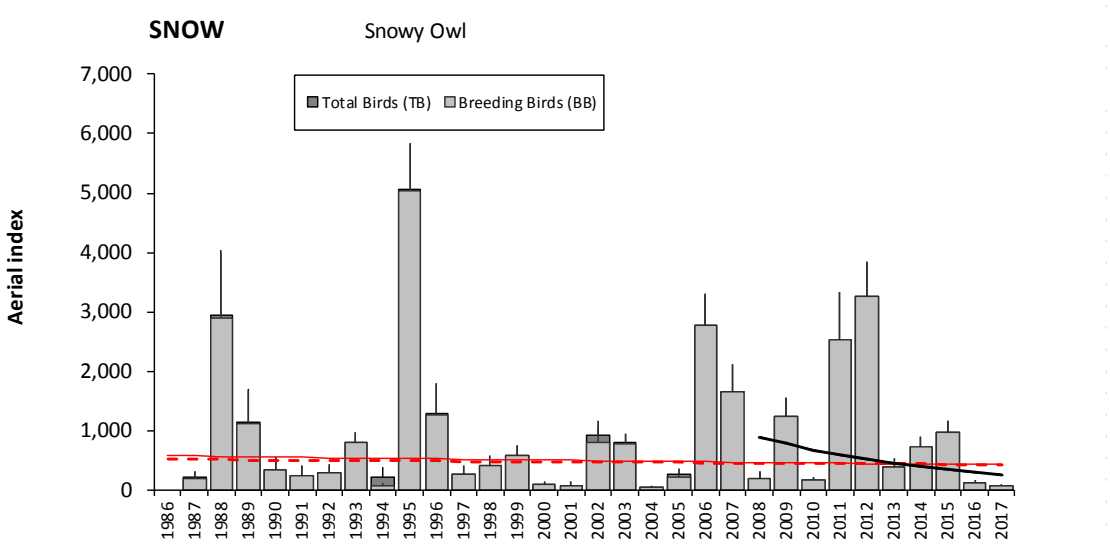
Year	Breeding Birds (BB)	SE Breeding Birds	Total Birds (TB)	SE Total Birds
1986				
1987				
1988				
1989				
1990				
1991				
1992	**145**	104	**145**	104
1993	**71**	40	**71**	40
1994	**0**	0	**0**	0
1995	**246**	128	**246**	128
1996	**166**	104	**166**	104
1997	**73**	101	**73**	101
1998	**0**	0	**0**	0
1999	**325**	124	**325**	124
2000	**407**	154	**407**	154
2001	**319**	164	**319**	164
2002	**127**	108	**127**	108
2003	**57**	72	**57**	72
2004	**337**	160	**337**	160
2005	**150**	89	**150**	89
* 2006	**601**	308	**601**	308
2007	**121**	60	**121**	60
2008	**269**	120	**269**	120
2009	**683**	328	**683**	328
2010	**86**	75	**86**	75
2011	**475**	143	**475**	143
2012	**2,393**	436	**2,393**	436
2013	**14**	13	**14**	13
2014	**438**	186	**438**	186
2015	**343**	148	**343**	148
2016	**593**	184	**593**	184
2017	**203**	123	**203**	123

All Year Index (1992-2017)	Breeding Birds (BB)	Total Birds (TB)
number of years =	26	26
average index =	**332**	**332**
SE average index =	91	91
95% CI index =	(155-510)	(155-510)
ave. annual growth =	**1.075**	**1.075**
95% CI annual growth =	(1.006-1.148)	(1.006-1.148)

10-Yr Index (2008-2017)	BB	TB
number of years =	10	10
average index =	**550**	**550**
SE average index =	215	215
95% CI index =	(127-972)	(127-972)
ave. annual growth =	**0.988**	**0.988**
95% CI annual growth =	(0.721-1.354)	(0.721-1.354)

Note:
Breeding Birds (BB) = Singles + 2 x (pairs)
Total Birds (TB) = Singles + (2 x pairs) + flocks

Figure 33. Summary of annual population indices for Short-eared Owl (*Asio flammeus*) on the Arctic Coastal Plain, Alaska, 1992–2017. Average annual growth rates were estimated using log-linear regression, with standard errors (SE) calculated from residual errors around the regression line. Long-term growth rates are depicted in red (solid line = total birds [TB], dotted line = breeding birds [BB]), while 10-year growth rates are depicted in black (bold = TB, non-bold = BB). *Estimates from 1992 to 2006 are adjusted to account for survey timing and geographic extent of current (2007–2017) survey design (study area = 57,336 km^2).



	Year	Breeding Birds (BB)	SE Breeding Birds	Total Birds (TB)	SE Total Birds
	1986	**0**	0	**0**	0
	1987	**209**	104	**212**	105
	1988	**2,895**	1,082	**2,946**	1,084
	1989	**1,129**	551	**1,149**	555
	1990	**348**	202	**354**	203
	1991	**236**	179	**240**	180
	1992	**295**	131	**300**	132
	1993	**805**	181	**805**	181
	1994	**76**	43	**232**	155
	1995	**5,050**	775	**5,057**	775
	1996	**1,279**	497	**1,293**	501
	1997	**279**	140	**281**	141
	1998	**410**	161	**414**	163
	1999	**590**	161	**590**	161
	2000	**98**	52	**98**	52
	2001	**84**	56	**84**	56
	2002	**814**	232	**918**	257
	2003	**793**	158	**795**	158
	2004	**50**	37	**50**	37
	2005	**218**	71	**262**	94
*	**2006**	**2,769**	524	**2,778**	524
	2007	**1,665**	464	**1,665**	464
	2008	**190**	124	**190**	124
	2009	**1,241**	328	**1,241**	328
	2010	**167**	64	**167**	64
	2011	**2,544**	792	**2,544**	792
	2012	**3,261**	590	**3,261**	590
	2013	**380**	164	**380**	164
	2014	**742**	153	**742**	153
	2015	**976**	195	**976**	195
	2016	**123**	53	**123**	53
	2017	**69**	40	**69**	40

All Year Index (1986-2017)	Breeding Birds (BB)	Total Birds (TB)
number of years =	32	32
average index =	**931**	**944**
SE average index =	208	208
95% CI index =	(524-1,338)	(537-1,351)
ave. annual growth =	**1.012**	**1.008**
95% CI annual growth =	(0.961-1.065)	(0.959-1.060)

10-Yr Index (2008-2017)	BB	TB
number of years =	10	10
average index =	**969**	**969**
SE average index =	349	349
95% CI index =	(285-1,654)	(285-1,654)
ave. annual growth =	**0.874**	**0.874**
95% CI annual growth =	(0.656-1.165)	(0.656-1.165)

Note:
Breeding Birds (BB) = Singles + 2 x (pairs)
Total Birds (TB) = Singles + (2 x pairs) + flocks

Figure 34. Summary of annual population indices for Snowy Owl (*Bubo scandiacus*) on the Arctic Coastal Plain, Alaska, 1986–2017. Average annual growth rates were estimated using log-linear regression, with standard errors (SE) calculated from residual errors around the regression line. Long-term growth rates are depicted in red (solid line = total birds [TB], dotted line = breeding birds [BB]), while 10-year growth rates are depicted in black (bold = TB, non-bold = BB). *Estimates from 1986 to 2006 are adjusted to account for survey timing and geographic extent of current (2007–2017) survey design (study area = 57,336 km^2).