U.S. Fish & Wildlife Service

# Waterfowl

*Population Status, 2016*

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August 10, 2016

In North America the process of establishing hunting regulations for waterfowl is conducted annually. In the United States the process involves a number of scheduled meetings in which information regarding the status of waterfowl is presented to individuals within the agencies responsible for setting hunting regulations. In addition, the proposed regulations are published in the Federal Register to allow public comment. This report includes the most current breeding population and production information available for waterfowl in North America and is a result of cooperative efforts by the U.S. Fish and Wildlife Service (USFWS), the Canadian Wildlife Service (CWS), various state and provincial conservation agencies, and private conservation organizations. This report is intended to aid the development of waterfowl harvest regulations in the United States for the 2017–2018 hunting season.

Cover: 2016–2017 Duck stamp, which features a pair of Trumpeter Swans (*Cygnus buccinator*) painted by Joseph Hautman of Plymouth, Minnesota, winner of the 2015 federal duck stamp design competition.

# Acknowledgments

Waterfowl Population and Habitat Information: The information contained in this report is the result of the efforts of numerous individuals and organizations. Principal contributors include the Canadian Wildlife Service, U.S. Fish and Wildlife Service, state wildlife conservation agencies, provincial conservation agencies from Canada, and Dirección General de Conservación Ecológica de los Recursos Naturales, Mexico. In addition, several conservation organizations, other state and federal agencies, universities, and private individuals provided information or cooperated in survey activities. Appendix A.1 provides a list of individuals responsible for the collection and compilation of data for the "Status of Ducks" section of this report. Appendix A.2 provides a list of individuals who were primary contacts for information included in the "Status of Geese and Swans" section. We apologize for any omission of individuals from these lists, and thank all participants for their contributions. Without this combined effort, a comprehensive assessment of waterfowl populations and habitat would not be possible.

This report was compiled by the U.S. Fish and Wildlife Service, Division of Migratory Bird Management, Population and Habitat Assessment Branch. The principal authors are Joshua Dooley, Pamela Garrettson, Walt Rhodes, and Nathan Zimpfer. The preparation of this report involved substantial efforts on the part of many individuals. Support for the processing of data and publication was provided by Emily Silverman, Guthrie Zimmerman, and John Sauer. Kathy Fleming and Phil Thorpe provided the maps.

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All Division of Migratory Bird Management reports are available from our Web site (http://www.fws.gov/birds/surveys-and-data/reports-and-publications.php).

# Executive Summary

This report summarizes the most recent information about the status of North American waterfowl populations and their habitats to facilitate the development of harvest regulations. The annual status of these populations is monitored and assessed through abundance and harvest surveys. This report details abundance estimates; harvest survey results are discussed in separate reports. The data and analyses were the most current available when this report was written. Future analyses may yield slightly different results as databases are updated and new analytical procedures become available.

In general, the Canadian and U.S. prairies experienced early spring phenology. However, habitat conditions in these areas during the 2016 Waterfowl Breeding and Population Habitat Survey (WBPHS) were poorer than last year because of below-average precipitation and subsequent drying of wetlands. Most prairie and parkland regions were at best fair for waterfowl production; only areas dominated by semi-permanent and permanent wetlands were rated good. The total pond estimate (Prairie Canada and U.S. combined) was $5.0 \pm 0.2$ million, which was 21% below the 2015 estimate of $6.3 \pm 0.2$ million, and similar to the long-term average of $5.2 \pm 0.03$ million. The 2016 estimate of ponds in Prairie Canada was $3.5 \pm 0.1$ million. This estimate was 16% below the 2015 estimate of $4.2 \pm 0.1$ million and similar to the long-term average ($3.5 \pm 0.02$ million). The 2016 pond estimate for the northcentral U.S. was $1.5 \pm 0.05$ million, which was 30% below the 2015 estimate of $2.2 \pm 0.09$ million and 11% below the long-term average ($1.7 \pm 0.01$ million).

In the eastern survey area, spring phenology was advanced in southern areas, and in Newfoundland and Labrador, where good to excellent breeding conditions were reported. In the eastern Arctic, including the Ungava Peninsula in northern Quebec, and Baffin and Bylot islands, breeding conditions were average to slightly below average. Ice and snow melt timing in the eastern Arctic was variable but near average. Breeding conditions were average across most of the central Arctic, with normal or slightly early spring phenology, and average or slightly above-average productivity reported in the Queen Maud Gulf region, on Southampton Island in northern Hudson Bay, and along the western portions of Hudson Bay. In western boreal regions of the traditional survey area and in Alaska, habitat conditions were similar to or improved relative to 2015, with above-average breeding conditions. Ice and snow melt timing was very early in Alaska and the western Arctic, with snow and ice melt dates that were the earliest recorded in some areas, and normal to slightly early in the north-central and south-central Arctic.

## Summary of Duck Populations

In the traditional survey area, which includes strata 1–18, 20–50, and 75–77, the total duck population estimate (excluding scoters [*Melanitta spp.*], eiders [*Somateria spp.* and *Polysticta stelleri*], long-tailed ducks [*Clangula hyemalis*], mergansers [*Mergus spp.* and *Lophodytes cucullatus*], and wood ducks [*Aix sponsa*]) was $48.4 \pm 0.8$ [SE] million birds. This estimate was similar to the 2015 estimate of $49.5 \pm 0.8$ million, and is 38% higher than the long-term average (1955–2015). Estimated mallard (*Anas platyrhynchos*) abundance was $11.8 \pm 0.4$ million, which was similar to the 2015 estimate of $11.6 \pm 0.4$ million, and 51% above the long-term average of $7.8 \pm 0.04$ million. Estimated abundances of gadwall (*A. strepera*; $3.7 \pm 0.2$ million) and American wigeon (*A. americana*; $3.4 \pm 0.2$ million) were similar to last year's estimates, and were 90% and 31% above their long-term averages of $2.0 \pm 0.02$ million and $2.6 \pm 0.02$ million, respectively. The estimated abundance of green-winged teal (*A. crecca*) was $4.3 \pm 0.3$ million, which was similar to the 2015 estimate of $4.1 \pm 0.2$ million, and

104% above the long-term average ($2.1 \pm 0.02$ million). This year again marks the highest estimate in the time series for green-winged teal. Estimated blue-winged teal (*A. discors*; $6.7 \pm 0.3$ million) abundance was 22% lower than the 2015 estimate of $8.5 \pm 0.4$ million, but 34% above the long-term average of $5.0 \pm 0.04$ million. Estimated abundance of northern shovelers (*A. clypeata*; $4.0 \pm 0.2$ million) was similar to the 2015 estimate but 56% above the long-term average of $2.5 \pm 0.02$ million. Northern pintail abundance (*A. acuta*; $2.6 \pm 0.2$ million) was similar to the 2015 estimate and 34% below the long-term average of $4.0 \pm 0.04$ million. Abundance estimates for redheads (*Aythya americana*; $1.3 \pm 0.1$ million) and canvasbacks (*A. valisineria*; $0.7 \pm 0.07$ million) were similar to their 2015 estimates and were 82% and 26% above their long-term averages of $0.7 \pm 0.01$ million and $0.6 \pm 0.01$ million, respectively. Estimated abundance of scaup (*A. affinis* and *A. marila* combined; $5.0 \pm 0.3$ million) was similar to the 2015 estimate and to the long-term average of $5.0 \pm 0.05$ million. The projected mallard fall flight index was $13.5 \pm 1.4$ million birds.

In the eastern survey area, estimated abundance of American black ducks (*Anas rubripes*) was $0.6 \pm 0.05$ million, which was 13% higher than last year's estimate of $0.5 \pm 0.04$ million, and similar to the 1990–2015 average of $0.6 \pm 0.04$ million. The estimated abundance of mallards ($0.4 \pm 0.1$ million) and mergansers ($0.4 \pm 0.04$ million) were similar to the 2015 estimates and their 1990–2015 averages. Abundance estimates of green-winged teal ($0.2 \pm 0.04$ million) and ring-necked ducks (*Aythya collaris*, $0.6 \pm 0.09$ million) were similar to their 2015 estimates and 1990–2015 averages. The estimate of goldeneyes (common and Barrow's [*Bucephala clangula* and *B. islandica*], $0.4 \pm 0.06$ million) was similar to the 2015 estimate and 14% lower than the 1990–2015 average.

## Summary of Goose Populations

In 2016, light goose (i.e., Ross's geese, lesser snow geese, and greater snow geese) abundance remains high. The rate of increase of some light goose populations breeding in the central and eastern Arctic (i.e., Mid-continent Population light geese, Ross's geese, and greater snow geese) has diminished compared to earlier decades, whereas lesser snow goose abundance and trends in northern Alaska, Wrangel Island, Russia, and other portions of the western Arctic have increased. Atlantic brant counts increased relative to last year, following three years of low Midwinter Survey indices, although productivity remained low for the fourth consecutive year. Pacific and western high Arctic brant abundance was similar to last year, but biologists continue to observe greater winter distribution in Alaska and lower abundance at primary breeding colonies. Midwinter indices of Central Flyway Arctic Nesting Geese indicate stable abundance, but counts have increased in northern Yukon Territory, where a portion of the breeding range is monitored. Abundances of temperate-nesting Canada goose populations remain high; however, abundance of both the Atlantic Flyway Resident Population and Mississippi Flyway Giant Canada goose Population was similar between 2016 and 2015, and growth of these populations has diminished or stabilized compared to earlier years of rapid increase. Abundances of Pacific, Rocky Mountain, and Hi-Line Populations of Canada geese were similar to last year and no trends were apparent, but indices for Western Prairie and Great Plains Populations of Canada geese continue to increase. A new survey was implemented in 2016 to monitor Mississippi Flyway Interior Canada goose populations (i.e., Southern James Bay, Mississippi Valley, and Eastern Prairie Populations). North Atlantic and Atlantic Population Canada goose breeding numbers remained similar to those of 2015. In Alaska, emperor goose spring survey counts and Dusky Canada goose breeding counts were lower in 2016, following high counts observed in 2015. Estimates of Aleutian, Cackling, Lesser, and Taverner's geese were similar to or greater than last year. This year's Pacific Population White-fronted goose estimate was markedly higher than last year, although no recent trend was indicated. The 2015 fall survey count of Mid-continent Population White-fronted geese was similar to the prior year's count. Available information indicated stable abundances for both the Western and Eastern Populations of tundra swans.

Of the 25 goose and swan populations included in this report, the primary population monitoring indices for five of these populations had significant ($P < 0.05$) positive trends during the most recent 10-year period: the Western Prairie and Great Plains Population, Dusky, and Aleutian Canada geese, Mid-continent Population light geese, and Wrangel Island Population lesser snow geese. No population had a significant negative 10-year trend. Of the nine populations for which primary indices included variance estimates, one population estimate significantly increased from the previous year (the Western Prairie Great Plains Population of Canada geese) and one population significantly decreased (Dusky Canada geese). Of the 16 populations for which primary indices did not include variance estimates, nine populations were higher than last year, and seven populations were lower.

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# Status of Ducks

This section summarizes the most recent information about the status of North American duck populations and their habitats to facilitate the development of harvest regulations. The annual status of these populations is assessed using databases resulting from surveys which include estimates of the size of breeding populations and harvest. This report details abundance estimates; harvest survey results are discussed in separate reports. The data and analyses were the most current available when this report was written. Future analyses may yield slightly different results as databases are updated and new analytical procedures become available.

## Methods

### Waterfowl Breeding Population and Habitat Survey

Federal, provincial, and state agencies conduct surveys each spring to estimate the size of breeding waterfowl populations and to evaluate habitat conditions. These surveys are conducted using airplanes and helicopters, and cover over 2.0 million square miles that encompass principal breeding areas of North America. The traditional survey area (strata 1–18, 20–50, and 75–77) comprises parts of Alaska, Canada, and the northcentral U.S., and covers approximately 1.3 million square miles (Appendix B). The eastern survey area (strata 51–54, 56–72) includes parts of Ontario, Quebec, Labrador, Newfoundland, Nova Scotia, Prince Edward Island, New Brunswick, New York, and Maine, covering an area of approximately 0.7 million square miles (Appendix B). In 2012, stratum 55 was discontinued primary because it overlapped an existing ground survey plot. In Prairie and Parkland Canada and the northcentral U.S., aerial waterfowl counts are corrected annually for visibility bias by conducting ground counts along a subsample of survey segments. In some northern regions of the traditional survey area, visibility corrections were derived from past helicopter surveys. In the eastern survey area, duck estimates are adjusted using visibility-correction factors derived from a comparison of airplane and helicopter counts. Annual estimates of duck abundance are available since 1955 for the traditional survey area and since 1996 for all strata (except 57–59 and 69) in the eastern survey area; however, some portions of the eastern survey area have been surveyed since 1990. In the traditional survey area, visibility-corrected estimates of pond abundance in Prairie Canada are available since 1961, and in the northcentral U.S. since 1974. Several provinces and states also conduct breeding waterfowl surveys using various methods; some have survey designs that allow calculation of measures of precision for their estimates. Information about habitat conditions was supplied primarily by biologists working in the survey areas. Unless otherwise noted, $z$-tests were used for assessing statistical significance, with alpha levels set at 0.1; $P$-values are given in tables along with wetland and waterfowl estimates.

Since 1990, the U.S. Fish and Wildlife Service (USFWS) has conducted aerial transect surveys using airplanes in portions of the eastern survey area, similar to those in the mid-continent, to estimate waterfowl abundance. Additionally, the Canadian Wildlife Service (CWS) has conducted a helicopter-based aerial plot survey in core American black duck breeding regions of Ontario, Quebec, and the Atlantic Provinces. Historically, data from these surveys were analyzed separately, despite overlap in geographic areas of inference. In 2004, the USFWS and CWS agreed to integrate the two surveys, produce composite estimates from both sets of survey data, and expand the geographic scope of the survey in eastern North America. Consequently, as of 2005, waterfowl abundances for eastern North America are estimated using a hierarchical-modeling approach that combines USFWS and CWS data (Zimmerman et al. 2012). In cases where the USFWS has traditionally not recorded observations to the species level (i.e., mergansers, goldeneyes), estimates were produced for multi-species groupings. Survey-wide composite estimates for the eastern survey area presented in this report currently correspond only to strata 51, 52, 63, 64, 66–68, and 70–72. These strata contain either (1) both USFWS airplane survey transects and CWS helicopter plots or (2) only helicopter plots (strata 71 and 72).

For widely distributed and abundant species (American black ducks, mallards, green-winged teal, ring-necked ducks, goldeneyes and mergansers), composite estimates of abundance were constructed using a hierarchical model (Zimmerman et al. 2012) which estimated the mean count per unit area surveyed for each stratum, year, and method (i.e., airplane or helicopter). These mean counts were then extrapolated over the area of each stratum to produce a stratum/year/method-specific population estimate. Estimates from the airplane surveys were adjusted for visibility bias by multiplying them by the total CWS helicopter survey estimates for all years divided by the total USFWS airplane survey estimates for all years that the two surveys overlapped. For strata containing both CWS and USFWS surveys (51, 52, 63, 64, 66–68, and 70), USFWS estimates were adjusted by visibility-correction factors derived from CWS plot estimates, and the CWS and adjusted USFWS estimates were then averaged to derive stratum-level estimates. No visibility adjustments were made for strata with only CWS plots (71 and 72). For two species groups, goldeneyes and mergansers, for which there are many survey units with no observations, a zero-inflated Poisson distribution (Martin et al. 2005) was used to fit the model. Using this technique, the binomial probability of encountering the species on a transect or a plot is modeled separately. This modified modeling approach was not adequate for the following species that occur at lower densities and are more patchily distributed in the eastern survey area: scaup, scoters (black [*Melanitta americana*], white-winged [*M. fusca*], and surf [*M. perspicillata*]), bufflehead (*Bucephala albeola*), and American wigeon. We will continue to investigate methods that might allow us to estimate abundance of these rarer species within a hierarchical-modeling framework.

To produce a consistent index for American black ducks, total indicated pairs are calculated using the CWS method of scaling observed pairs. The CWS scaling is based on sex-specific observations collected during the CWS survey in eastern Canada, which indicate that approximately 50% of black duck pair observations are actually two males. Thus, observed black duck pairs are scaled by 1.5 rather than the 1.0 scaling traditionally applied by the USFWS. These indicated pairs are then used to calculate indicated birds based on the USFWS protocol. For all other species, the USFWS definitions are used to calculate indicated pairs and indicated birds (see Zimmerman et al. 2012 for further details). This model-based approach and changes in analytical procedures for some species may preclude comparisons with results from previous reports.

## Survey Coverage in 2016

In 2016, aircrew shortages led to a reduced set of strata flown in the eastern survey area. Strata 57–59, 63 and 64 were not flown. However, strata 57-59 are not currently part of existing estimation frameworks, and strata 63 and 64 overlap with the Canadian helicopter survey. The hierarchical modeling framework used to integrate CWS and USFWS data in the eastern survey area can produce population estimates provided at least one survey is conducted within a stratum.

## Total Duck Species Composition

In the traditional survey area, our estimate of total ducks excludes scoters, eiders, long-tailed ducks, mergansers, and wood ducks because the traditional survey area does not include a large portion of their breeding ranges (Smith 1995).

## Mallard Fall-flight Index

The mallard fall-flight index is a prediction of the size of the fall abundance of mallards originating from the mid-continent region of North America. For management purposes, the mid-continent population has historically been composed of mallards originating from the traditional survey area, as well as Michigan, Minnesota, and Wisconsin. However, since 2008, the status of western mallards has been considered separately in setting regulations for the Pacific Flyway, and thus Alaska–Yukon mallards (strata 1–12) have been removed from the mid-continent stock. The fall-flight index is based on the mallard models used for adaptive harvest management and considers breeding population size, habitat conditions, adult summer survival, and the projected fall age ratio (young/adult). The projected fall age ratio is predicted from models that depict how age ratios vary with changes in spring population size and Canadian pond abundance. The fall-flight index represents a weighted average of the fall flights predicted by the four alternative models of mallard population dynamics used in adaptive harvest management (U.S. Fish and Wildlife Service 2015).

# Results and Discussion

## 2016 Overall Habitat Conditions and Population Status

In general, habitat conditions during the 2016 WBPHS were poorer than last year in the prairie states and provinces, and similar to or improved relative to 2015 in the eastern survey area, western boreal regions of the traditional survey area, and Alaska (Figure 1). The Canadian prairies experienced below-average winter and spring precipitation and well above-average temperatures. Nearly all of the of the U.S. prairies experienced below-average precipitation, with the exception of southeastern South Dakota, where early spring precipitation ameliorated multiple years of drought. These weather patterns were reflected by decreases in pond estimates throughout the prairie pothole region. Most prairie and parkland regions were at best fair for waterfowl production; only areas dominated by semi-permanent and permanent wetlands were rated good. The total pond estimate (Prairie Canada and U.S. combined) was $5.0 \pm 0.2$ million, which was 21% below the 2015 estimate of $6.3 \pm 0.2$ million, and similar to the long-term average of $5.2 \pm 0.03$ million (Table 1, Figure 2). The 2016 estimate of ponds in Prairie Canada was $3.5 \pm 0.1$ million. This estimate was 16% below the 2015 estimate of $4.2 \pm 0.1$ million and similar to the long-term average ($3.5 \pm 0.02$ million). The 2016 pond estimate for the northcentral U.S. was $1.5 \pm 0.05$ million, which was 30% below the 2015 estimate of $2.2 \pm 0.09$ million and 11% below the long-term average ($1.7 \pm 0.01$ million). Spring phenology was early elsewhere in the traditional survey area as well. Alaska, and the western boreal portions of the traditional survey area experienced well above-average temperatures, and average to below-average precipitation. However, these areas are characterized by large permanent water bodies and river deltas; and water levels were adequate in most areas, with very little flooding. The early spring and the absence of flooding in important nesting areas likely aided waterfowl production. Alaska was rated excellent throughout, and most boreal portions of the traditional survey area were rated good or excellent.

Conditions in much of the eastern survey area improved relative to 2015. In general, spring phenology was advanced in southern areas and in Newfoundland and Labrador, but delayed in more northern areas. Most areas received adequate precipitation and had good water conditions with little flooding. Southern Ontario and southern Quebec were rated good to excellent, except for the extreme southern portion of Ontario and the St. Lawrence River Valley. Habitat was classified as good in Nova Scotia, Labrador, and on Prince Edward Island, and excellent in Newfoundland. Ice persisted late, and early-spring precipitation was below normal in northern Maine and northeastern New Brunswick, so these areas were considered only fair for waterfowl production. Most of northern Quebec was rated as good, except in the northeastern corner of the surveyed area bordering Labrador, where ice persisted late.

In the traditional survey area, which includes strata 1–18, 20–50, and 75–77, the total duck population estimate was $48.4 \pm 0.8$ million birds. This estimate was similar to the 2015 estimate

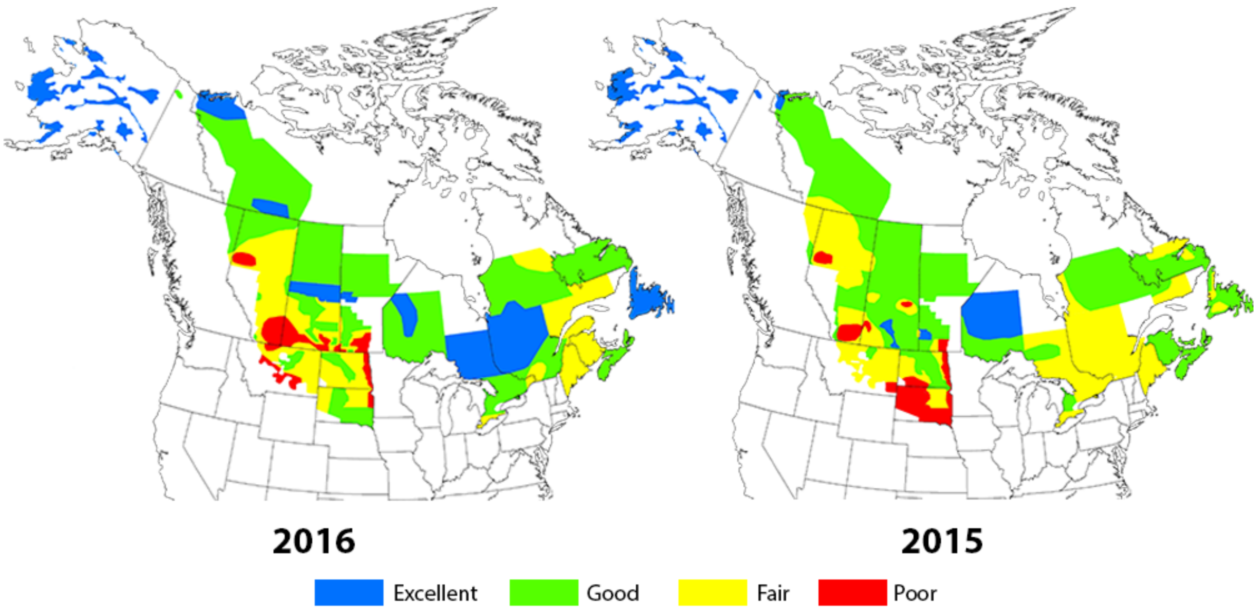


Figure 1. Breeding waterfowl habitat conditions during the 2015 and 2016 Waterfowl Breeding Population and Habitat Survey, as judged by U.S. Fish and Wildlife Service and Canadian Wildlife Service biologists.

of 49.5 ± 0.8 million, and 38% higher than the long-term average (1955–2015). In the eastern Dakotas, total duck numbers were similar to the 2015 estimate, but 37% above the long-term average. The total duck estimate in southern Alberta was 11% below last year's estimate but 17% above the long-term average. The total duck estimate was 21% lower than last year's in southern Saskatchewan, but 37% above the long-term average. In southern Manitoba, the total duck population estimate was similar to last year's estimate and 15% above the long-term average. The total duck estimate in central and northern Alberta–northeastern British Columbia–Northwest Territories was 22% higher than last year's estimate and 93% above the long-term average. The estimate in the northern Saskatchewan–northern Manitoba–western Ontario survey area was similar to the 2015 estimate and to the long-term average. The total duck estimate in the Montana–western Dakotas area was 18% lower than the 2015 estimate but 29% above the long-term average. In the Alaska–Yukon Territory–Old Crow Flats region the total duck estimate was 28% higher than last year's estimate and 17% higher than the long-term average.

Several states and provinces conduct breeding waterfowl surveys in areas outside the geographic extent of the WBPHS of the USFWS and CWS (Appendix C.2). In California, Oregon, Washington, British Columbia, Wisconsin, Michigan, and the northeast U.S., measures of precision for estimates of total duck numbers are available (Table 2). The total duck estimate in California was similar to the 2015 estimate and 27% below the long-term average (1992–2015). In Washington the total duck estimate was 37% lower than the 2015 estimate, and 30% below the long-term average (2010–2015). Oregon's 2016 total duck estimate was 24% lower than 2015, and 20% below its long-term average. British Columbia's total duck estimate was 12% lower than the 2015 estimate, and 9% below the long term average (2006–2015). Wisconsin's 2016 total duck estimate was similar to the 2015 estimate and to the long-term average (1973–2015). In Michigan, the total duck estimate was similar to the 2015 estimate and to the long-term average (1991–2015). The total breeding duck estimate in the northeast U.S. was similar to the 2015 estimate and to the long-term average

Table 1. Estimated number of May ponds in portions of Prairie and Parkland Canada and the northcentral U.S.

| | | | Change from 2015 | | | Change from LTA | |
|---|---|---|---|---|---|---|---|
| Region | 2016 | 2015 | % | *P* | LTA | % | *P* |
| Prairie & Parkland Canada | | | | | | | |
| S. Alberta | 758 | 1,023 | −26 | 0.001 | 767 | −1 | 0.838 |
| S. Saskatchewan | 2,088 | 2,571 | −19 | 0.008 | 2,083 | +0 | 0.970 |
| S. Manitoba | 649 | 557 | +17 | 0.117 | 661 | −2 | 0.790 |
| Subtotal | 3,494 | 4,151 | −16 | 0.002 | 3,510 | 0 | 0.915 |
| Northcentral U.S. | | | | | | | |
| Montana & western Dakotas | 672 | 910 | −26 | <0.001 | 573 | +17 | 0.013 |
| Eastern Dakotas | 846 | 1,247 | −32 | <0.001 | 1,128 | −25 | <0.001 |
| Subtotal | 1,518 | 2,157 | −30 | <0.001 | 1,701 | −11 | 0.001 |
| Total | 5,012 | 6,308 | −21 | <0.001 | 5,220 | −4 | 0.192 |

[a] Long-term average. Prairie and and Parkland Canada, 1961–2015; northcentral U.S. and Total 1974–2015.

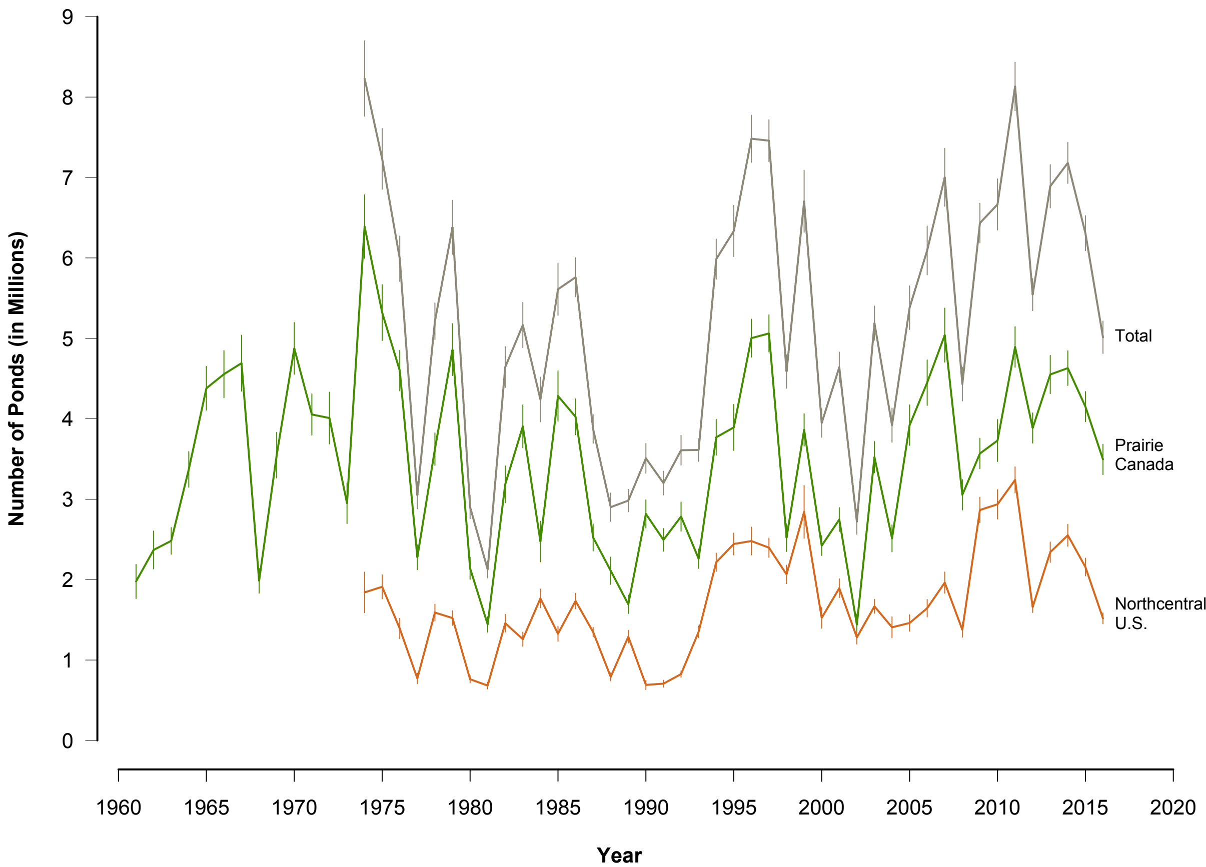


Figure 2. Number of ponds in May and 90% confidence intervals in Prairie Canada, the northcentral U.S., and both areas combined (total ponds).

Table 2. Total duck[a] breeding population estimates (in thousands) for the traditional survey area and other regions.

| Region | 2016 | 2015 | Change from 2015 % | Change from 2015 P | LTA[b] | Change from LTA % | Change from LTA P |
|---|---|---|---|---|---|---|---|
| Alaska–Yukon Territory–Old Crow Flats | 4,327 | 3,389 | +28 | <0.001 | 3,688 | +17 | 0.003 |
| C. & N. Alberta–N.E. British Columbia–NWT | 14,041 | 11,546 | +22 | 0.001 | 7,285 | +93 | <0.001 |
| N. Saskatchewan–N. Manitoba–W. Ontario | 3,246 | 3,527 | −8 | 0.353 | 3,462 | −6 | 0.291 |
| S. Alberta | 5,032 | 5,678 | −11 | 0.056 | 4,302 | +17 | 0.001 |
| S. Saskatchewan | 10,753 | 13,542 | −21 | <0.001 | 7,876 | +37 | <0.001 |
| S. Manitoba | 1,777 | 1,988 | −11 | 0.201 | 1,548 | +15 | 0.038 |
| Montana & Western Dakotas | 2,229 | 2,730 | −18 | 0.034 | 1,721 | +29 | 0.003 |
| Eastern Dakotas | 6,957 | 7,121 | −2 | 0.707 | 5,064 | +37 | <0.001 |
| Total | 48,363 | 49,522 | −2 | 0.318 | 34,946 | +38 | <0.001 |
| **Other regions** | | | | | | | |
| California | 410 | 316 | +30 | 0.110 | 566 | −27 | <0.001 |
| Michigan | 521 | 431 | +21 | 0.363 | 634 | −18 | 0.200 |
| Northeast U.S.[c] | 1,241 | 1,197 | +4 | 0.724 | 1,375 | −10 | 0.146 |
| Oregon | 214 | 280 | −24 | 0.080 | 266 | −20 | 0.013 |
| Washington | 121 | 193 | −37 | <0.001 | 175 | −30 | ,0.001 |
| Wisconsin | 390 | 373 | +5 | 0.760 | 442 | −12 | 0.230 |

[a] Includes 10 species in Appendix C.3, plus American black ducks, ring-necked ducks, goldeneyes, bufflehead, and ruddy ducks (*Oxyura jamaicensis*); excludes eiders, long-tailed ducks, scoters, mergansers, and wood ducks.
[b] Long-term average for regions in the traditional survey area, 1955–2015; years for other regions vary (see Appendix C.2)
[c] Includes all or portions of CT, DE, MD, MA, NH, NJ, NY, PA, RI, VT, and VA.

(1993–2015). Of the states without measures of precision for total duck numbers, the 2016 estimate of total ducks in Minnesota was 47% higher than the 2015 estimate (see Regional Habitat and Population Status for estimates).

Trends and annual breeding population estimates for 10 principal duck species for the traditional survey area are provided in this report (Tables 3–12, Figure 3, Appendix C.3). Percent change was computed prior to rounding and therefore may not match calculations that use the rounded estimates presented in the tables and text. Estimated mallard abundance was 11.8 ± 0.4 million, which was similar to the 2015 estimate of 11.6 ± 0.4 million, and 51% above the long-term average of 7.8 ± 0.04 million (Table 3). In the eastern Dakotas, the mallard estimate was similar to last year's count, and 55% above the long-term average. The mallard estimate in southern Alberta was similar to last year's estimate and 37% above the long-term average. In the Montana–western Dakotas survey area, the mallard count was similar to the 2015 estimate and to the long-term average. In the central and northern Alberta–northeastern British Columbia–Northwest Territories region the mallard estimate was 27% higher than the 2015 estimate and 128% above the long-term average. In the northern Saskatchewan–northern Manitoba–western Ontario survey area, the mallard estimate was similar to the 2015 estimate and 46% above the long-term average. Mallard numbers were similar to the 2015 estimate and 54% above their long-term average

Table 3. Mallard breeding population estimates (in thousands) for regions in the traditional and eastern survey areas, and other regions.

| | | | Change from 2015 | | | Change from LTA | |
|---|---|---|---|---|---|---|---|
| Region | 2016 | 2015 | % | *P* | LTA[a] | % | *P* |
| Alaska–Yukon Territory–Old Crow Flats | 584 | 471 | +24 | 0.171 | 380 | +54 | 0.002 |
| C. & N. Alberta–N.E. British Columbia–NWT | 2,524 | 1,981 | +27 | 0.050 | 1,109 | +128 | <0.001 |
| N. Saskatchewan–N. Manitoba–W. Ontario | 1,669 | 1,728 | −3 | 0.823 | 1,140 | +46 | 0.004 |
| S. Alberta | 1,488 | 1,392 | +7 | 0.523 | 1,085 | +37 | <0.001 |
| S. Saskatchewan | 2,784 | 3,068 | −9 | 0.173 | 2,097 | +33 | <0.001 |
| S. Manitoba | 470 | 538 | −13 | 0.456 | 391 | +20 | 0.085 |
| Montana & Western Dakotas | 629 | 767 | −18 | 0.152 | 529 | +19 | 0.119 |
| Eastern Dakotas | 1,644 | 1,698 | −3 | 0.742 | 1,060 | +55 | <0.001 |
| Total | 11,793 | 11,643 | +1 | 0.772 | 7,791 | +51 | <0.001 |
| **Eastern survey area** | 409 | 399 | +2 | – –[b] | 391 | +4 | – –[b] |
| **Other regions** | | | | | | | |
| California | 264 | 174 | +52 | 0.048 | 349 | −24 | 0.023 |
| Michigan | 278 | 238 | +17 | 0.481 | 349 | −20 | 0.186 |
| Minnesota | 243 | 206 | +18 | 0.514 | 228 | +7 | 0.718 |
| Northeast U.S.[c] | 551 | 540 | +2 | 0.862 | 727 | −24 | <0.001 |
| Oregon | 87 | 86 | 0 | 0.999 | 92 | −5 | 0.602 |
| Washington | 60 | 86 | −31 | 0.004 | 83 | −28 | <0.001 |
| Wisconsin | 164 | 176 | −7 | 0.718 | 182 | −10 | 0.452 |

[a] Long-term average. Traditional survey area 1955–2015; eastern survey area 1990–2015; years for other regions vary (see Appendix C.2).
[b] *P*-values not provided because these data were analyzed using Bayesian methods.
[c] Includes all or portions of CT, DE, MD, MA, NH, NJ, NY, PA, RI, VT, and VA.

in the Alaska–Yukon Territory–Old Crow Flats region. In the southern Manitoba survey area, the mallard estimate was similar to last year and 20% above the long-term average. In southern Saskatchewan, mallard numbers were similar to the 2015 estimate, and 33% above the long-term average.

In the eastern survey area, the estimated abundance of mallards was 0.4 ± 0.1 million, which was similar to the 2015 estimate and the 1990–2015 average. The value for mallards in the eastern survey is a composite estimate of CWS and USFWS data in several Canadian strata, and is not comparable to the eastern mallard estimate used for AHM (U.S. Fish and Wildlife Service 2015), which is based on data from northeast U.S. plot surveys and USFWS transect data from strata 51–54 and 56. Mallard abundances with estimates of precision are also available for other areas where surveys are conducted (California, Nevada, Washington, British Columbia, Oregon, Wisconsin, the northeast U.S., as well as Michigan and Minnesota; Table 3). Mallard numbers in California were 52% higher than last year, but 24% below the long-term average (1992–2015). In Washington, mallard numbers were 31% lower than the 2015 estimate and 25% below the long-term average (1978–2015). In Wisconsin, Oregon, and British Columbia, mallard estimates were similar to last year's estimates and to their

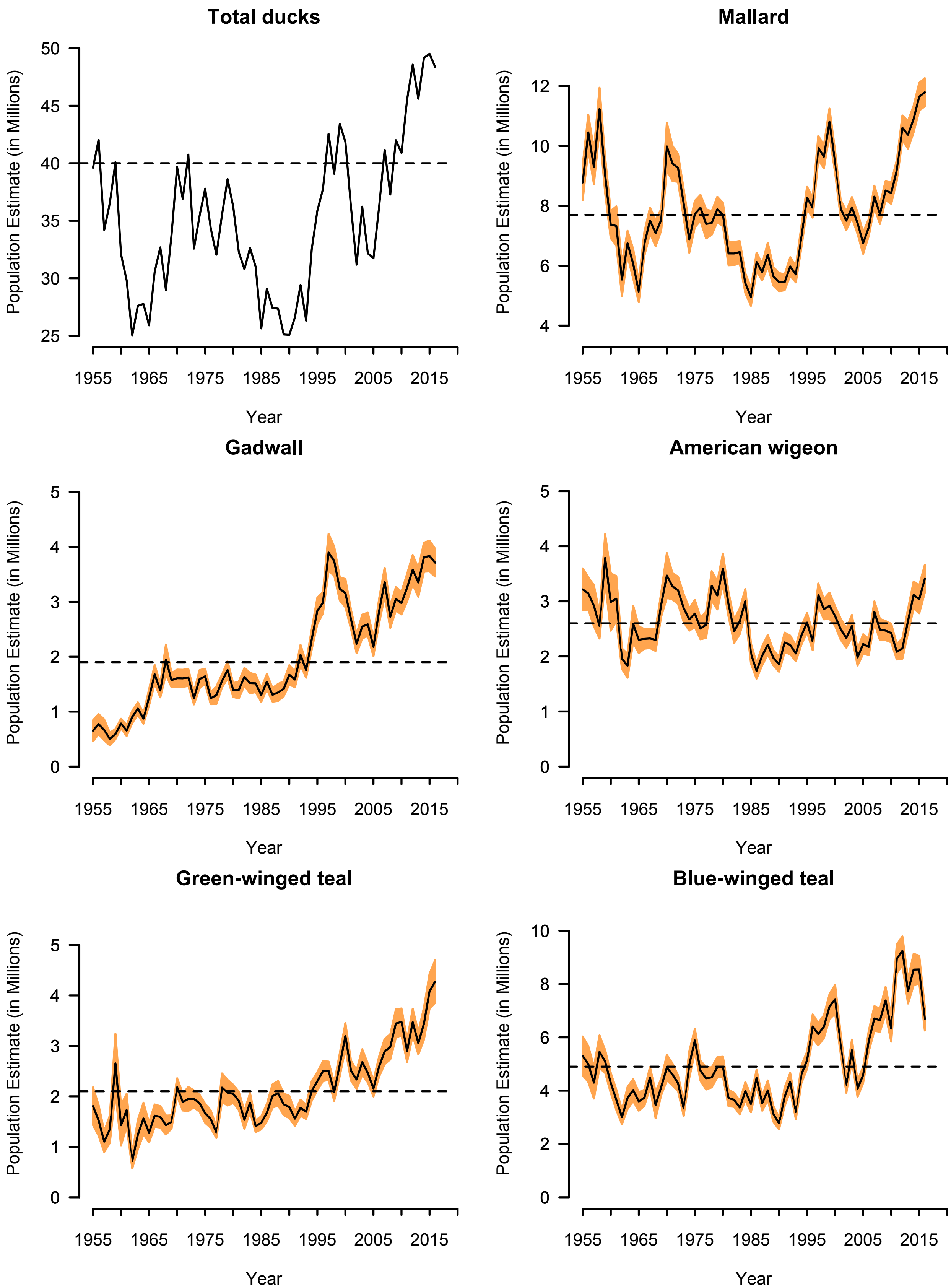


Figure 3. Breeding population estimates, 90% confidence intervals, and North American Waterfowl Management Plan population goals (dashed line) for selected species in the traditional survey area (strata 1–18, 20–50, 75–77).

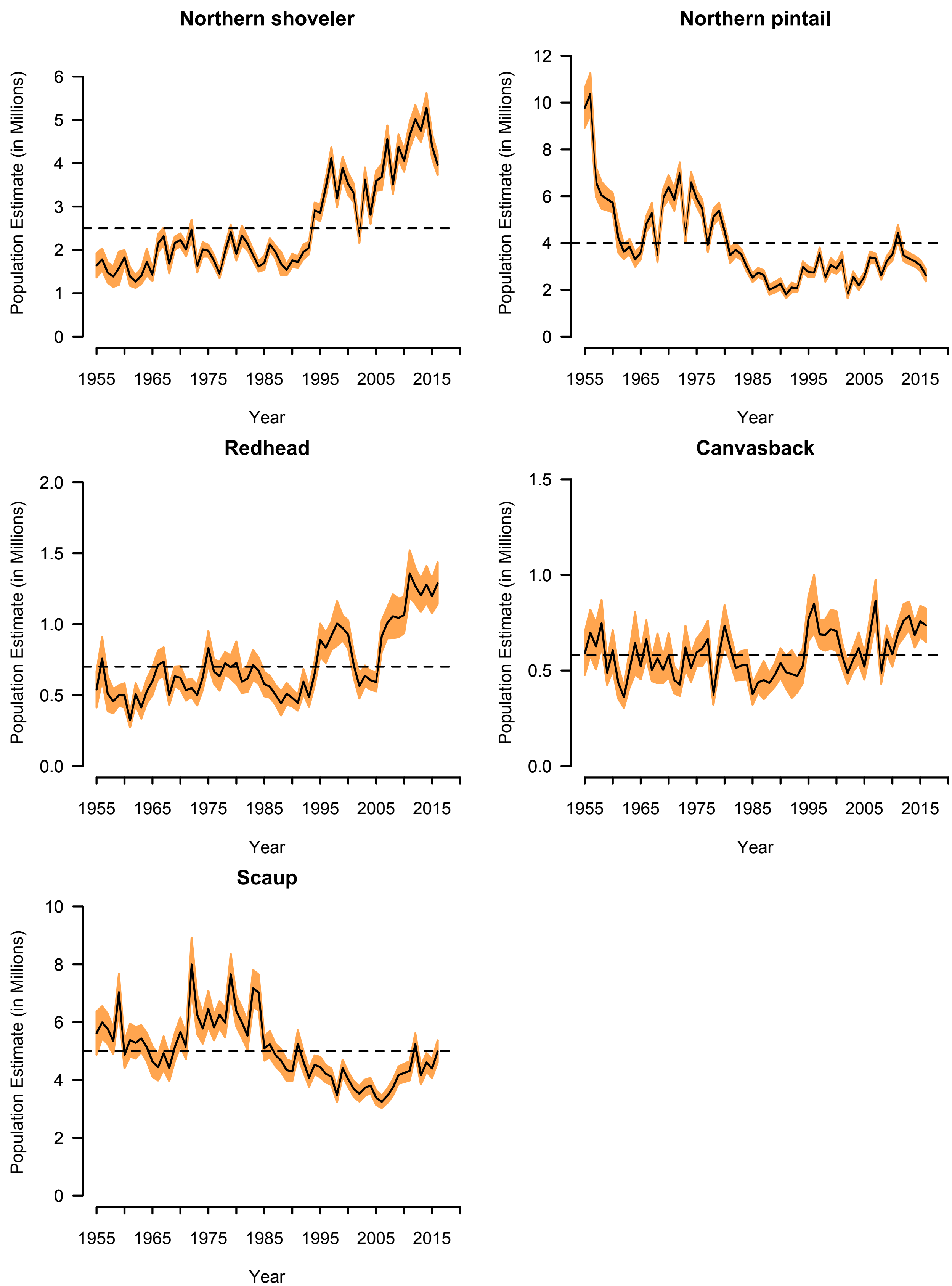


Figure 3. Continued.

respective long-term averages (2010–2015, 1994–2015, and 2006–2015). The mallard estimate was similar to the 2015 estimate in the northeast U.S., but was 24% below the long-term average. In Michigan, the 2016 mallard estimate was similar to the 2015 estimate and to the long-term average (1991–2015). In Minnesota, the 2016 mallard estimate was similar to last year's estimate and the long-term average (1968–2015).

In the traditional survey area the 2016 estimate for blue-winged teal (6.7 ± 0.3 million) was 22% below the 2015 estimate, but 34% above the long-term average of 5.0 ± 0.04 million (Table 7). Estimated abundances of gadwall (3.7±0.2 million) and American wigeon (3.4±0.2 million) were similar to last year's estimates, and were 90% and 31% above their long-term averages of 2.0 ± 0.02 million and 2.6 ± 0.02 million, respectively (Table 4 and Table 5). The estimated abundance of green-winged teal was 4.3 ± 0.3 million, which was similar to the 2015 estimate of 4.1 ± 0.3 million and 104% above the long-term average (2.1 ± 0.02 million; Table 6). Estimated abundance of northern shovelers (4.0±0.2 million) was similar to the 2015 estimate but 56% above the long-term average of 2.5±0.02 million (Table 8). Northern pintail abundance (2.6±0.2 million) was similar to the 2015 estimate, and 34% below the long-term average of 4.0±0.04 million (Table 9). Abundance estimates for redheads (1.3 ± 0.1 million) and canvasbacks (0.7 ± 0.07 million) were similar to their 2015 estimates and were 82% and 26% above their long-term averages of 0.7 ± 0.01 million and 0.6 ± 0.01 million, respectively (Table 10 and Table 11). The combined estimate of scaup (5.0±0.3 million) was similar to the 2015 estimate and to the long-term average of 5.0 ± 0.05 million (Table 12).

In the eastern survey area, the estimate of goldeneyes was 0.4 ± 0.06 million, similar to the 2015 estimate, and 14% below the 1990–2015 average. The green-winged teal estimate (0.2 ± 0.04 million) was similar to its 2015 estimate and to its 1990–2015 average. Estimates of mergansers (0.4±0.04 million) and ring-necked ducks (0.6 ± 0.09 million) were similar to their 2015 estimates and 1990–2015 averages (Table 13, Figure 4, Appendix C.5). One time series for assessing changes in American black duck population status is provided by the breeding waterfowl surveys conducted by the USFWS and CWS in the eastern survey area (Table 13, Figure 4). The 2016 estimate of American black ducks in the eastern survey area was 0.6 ± 0.05 million, which was 13% higher than last year's estimate of 0.5 ± 0.04 million, and similar to the 1990–2015 average. In addition, black duck population estimates for northeast states from New Hampshire south to Virginia are also available from the Atlantic Flyway Breeding Waterfowl Survey. The 2016 estimate of 39,700 was similar to the 2015 estimate, and 34% lower than the long-term (1993–2015) average of 60,200.

Trends in wood duck populations are available from the North American Breeding Bird Survey (BBS). The BBS, a series of roadside routes surveyed during May and June each year, provides the only long-term range-wide breeding population index for this species. Wood ducks are encountered with low frequency along BBS routes, which limits the amount and quality of available information (Sauer and Droege 1990). However, hierarchical analysis of these data (J. Sauer, U.S. Geological Survey Biological Resources Division, unpublished data) incorporated adjustments for spatial and temporal variation in BBS route quality, observer skill, and other factors that may affect detectability (Link and Sauer 2002). This analysis also produces annual abundance indices and measures of variance, in addition to the trend estimates (average % change) and associated 95% credible intervals (LCL, UCL in parentheses following trend estimates) presented here. In the Atlantic and Mississippi flyways combined, the BBS wood duck index increased by an average of 1.35% (0.85%, 1.83%) per year over the entire survey period (1966–2015), 1.79% (1.08%, 2.50%) over the past 20 years (1996–2015), and 2.25% (1.03%, 3.58%) over the most recent (2006–2015) 10-year period. The Atlantic Flyway wood duck index increased by an average of 1.16% (0.49%, 1.81%) annually over the entire time series (1966–2015), by 2.04% (1.04%, 3.13%) over the past 20 years (1996–2015), and by 2.55% (0.65%, 4.69%) from 2006 to 2015. In the Mississippi

Table 4. Gadwall breeding population estimates (in thousands) for regions in the traditional survey area.

| | | | Change from 2015 | | | Change from LTA | |
|---|---|---|---|---|---|---|---|
| Region | 2016 | 2015 | % | *P* | LTA[a] | % | *P* |
| Alaska–Yukon Territory–Old Crow Flats | 11 | 2 | +430 | 0.280 | 2 | +461 | 0.259 |
| C. & N. Alberta–N.E. British Columbia–NWT | 107 | 34 | +212 | <0.001 | 50 | +113 | 0.001 |
| N. Saskatchewan–N. Manitoba–W. Ontario | 21 | 7 | +211 | 0.017 | 26 | −20 | 0.344 |
| S. Alberta | 653 | 564 | +16 | 0.442 | 326 | +100 | <0.001 |
| S. Saskatchewan | 1,473 | 1,463 | +1 | 0.948 | 659 | +123 | <0.001 |
| S. Manitoba | 135 | 205 | −34 | 0.143 | 78 | +73 | 0.094 |
| Montana & Western Dakotas | 282 | 528 | −47 | 0.030 | 216 | +30 | 0.235 |
| Eastern Dakotas | 1,031 | 1,031 | 0 | 1.000 | 595 | +73 | <0.001 |
| Total | 3,712 | 3,834 | −3 | 0.679 | 1,952 | +90 | <0.001 |

[a] Long-term average, 1955–2015.

Table 5. American wigeon breeding population estimates (in thousands) for regions in the traditional survey area.

| | | | Change from 2015 | | | Change from LTA | |
|---|---|---|---|---|---|---|---|
| Region | 2016 | 2015 | % | *P* | LTA[a] | % | *P* |
| Alaska–Yukon Territory–Old Crow Flats | 724 | 541 | +34 | 0.057 | 556 | +30 | 0.043 |
| C. & N. Alberta–N.E. British Columbia–NWT | 1,788 | 1,506 | +19 | 0.235 | 912 | +96 | <0.001 |
| N. Saskatchewan–N. Manitoba–W. Ontario | 92 | 99 | −8 | 0.754 | 231 | −60 | <0.001 |
| S. Alberta | 237 | 305 | −22 | 0.234 | 280 | −15 | 0.275 |
| S. Saskatchewan | 215 | 251 | −14 | 0.403 | 402 | −46 | <0.001 |
| S. Manitoba | 5 | 8 | −43 | 0.110 | 53 | −91 | <0.001 |
| Montana & Western Dakotas | 198 | 195 | +2 | 0.953 | 111 | +78 | 0.025 |
| Eastern Dakotas | 153 | 131 | +17 | 0.733 | 58 | +165 | 0.060 |
| Total | 3,411 | 3,037 | +12 | 0.181 | 2,604 | +31 | <0.001 |

[a] Long-term average, 1955–2015.

Table 6. Green-winged teal breeding population estimates (in thousands) for regions in the traditional survey area.

| | | | Change from 2015 | | | Change from LTA | |
|---|---|---|---|---|---|---|---|
| Region | 2016 | 2015 | % | $P$ | LTA[a] | % | $P$ |
| Alaska–Yukon Territory–Old Crow Flats | 779 | 566 | +38 | 0.097 | 409 | +90 | 0.002 |
| C. & N. Alberta–N.E. British Columbia–NWT | 2,337 | 2,333 | 0 | 0.992 | 850 | +175 | <0.001 |
| N. Saskatchewan–N. Manitoba–W. Ontario | 116 | 140 | −17 | 0.299 | 202 | −43 | <0.001 |
| S. Alberta | 300 | 327 | −8 | 0.754 | 203 | +48 | 0.152 |
| S. Saskatchewan | 468 | 452 | +3 | 0.825 | 272 | +72 | <0.001 |
| S. Manitoba | 140 | 99 | +41 | 0.177 | 54 | +157 | 0.001 |
| Montana & Western Dakotas | 36 | 56 | −36 | 0.147 | 41 | −11 | 0.527 |
| Eastern Dakotas | 100 | 107 | −7 | 0.825 | 59 | +69 | 0.046 |
| Total | 4,275 | 4,081 | +5 | 0.648 | 2,091 | +104 | <0.001 |

[a] Long-term average, 1955–2015.

Table 7. Blue-winged teal breeding population estimates (in thousands) for regions in the traditional survey area.

| | | | Change from 2015 | | | Change from LTA | |
|---|---|---|---|---|---|---|---|
| Region | 2016 | 2015 | % | $P$ | LTA[a] | % | $P$ |
| Alaska–Yukon Territory–Old Crow Flats | 0 | 0 | 0 | | 1 | -100 | <0.001 |
| C. & N. Alberta–N.E. British Columbia–NWT | 447 | 360 | +24 | 0.408 | 275 | +62 | 0.027 |
| N. Saskatchewan–N. Manitoba–W. Ontario | 135 | 94 | +43 | 0.398 | 233 | −42 | 0.009 |
| S. Alberta | 898 | 1,169 | −23 | 0.172 | 623 | +44 | 0.031 |
| S. Saskatchewan | 2,104 | 3,567 | −41 | <0.001 | 1,421 | +48 | 0.001 |
| S. Manitoba | 332 | 522 | −36 | 0.039 | 377 | −12 | 0.385 |
| Montana & Western Dakotas | 639 | 618 | +3 | 0.894 | 304 | +110 | 0.009 |
| Eastern Dakotas | 2,136 | 2,217 | −4 | 0.785 | 1,774 | +20 | 0.037 |
| Total | 6,689 | 8,547 | −22 | <0.001 | 5,008 | +34 | <0.001 |

[a] Long-term average, 1955–2015.

**Table 8.** Northern shoveler breeding population estimates for regions in the traditional survey area.

| Region | 2016 | 2015 | Change from 2015 % | Change from 2015 *P* | LTA[a] | Change from LTA % | Change from LTA *P* |
|---|---|---|---|---|---|---|---|
| Alaska–Yukon Territory–Old Crow Flats | 560 | 397 | +41 | 0.066 | 292 | +92 | <0.001 |
| C. & N. Alberta–N.E. British Columbia–NWT | 786 | 454 | +73 | 0.003 | 228 | +244 | <0.001 |
| N. Saskatchewan–N. Manitoba–W. Ontario | 17 | 20 | −13 | 0.702 | 39 | −56 | <0.001 |
| S. Alberta | 461 | 887 | −48 | <0.001 | 428 | +8 | 0.578 |
| S. Saskatchewan | 1,207 | 1,692 | −29 | 0.012 | 781 | +55 | <0.001 |
| S. Manitoba | 119 | 131 | −9 | 0.695 | 113 | +5 | 0.773 |
| Montana & Western Dakotas | 209 | 297 | −30 | 0.208 | 172 | +22 | 0.307 |
| Eastern Dakotas | 608 | 513 | +18 | 0.310 | 492 | +23 | 0.068 |
| Total | 3,967 | 4,391 | −10 | 0.142 | 2,546 | +56 | <0.001 |

[a] Long-term average, 1955–2015.

**Table 9.** Northern pintail breeding population estimates for regions in the traditional survey area.

| Region | 2016 | 2015 | Change from 2015 % | Change from 2015 *P* | LTA[a] | Change from LTA % | Change from LTA *P* |
|---|---|---|---|---|---|---|---|
| Alaska–Yukon Territory–Old Crow Flats | 816 | 668 | +22 | 0.260 | 924 | −12 | 0.296 |
| C. & N. Alberta–N.E. British Columbia–NWT | 799 | 639 | +25 | 0.403 | 360 | +122 | 0.007 |
| N. Saskatchewan–N. Manitoba–W. Ontario | 16 | 52 | −70 | 0.004 | 36 | −57 | <0.001 |
| S. Alberta | 168 | 260 | −35 | 0.034 | 664 | −75 | <0.001 |
| S. Saskatchewan | 289 | 720 | −60 | <0.001 | 1,136 | −75 | <0.001 |
| S. Manitoba | 19 | 41 | −52 | 0.011 | 100 | −81 | <0.001 |
| Montana & Western Dakotas | 135 | 197 | −32 | 0.161 | 259 | −48 | <0.001 |
| Eastern Dakotas | 378 | 466 | −19 | 0.317 | 510 | −26 | 0.003 |
| Total | 2,618 | 3,043 | −14 | 0.121 | 3,988 | −34 | <0.001 |

[a] Long-term average, 1955–2015.

**Table 10.** Redhead breeding population estimates (in thousands) for regions in the traditional survey area.

| | | | Change from 2015 | | | Change from LTA | |
|---|---|---|---|---|---|---|---|
| Region | 2016 | 2015 | % | *P* | LTA[a] | % | *P* |
| Alaska–Yukon Territory–Old Crow Flats | 1 | 0 | 0 | 0.290 | 1 | −53 | 0.270 |
| C. & N. Alberta–N.E. British Columbia–NWT | 87 | 47 | +84 | 0.116 | 40 | +118 | 0.024 |
| N. Saskatchewan–N. Manitoba–W. Ontario | 11 | 20 | −43 | 0.393 | 25 | −55 | 0.049 |
| S. Alberta | 219 | 167 | +31 | 0.363 | 128 | +71 | 0.026 |
| S. Saskatchewan | 637 | 603 | +6 | 0.765 | 228 | +179 | <0.001 |
| S. Manitoba | 145 | 102 | +41 | 0.418 | 74 | +96 | 0.150 |
| Montana & Western Dakotas | 20 | 8 | +151 | 0.228 | 11 | +79 | 0.350 |
| Eastern Dakotas | 170 | 248 | −32 | 0.074 | 201 | −16 | 0.270 |
| Total | 1,289 | 1,196 | +8 | 0.531 | 709 | +82 | <0.001 |

[a] Long-term average, 1955–2015.

**Table 11.** Canvasback breeding population estimates (in thousands) for regions in the traditional survey area.

| | | | Change from 2015 | | | Change from LTA | |
|---|---|---|---|---|---|---|---|
| Region | 2016 | 2015 | % | *P* | LTA[a] | % | *P* |
| Alaska–Yukon Territory–Old Crow Flats | 78 | 41 | +91 | 0.308 | 84 | −8 | 0.818 |
| C. & N. Alberta–N.E. British Columbia–NWT | 144 | 109 | +32 | 0.503 | 76 | +90 | 0.099 |
| N. Saskatchewan–N. Manitoba–W. Ontario | 35 | 35 | 0 | 0.992 | 51 | −31 | 0.277 |
| S. Alberta | 72 | 114 | −37 | 0.153 | 66 | +9 | 0.765 |
| S. Saskatchewan | 256 | 270 | −5 | 0.755 | 200 | +28 | 0.115 |
| S. Manitoba | 68 | 38 | +80 | 0.027 | 56 | +21 | 0.321 |
| Montana & Western Dakotas | 20 | 18 | +10 | 0.879 | 9 | +112 | 0.319 |
| Eastern Dakotas | 63 | 132 | −52 | 0.057 | 42 | +50 | 0.074 |
| Total | 736 | 757 | −3 | 0.824 | 584 | +26 | 0.028 |

[a] Long-term average, 1955–2015.

Table 12. Scaup (greater and lesser combined) breeding population estimates (in thousands) for regions in the traditional survey area.

| | | | Change from 2015 | | | Change from LTA | |
|---|---|---|---|---|---|---|---|
| Region | 2016 | 2015 | % | *P* | LTA[a] | % | *P* |
| Alaska–Yukon Territory–Old Crow Flats | 653 | 587 | +11 | 0.524 | 901 | −27 | 0.001 |
| C. & N. Alberta–N.E. British Columbia–NWT | 2,805 | 2,215 | +27 | 0.076 | 2,521 | +11 | 0.287 |
| N. Saskatchewan–N. Manitoba–W. Ontario | 349 | 345 | +1 | 0.950 | 547 | −36 | <0.001 |
| S. Alberta | 257 | 262 | −2 | 0.937 | 331 | −22 | 0.127 |
| S. Saskatchewan | 433 | 471 | −8 | 0.680 | 417 | +4 | 0.809 |
| S. Manitoba | 102 | 112 | −9 | 0.754 | 127 | −19 | 0.302 |
| Montana & Western Dakotas | 15 | 10 | +47 | 0.662 | 48 | −69 | 0.002 |
| Eastern Dakotas | 376 | 393 | −4 | 0.886 | 124 | +204 | <0.001 |
| Total | 4,992 | 4,395 | +14 | 0.126 | 5,016 | 0 | 0.936 |

[a] Long-term average, 1955–2015.

Flyway, the corresponding BBS wood duck indices increased by 1.44% (0.78%, 2.06%, 1966–2015), 1.67% (0.77%, 2.56%, 1996–2015), and 2.10% (0.59%, 3.75%, 2006–2015; J. Sauer, U.S. Geological Survey Biological Resources Division, unpublished data). An independent wood duck population estimate is available for the northeast states from New Hampshire south to Virginia, from the Atlantic Flyway Breeding Waterfowl Survey. The 2016 survey estimate of 430,600 was similar to the 2015 (406,200) and 1993–2015 average (382,300) estimates.

## Regional Habitat and Population Status

A description of habitat conditions and duck populations for each of the major breeding areas follows. In the past this information was taken from more detailed reports of specific regions. Although these reports are no longer produced, habitat and population status for each region will continue to be summarized in this report. More detailed information on regional waterfowl and habitat conditions during the May waterfowl survey is also available on the flyways.us website (http://www.flyways.us/status-of-waterfowl).

*Southern Alberta (strata 26–29, 75–76)*
*reported by Jim Bredy*

The effect of last year's El Niño weather pattern was evident in southern and central Alberta. Precipitation indices were below normal (60–85% of average) over most of the survey area since the spring of 2015. Coupled with a warmer-than-normal ($>5$°C above average) fall and winter, this resulted in fewer ponds available in 2016 for nesting waterfowl. However, in the longer term the periodic drying of smaller wetlands makes them more productive and is necessary for the health of those basins. The quality of the upland nesting habitat also deteriorated as a result of the warm, dry conditions. Despite the dry conditions, several storm fronts hit southern Alberta during the third week of May. These slow moving systems dumped up to 70 mm of rain in the Edmonton area. However, most of this moisture had already been absorbed into the dry soils by survey's end. Thus, we are expecting a decrease in waterfowl production this year in the southern and central Alberta survey area.

May ponds were 26% below the 2015 estimate and similar to their long-term average. The total duck estimate was 11% below the 2015 estimate, and 17% above the long-term average. The mallard estimate was similar to 2015 and

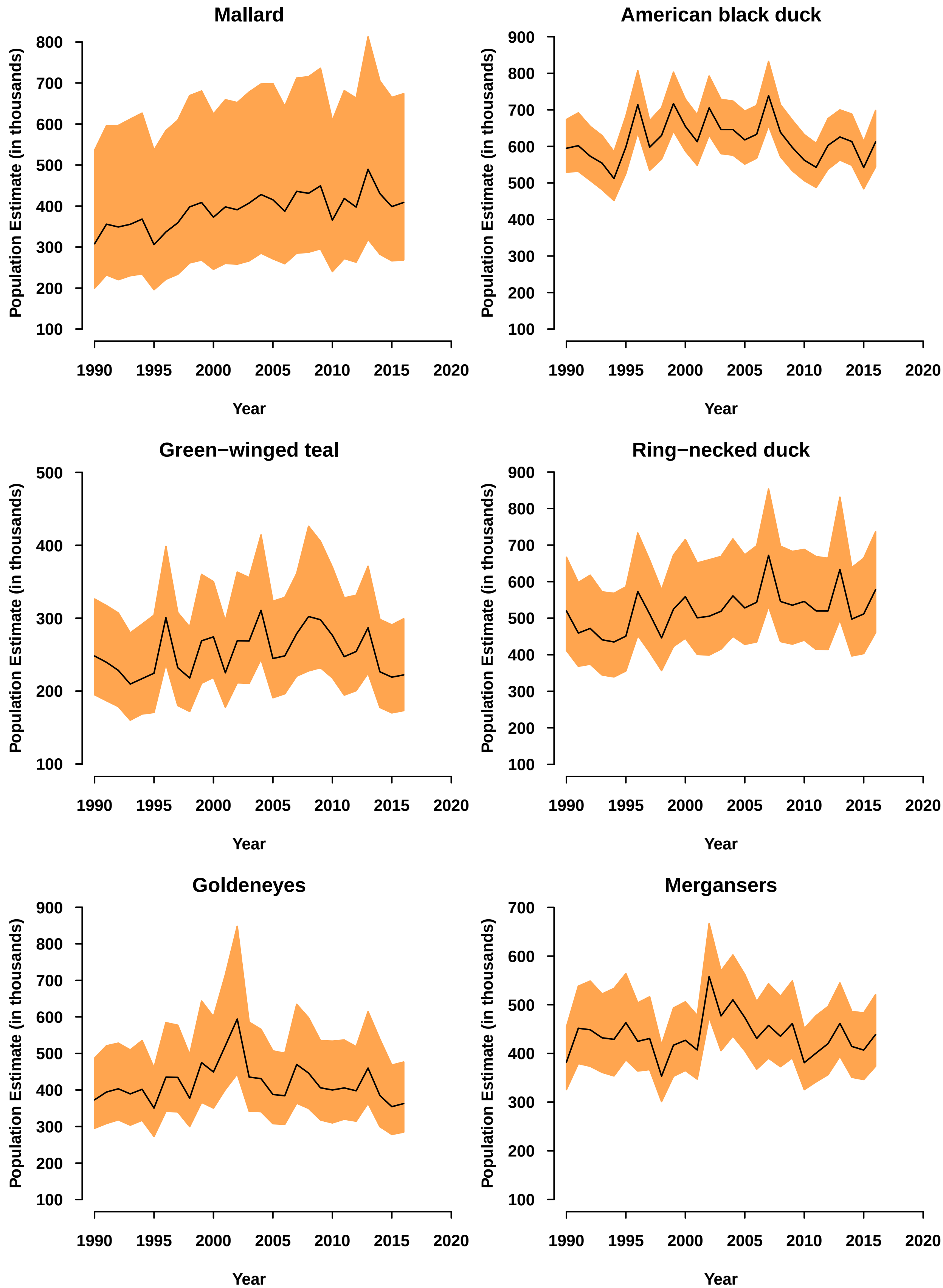


Figure 4. Breeding population estimates and 90% credible intervals from Bayesian hierarchical models for species in the eastern survey area (strata 51, 52, 63, 64, 66–68, 70–72).

Table 13. Duck breeding population estimates[a] (in thousands) for six most abundant species in the eastern survey area.

| | 2016 | 2015 | % Change from 2015 | Average[b] | % Change from average |
|---|---|---|---|---|---|
| Mallard | 409 | 399 | +2 | 391 | +4 |
| American black duck | 612 | 542 | +13[c] | 618 | −1 |
| Green-winged teal | 222 | 219 | +2 | 255 | −13 |
| Ring-necked duck | 578 | 512 | +13 | 520 | +10 |
| Goldeneyes (common and Barrow's) | 363 | 354 | +2 | 422 | −14[c] |
| Mergansers (common, red-breasted, and hooded) | 439 | 407 | +8 | 437 | 0[d] |

[a] Estimates derived using FWS and CWS data from strata 51, 52, 63, 64, 66–68, 70–72.
[b] Average for 1990–2015.
[c] Indicates significant change. Significance ($P \leq 0.10$) determined by non-overlap of Bayesian credibility intervals.
[d] Rounded values mask change in estimates

37% above the long-term average. Gadwall were similar to their 2015 estimate and 100% above their long-term average. The American wigeon estimate was similar to last year and to the long-term average. Green-winged teal were similar to the 2015 estimate and to the long-term average. The blue-winged teal estimate was similar to the 2015 estimate, and 44% above the long-term average. The northern shoveler estimate was 48% below last year's estimate, and similar to the long-term average. Northern pintails were 35% below 2015 and 75% below the long-term average. Redheads were similar to 2015 and 71% above the long-term average. Canvasbacks and scaup were similar to their 2015 estimates and their long-term averages.

*Southern Saskatchewan (strata 30–33)*
*reported by Phil Thorpe*

Late summer and fall of 2015 were drier and warmer than average across the crew area and this pattern remained unchanged throughout the winter and into the spring of 2016. During the winter of 2015–2016 below-average precipitation and above-average temperatures predominated across the area. The late winter and spring months had record-breaking high temperatures. During the survey, because of the above-average temperatures, vegetation phenology and crop seeding were ahead of normal. Precipitation in May was above average only because of a two-day rain event early in the month. Because of the below-average precipitation throughout the fall, winter, and spring, no ephemeral or temporary wetlands were observed during the first part of the survey. Sheetwater was observed only after a rain event early in May. Seasonal and semi-permanent wetland water levels varied considerably across the crew area, with dry seasonal wetlands in the grasslands to drawn-down seasonal and semi-permanent wetlands in the western Parklands. The western Parklands were noticeably drier than the eastern Parklands. Many wetlands in the east were still flooded outside their margins despite the below-average precipitation received during the winter and spring.

The majority of the survey area had fair-to-good production potential for waterfowl. The southern grasslands were extremely dry this year and had lower use by waterfowl, so production and recruitment from this area was expected to be poor. Fair-to-good conditions were found in the grasslands north of Regina. The northeast Parklands were drier and received less precipitation over the winter and into the spring. However some wetlands remained flooded outside of their boundaries, primarily due to carry-over water from previous years, and should provide good brood habitat throughout the summer. As a result, fair-to-good production was expected from the northeast Parklands. In stratum 30, the northwest Parklands should also have good production potential, but conditions were only fair in the western half of the survey stratum closer to Alberta. Overall, it should be a fair-to-good year for production from southern Saskatchewan, but there was likely some overflight of some waterfowl due to the dry conditions in May. Weather forecasters are predicting that 2017 will be a La Niña year, which tends to create a cooler and wetter weather pattern for the prairies, so conditions could improve for spring 2017.

The 2016 May pond estimate in this survey area was 19% below the 2015 estimate, and similar to the long-term average. Total duck abundance was 21% lower than last year, but 37% above the long-term average. Mallards were similar to their 2015 estimate, but 33% above the long-term average. Green-winged teal were similar to last year, and 72% above their long-term average. Blue-winged teal were 41% below their 2015 estimate, but 48% above the long-term average. Northern shovelers were 29% below their 2015 estimate and 55% above the long-term average. The gadwall estimate was similar to last year, and 123% above the long-term average. American wigeon were similar to last year and 46% lower than the long-term average. Northern pintails were 60% and 75% below their 2015 estimate and long-term average, respectively. Redheads were similar to 2015 and 179% above their long-term average. Canvasback and scaup were similar to their 2015 estimates and their long-term averages.

*Southern Manitoba (strata 34–40; includes southeast Saskatchewan)*
*reported by Sarah Yates*

Habitat conditions in southern Manitoba and southeastern Saskatchewan were drastically drier in 2016 than during the previous two springs. The crew area experienced above-average temperatures and below-average precipitation from fall 2015 to early spring 2016. Winter precipitation in all strata was below average (40–85% of average) and winter temperatures averaged 4–5°C above normal in southeastern Saskatchewan, and 2–4°C above normal in southern Manitoba. Spring temperatures continued to range 4–5°C above average in most places, but accumulated spring precipitation (April–May) was above average (85–150% of average) throughout all surveyed strata. Despite the spring precipitation, the entire crew area lacked sheetwater and most seasonal wetlands were dry; even semi-permanent and permanent wetlands were well below their margins and receding.

Conditions in the majority of the southern transects in strata 35, 38, and 39 ranged from poor to fair because seasonal wetlands were lacking, and semi-permanent wetlands were either dry or receding quickly. Only areas with a lot of permanent water, like Turtle Mountain Provincial Park, had what could be considered good waterfowl habitat. While there were pockets of fair habitat closer to some of the larger waterbodies in stratum 39 (e.g., Oak Lake and Whitewater Lake), the majority of the seasonal wetlands and potholes were dry, leaving only some semi-permanent and permanent waterbodies for breeding waterfowl. Due to the early and dry spring in these areas, agricultural activities had begun quite early and many areas were tilled and in production by early May.

Habitat was considered poor throughout most of stratum 35, with only a few pockets of fair habitat. While conditions on the Saskatchewan-Manitoba border are consistently drier and heavily developed for oil production, conditions were much worse in 2016 than 2015. Counts on many of the air-grounds in this stratum were well below average and ducks were heavily concentrated on limited water areas. Habitat conditions were rated good on some of the northcentral lines, mainly due to the presence of more permanent water in Moose Mountain Provincial Park.

Conditions did improve from fair to good as the survey moved north in both Saskatchewan and Manitoba. This was mostly due, again, to the increased percentage of semi-permanent and permanent wetlands. Stratum 34 in Saskatchewan could be considered good. Areas around Yorkton were holding water and waterfowl counts dramatically increased. However, conditions became drier in the segments adjacent and south of Regina. In general, conditions improved moving west to east in stratum 34.

Permanent water dominates in the parkland habitats of strata 36 and 40, and while ponds were below their margins in many areas, habitat looked good for nesting waterfowl throughout both strata. Stratum 37 was more variable, as the more southern lines between Brandon and Winnipeg were rated fair due to the high proportion of agricultural activity there, but conditions improved to good closer to the larger lakes and segments north of Winnipeg.

The 2016 May pond estimate in this crew area was similar to the 2015 estimate and the long-term average. The total duck estimate was similar to 2015 and 15% above the long-term average. Mallard numbers were similar to 2015, and 20% higher than the long-term average. The gadwall estimate was similar to last year and 73% above the long-term average. American wigeon were similar to their 2015 estimate, and 91% below the long-term average. The blue-winged teal estimate was 36% lower than last year and similar to the long-term average. Green-winged teal were similar to last year and 157% above the long-term average. Northern pintails were 52% and 81% below their 2015 estimate and the long-term average, respectively. The northern shoveler estimate was similar to last year's estimate and to the long-term average. The canvasback estimate was 80% higher than last year's estimate, and similar to the long-term average. Both scaup and redheads were similar to their 2015 estimates and their long-term averages in this survey area.

*Montana and Western Dakotas (strata 41–44)*
*reported by Rob Spangler*

Over this past water year, Montana and the western Dakotas received average to below-average precipitation. Fall precipitation averaged about 25% of normal in North Dakota and about 10–25% of normal in South Dakota. Precipitation varied dramatically across Montana, ranging from 50–200% of normal. Dry conditions persisted in areas near the Rocky Mountains, and localized flooding occurred in central Montana. Fall precipitation in eastern Montana averaged approximately 150% of normal. Winter brought drier conditions and less precipitation (50% of normal) until April when precipitation increased significantly. May brought drier conditions to western South and North Dakota with most precipitation occurring just east of the Missouri River and in eastern Montana. Crowding of waterfowl occurred in dry areas where pond densities were low, and intensive cattle grazing and agriculture across the survey area has impacted nesting.

Wetland conditions in western South Dakota (stratum 44) were mostly fair in the western portions near Montana and Wyoming where many wetlands, dugouts, and reservoirs averaged 50% of capacity. Conditions were good in the eastern half of stratum 44, with wetlands at 75% of capacity, and some sheetwater from recent storms. In western North Dakota (stratum 43), conditions were generally fair with wetlands averaging 45% of capacity. Habitat conditions were considered mostly fair with some poor in the western portions of strata 42 and 41 in Montana. The majority of stratum 41 was classified as fair with ponds and reservoirs averaging 40–50% of capacity. However, some habitat in central portion of Montana was rated good. Overall, mostly fair waterfowl production was expected over the Western Dakotas and Montana survey area.

The 2016 May pond count in this crew area was 26% below last year's estimate, but 17% higher than the long-term average. Total duck numbers decreased by 18% from 2015, but were 29% higher than the long-term average. Mallard, northern shoveler, green-winged teal, redhead, and canvasback estimates were all similar to their 2015 estimates and long-term averages. The gadwall estimate was 47% below last year's estimate and similar to the long-term average. The American wigeon estimate was similar to 2015 and 78% above the long-term average. The blue-winged teal estimate was similar to last year and 110% higher than the long-term average. The northern pintail estimate was similar to 2015 and 48% lower than the long-term average. The scaup estimate was similar to last year, but 69% lower than the long-term average.

*Eastern Dakotas (strata 45–49)*
*reported by Terry Liddick*

On the whole, as in 2015, conditions in the eastern Dakotas crew area in 2016 were fair at best. Winter 2015 and spring 2016 precipitation was below average across both states, with the exception of southeastern South Dakota. This resulted from the El Niño-influenced weather pattern over the winter of 2015–2016 that kept most of the moisture to the south. Similarly, a very wet pattern extended from Nebraska up through southeastern South Dakota during April. Thus, the southeastern South Dakota portion of the survey area (rated poor in 2015) was much wetter, and rated good in 2016. By contrast, northern South Dakota was drier than in 2015. Given the mild, albeit dry, winter and spring, upland vegetation was advanced this year and many trees were already leafed out in early May.

In stratum 48 and 49 in South Dakota, conditions were judged as good on the coteaus and the portion of the state south of Huron in the prairie areas of the drift plain, particularly in stratum 49 and the southern portion of stratum 48. However, north of Huron, many semi-permanent wetland basins were dry, as were most of the ephemeral wetlands. Few if any wetlands were more than 50% full, except in the coteau regions, and even there many seasonal wetlands were dry. Farming activities were advanced due to the above- or near-average winter and spring temperatures and lack of spring precipitation. Most of South Dakota was extremely dry during the survey, and without adequate spring and summer precipitation it appears as if it could easily slip back into drought. Production should be average in the coteau regions of South Dakota but probably well below average in the drift plain regions.

Conditions deteriorated moving northward into stratum 45 and 46 in North Dakota, with most of the state considered fair at best and only the coteau regions rated as good. North Dakota conditions seemed slightly better than South Dakota when we first entered the state on 10 May, but it also benefitted from three days of rain that began the day after we arrived. Virtually all of the permanent wetland basins in the coteau regions were at least 60% full, but vegetation margins were present and many semi-permanent and seasonal wetlands were dry. The Souris and James Rivers were well within their banks, and Devil's Lake and Lake Sakakawea had exposed beach areas, similar to 2015. There are few intact wetlands remaining in stratum 47 and most of the segments were again devoid of wetlands and waterfowl.

Overall, the coteau regions of both states were rated good, and should produce average numbers of waterfowl. Poor production was expected in most of the drift prairie. In particular, stratum 47 in eastern North Dakota remained poor due to the dry conditions, compounded by the extensive wetland draining that has occurred.

In the eastern Dakotas, the 2016 May pond estimate was 32% lower than 2015, and 25% lower than the long-term average. The total duck estimate was similar to that of last year, and 37% above the long-term average. Mallard numbers were similar to 2015 and 55% higher than the long-term average. The gadwall estimate was similar to 2015 and 73% above the long-term average. The American wigeon estimate was similar to 2015, and 165% above the long-term average. Green-winged teal were similar to their 2015 estimate, but 69% higher than their long-term average. Blue-winged teal were similar to last year and 20% higher than their long-term average. The northern shoveler estimate was similar to last year and 23% higher than the long-term average. The northern pintail estimate was similar to the 2015 estimate, and 26% below the long-term average. The redhead estimate was 32% lower than last year and similar to the long-term average. The canvasback estimate was 52% below last year's, and 50% above the long-term average. Scaup numbers were similar to last year, and 204% above their long-term average.

*Northern Saskatchewan, Northern Manitoba, and Western Ontario (strata 21–25, 50)*
*reported by Walt Rhodes and Jim Wortham*

Northern Saskatchewan and Northern Manitoba experienced a warm fall and winter period with generally below-average precipitation. The overall warm winter produced an extremely early ice-out across the region, even earlier than last year and far earlier than the late springs of 2013 and 2014. Reindeer Lake, the largest lake in the crew area, was completely ice free during the survey, an unusual event that had not been observed for at least 20 years. The early ice out, combined with no major spring storms, should bode well for waterfowl production. Wetland levels were adequate, particularly where the crew area covers the Parklands, but signals of a longer drying trend remain. The survey area experienced a warm fall and winter period with generally below-average precipitation. Temperatures were average for August and September 2015 but began a warming trend (> 5°C above average) through January 2016. February 2016 temperatures were generally below average 2–4°C but there was a sharp contrast across the area, being colder across Manitoba and warming sharply towards the southeastern portion of the crew area. March 2016 was again above average (2–3°C) and April 2016 was cool, again with a gradient similar to February. Precipitation amounts followed a similar trend. They were average through October 2015, although drier towards Ft. McMurray that particular month. Snowfall was below to well-below average, generally 40–85% but in some cases 40% of average, through February 2016. Areas near Flin Flon, MB, and through the northern Parklands did seem to run closer to average during this time. March 2016 precipitation was generally average (85–20%) over most of the crew area but northern Saskatchewan was below average for the month (40–60%). April 2016 was average but it was drier towards Gillam, MB. The overall warm winter produced an extremely early ice-out across the region, even earlier than last year and far earlier than the late springs of 2013 and 2014. It was so early that Reindeer Lake, the largest lake in the crew area, was completely ice free, a fact that has not been seen by me or the previous pilot-biologist that flew the crew area, covering a time period greater than 20 years. The early ice out combined with no major spring storms should bode well for waterfowl production that did take place. Wetland levels were adequate, particularly where the crew area covers the Parklands, but signals of a longer drying trend remains. It was again apparent that an overflight of prairie-nesting waterfowl had settled in the crew area. This was particularly evident in stratum 25, which seemed to be overflowing with some species.

Spring came early to western Ontario (stratum 50) and lakes were ice-free and ready for nesting waterfowl by the second week of May. Habitat conditions were good to excellent. However, beaver activity is important for maintaining waterfowl habitat quality in this area, and occupation rates have been low. Roughly 60% of prime marshes or creeks were occupied by beavers, but where active lodges existed, conditions were excellent for nesting waterfowl.

The 2016 total duck estimate in this survey area was similar to the 2015 estimate and to the long-term average. The mallard estimate was similar to last year, and 46% above the long-term average. Gadwall numbers increased by 211% relative to 2015 and were similar to the long-term average. The American wigeon estimate was similar to 2015, and 60% lower than the long-term average. Green-winged teal were similar to last year and 43% lower than the long-term average. Blue-winged teal estimates were similar to 2015, but 42% lower than the long-term average. Northern shovelers were similar to last year but 56% lower than the long-term average. Northern pintails were 70% lower than last year, and 57% below their long-term average. The redhead estimate was similar to 2015 but 55% below the long-term average. The canvasback estimate was similar to 2015 and to the long-term average. The scaup estimate was similar to 2015 and 36% below the long-term average.

*Central and Northern Alberta, Northeastern British Columbia, and Northwest Territories (strata 13–18, 20, 77)*
*reported by Fred Roetker*

Northern Alberta, northeastern British Columbia, and the Northwest Territories experienced an early spring in 2016. Although much of northern Alberta, including the Peace-Athabasca Delta, was considerably drier than normal, habitat conditions improved farther north. Many northern boreal wetlands and lakes were full of water, especially those north of Fort Smith to Hay River, NT, so much so that the once dry and century-old grassy buffers between open water and the spruce/alder forest were underwater. Farther north in the Northwest Territories habitat generally looked good. The early ice break-up should bode well for nesting waterfowl. Water levels in the Mackenzie River were lower than normal; however most wetlands in the important Mackenzie River Delta looked ideal. Habitats to the east and along the Arctic coast appeared ideal as well, with optimum water levels, and considerably less ice than in most years.

In this survey area, the total duck estimate for 2016 was 22% higher than the 2015 estimate and 93% higher than the long-term average. Mallard numbers were 27% above the 2015 estimate, and 128% above the long-term average. The American wigeon estimate was similar to last year's and was 96% higher than the long-term average. Gadwall were 212% higher than the 2015 estimate and 113% above their long-term average. Green-winged teal were similar to their 2015 estimate and 175% above their long-term average. Blue-winged teal were similar to their 2015 estimate and 62% above the long-term average. Northern shovelers were 73% and 244% above the 2015 estimate, and the long-term average, respectively. The Northern pintail estimate was similar to last year's, and 122% higher than the long-term average. Redhead and canvasback estimates were similar to 2015 estimates, but 118% and 90% higher than their long-term averages respectively. The scaup estimate was 27% higher than last year, and similar its long-term average.

*Alaska, Yukon Territory, and Old Crow Flats (strata 1–12)*
*reported by Debbie Groves*

Alaska experienced an exceptionally early spring in 2016. Below-average winter precipitation, except in some portions of interior Alaska, combined with well-above-average spring temperatures led to an early snowmelt and record-setting early ice-breakup dates in many parts of the state. Only minimal flooding of some rivers and streams was observed during the survey. Water levels in lakes and ponds were higher than the extremely low levels observed in 2015, and appeared close to normal. Spring phenology on the Old Crow Flats was about average, with just a few of the largest lakes remaining partially frozen on 4 June. A brief period of below-freezing temperatures and up to a few inches of snow occurred on the Old Crow Flats in early June, which may have impacted nesting waterfowl to an unknown degree. Overall, good-to-excellent waterfowl production is likely in the Alaska-Yukon strata in 2016.

The 2016 total duck estimate in this survey area was 28% higher than the 2015 estimate, and 17% higher than the long-term average. Mallard numbers were similar to last year and 54% higher than the long-term average. Gadwall were similar to the 2015 estimate and to the long-term average. American wigeon were 34% higher than last year and 30% above their long-term average. Green-winged teal were 38% higher than last year's estimate, and 90% above their long-term average. The northern shoveler estimate was 41% higher than the 2015 estimate, and 92% higher than the long-term average. Northern pintails and canvasbacks were similar to their 2015 estimates and to their long-term averages. The scaup estimate was similar to the 2015 estimate and 27% lower than the long-term average. Blue-winged teal and redheads are uncommon in this crew area, so annual estimates for these species are typically not meaningful.

*Eastern survey area (strata 51–72)*
*reported by Stephen Earsom, Mark Koneff, Bruce Pollard, John Bidwell, Brian Lubinski, and Jim Wortham*

The majority of southern Ontario and southern Quebec experienced near-average precipitation between 1 November 2015 and 31 March 2016. While some areas had slightly below-average precipitation in April and May 2016, this was not generally noticeable on the landscape. Snow and ice retreated roughly a week later than last year, in the northern areas, and combined with the average winter precipitation this left many streams, beaver ponds, and string bogs near full-capacity during our survey. Permanent lakes were not noticeably different from other years. Tree leaf-out was well underway on 3 May in stratum 54. Ice was not present on any of the Great Lakes. Many tree species had leaves both in strata 54 and 53 and in lower elevation areas of 56. Despite these conditions, good survey weather and no mechanical issues allowed us to catch up with the phenology. Survey timing for strata 51, 52, and northern portions of 56 was appropriate, though phenology varied as always with terrain and local weather. The northern half of stratum 68 had some ice cover at the time of the survey. While all beaver ponds, string bogs, and small lakes were open, most large lakes were still mostly covered with ice. No broods were observed at any time during the survey. With the exception of extreme southern Ontario and the lower St. Lawrence River Valley, all of our area merited a good or excellent rating, and we would not expect habitat to be a widespread limiting factor for waterfowl production in 2016.

Northern Quebec (stratum 69) experienced a late spring this year, and many lakes remained ice covered into June following a relatively dry but normal to warm winter. Ice persisted mainly in the northeast and northcentral portions and those areas along the border with Labrador. In addition, ice that remained elsewhere across the region may have delayed some birds' migration further north. In general, habitats were good and water was abundant. Disturbance from energy development continues in southern portions of stratum 70 along the north shore of the St. Lawrence River. However, these disturbances are judged to be long-term and cannot be considered when evaluating the annual habitat suitability for waterfowl. Habitats are assessed based on their potential to accommodate nesting birds, and the potential of the southern areas of this stratum have now decreased. Thus, habitats there were regarded as fair this year due to drier-than-normal conditions and the impact on available nesting cover from wildfires during recent years.

Winter 2015–2016 in the Maine and Atlantic Canada Region was generally warm with temperatures well-above average. In Maine and the Maritime Provinces, winter precipitation was near the long-term average, and slightly below normal in Newfoundland and Labrador. Snowmelt in Maine and the Maritimes came very early in 2016 and no flooding was observed. Temperatures in late March to May across the entire region were below the long-term average, which slowed phenology considerably. While ice-out also came early in southern Maine and coastal regions of the Maritimes, ice persisted on lakes in northern Maine and northwestern New Brunswick through early May. Early spring precipitation in Maine and the Maritimes was below normal. At the time of the survey, water levels in many wetlands, particularly in Maine and New Brunswick, were notably low, and these conditions persisted into early June. Habitats were classified as fair in Maine and New Brunswick and good in Prince Edward Island and Nova Scotia. Spring precipitation in Newfoundland and Labrador was close to normal. Spring phenology in Newfoundland and Labrador was advanced, and all wetlands and lakes at lower elevations and lower latitudes were ice-free. Larger and deeper lakes at higher elevations and latitudes were still ice-covered, though fringes were ice-free. Habitat conditions and predicted production in Newfoundland were classified as excellent, while conditions in Labrador were characterized as good.

The estimated abundance of mallards in the eastern survey area ($0.4 \pm 0.1$ million) was similar to the 2015 estimate and the 1990–2015 average. Estimated abundance of American black ducks was $0.6 \pm 0.05$ million, which was 13% higher than last year's estimate of $0.5 \pm 0.04$ million, and similar to the 1990–2015 average (Table 13). The estimate of goldeneyes was $0.4 \pm 0.06$ million, similar to the 2015 estimate, and 14% below the 1990–2015 average. The green-winged teal estimate ($0.2 \pm 0.04$ million) was similar to its 2015 estimate and to its 1990–2015 average. Estimates of mergansers ($0.4 \pm 0.05$ million) and ring-necked ducks ($0.6 \pm 0.09$ million) were similar to their 2015 estimates and 1990–2015 averages.

*Other areas*

In 2016, conditions for breeding waterfowl were improved in the Pacific Flyway relative to 2015, but many areas remained under drought. In California, habitat conditions were significantly better in 2016 than in 2015 because of late spring (March and April) rains. Although California remained under a drought, conditions for breeding waterfowl were much improved. Many of the water restrictions in the Sacramento Valley have been lifted, and the return of some fallow rice fields to active production was expected, which should benefit waterfowl. In areas where stock ponds are common, all were flooded and vastly increased mallard counts were noted. In California, the total duck estimate in 2016 was 410,000, which was similar to the 2015 estimate of 316,000 but 27% lower than the long-term average (1992–2015) of 566,000. The mallard estimate in 2016 was 264,000, which was 52% higher than the 2015 estimate of 174,000, but 24% lower than the long-term average of 349,000. Habitat conditions in western Oregon were rated as good, and were slightly improved over last year. Conditions in southcentral and southeast Oregon were much improved compared to last year, but many large wetland basins still remained dry after an extended drought. Conditions in northeast Oregon were good, similar to 2015. In Oregon, the total duck estimate in 2016 was 214,000, which was 24% lower than the 2015 estimate of 280,000, and 20% below the long-term (1994–2015) average. The 2016 Oregon mallard count was 87,000, which was the same as last year (87,000) and similar to the long-term average (92,000). In both western and eastern Washington, March and April precipitation was higher in 2016 than the record lows recorded during spring 2015. Precipitation levels in 2016 were above long-term averages, but below the shorter term (2010–2016) averages reported by the National Weather Service in both areas. The water feature index (water features/km) increased from 1.33 in 2015 to 1.44 in western Washington, but declined slightly in eastern Washington, possibly because of a change in observers. The estimate for total ducks in Washington (121,000) was 37% below the 2015 estimate (193,000) and 28% below the long-term average. The mallard estimate in Washington was 60,000, which was 31% lower than last year's estimate of 86,000 and 25% below the long-term average. The strongest El Niño in the last 20 years brought warm 2015–2016 winter temperatures to British Columbia. April was generally warm and dry and included an extended period of record heat in the third week of the month, which brought significant and rapid melt of the provincial snow pack. Spring waterfowl migration appeared to be 2–3 weeks earlier than average for most species, and counts of spring migrants were lower than in previous years. Wetland water levels were generally low in the southern Interior and average in the central and northern Interior. In general, the May 2016 habitat conditions were poor in the prime breeding waterfowl areas in southern British Columbia and fair to good in the northern Interior. In British Columbia, the 2016 total duck estimate was 318,700, which was 12% lower than last year (363,300) and 9 % lower than the long-term average (2006–2015) of 350,300. The 2016 mallard estimate was 73,900, which was similar to last year's estimate of 82,300 and the long-term average (83,800). No information was available from Nevada at the time of this writing.

In the Midwest, early spring temperatures were very warm, which triggered early migration and breeding behavior in many areas. In Minnesota, overall wetland conditions in spring 2016 were dry, similar to 2015. Average March temperatures were 4°C above normal, and ice out was 3–4 weeks earlier than the median in most parts of the state. During early May 9% of the state was considered in drought condition, and by early June, 43% was under a drought The number of permanent or semi-permanent wetlands was similar to 2015 and 13% below the long-term average. The total duck population in Minnesota, excluding scaup, was 768,000, 47% above last year's index of 524,000, and 25% above the long-term average (1968–2015). The 2016 estimated Minnesota mallard breeding population was 243,000, similar to last year's estimate of 206,000, and to the long-term average of 228,000. In Michigan, the 2016 statewide wetland abundance estimate was 499,100 ponds, which was similar to the 2015 estimate and near the long-term average (1991–2015). The estimate for total ducks was 502,600, 21% lower than the 1991–2015 average. The Michigan mallard estimate was 278,000, which was similar to the 2015 estimate of 238,000, and similar to the long-term average of 349,000. In Wisconsin, warm weather arrived in March, earlier than the previous two years, which triggered migration and breeding activity by mallards and Canada geese. However, cold temperatures in April and early May delayed the migration of blue-winged teal. Overall, average statewide spring precipitation was 15% above normal, but nesting areas that typically have high numbers of ducks in southern and eastern Wisconsin were drier than normal which may have caused some ducks to overfly this potentially important breeding habitat. The 2016 total Wisconsin breeding duck population estimate was 390,500, similar to the 2015 estimate (372,800) and 12% lower than the long-term average (1972–2015). The 2016 Wisconsin mallard population estimate of 164,100 was similar to the 2015 estimate of 176,200 and to the long-term average (1972–2015). Conditions in the Nebraska Sandhills were again good to excellent this spring and early summer, with abundant precipitation in May and beyond. Duck production was expected to be above average. Nebraska has not conducted a spring waterfowl survey in recent years.

In the northeast U.S., the waterfowl breeding season started early, with warm temperatures in March. Colder temperatures returned in April, resulting in a near-average spring phenology. Many states reported unusual spring temperature fluctuations. Lower than average snowfall across the survey area, and below-normal early spring precipitation, contributed to average or below-average water levels in most states. The total duck estimate from the 2016 Atlantic Flyway Breeding Waterfowl survey was 1.2 million, which was the same as the 2015 estimate of 1.2 million and similar to the long-term (1993–2015) average of 1.4 million. Mallard numbers (551,300) were similar to the 2015 estimate of 540,100 and 24% below the long-term average of 727,300.

### Mallard Fall-flight Index

The mid-continent mallard population is composed of mallards from the traditional survey area (revised in 2008 to exclude Alaska mallards), Michigan, Minnesota, and Wisconsin, and is estimated to be $13.5 \pm 1.4$ million birds in 2016 (Figure 5). This is similar to the 2015 estimate of $13.8 \pm 1.4$ million.

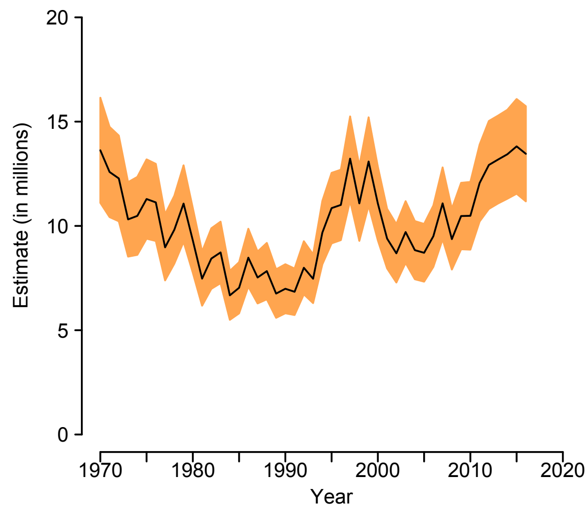


Figure 5. Estimates and 90% confidence intervals for the predicted size of the mallard population in the fall.

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# Status of Geese and Swans

This section summarizes information regarding the status and productivity of goose and tundra swan populations in North America. Information was compiled from a broad geographic area and is provided to assist managers in regulating harvest. Most populations of geese and swans in North America nest in the Arctic and subarctic regions of Alaska and northern Canada (Figure 6), but several Canada goose populations nest in temperate regions of the United States and southern Canada ("temperate-nesting" populations). Arctic-nesting geese rely predominantly on stored reserves for egg production. Thus, persistent snow cover reduces nest site availability, delays nesting activity, and often results in depressed reproductive effort and productivity. In general, goose productivity will be better than average if nesting begins by late May in western and central portions of the Arctic, and by early June in the eastern Arctic. Production usually is poor if nest initiations are delayed much beyond 15 June. For temperate-nesting Canada goose populations, productivity is generally less variable among years, but recruitment can be affected by local factors such as drought or weather events.

## Methods

We have used the most widely accepted nomenclature for various waterfowl populations, but they may differ from other published information. Species nomenclature follows the List of Migratory Birds in Title 50 of the Code of Federal Regulations, Section 10.13, revised 1 November 2013 (78 FR 65844). Some of the goose populations described herein are composed of more than one subspecies, and some light goose populations contain two species (i.e., snow and Ross's geese). Population estimates for geese (Appendices D.1, D.2, and D.3) are derived from a variety of surveys conducted by biologists from federal, state, and provincial agencies, or from universities (Appendix A.2). Surveys include the Midwinter Survey (MWS, conducted each January in wintering areas), the Waterfowl Breeding Population and Habitat Survey (WBPHS, see Status of Ducks section of this report), and surveys that are specifically designed for various goose populations. Where survey methodology allowed, 95% confidence intervals are presented in parentheses following population estimates. Trends of population estimates were calculated by regressing the natural logarithm of survey results on year, and slope coefficients were presented and tested for equality to zero ($t$-statistic). Changes in population indices between the current and previous year were calculated and, where possible, assessed with a two-tailed $z$-test using the sum of sampling variances for the two estimates. All statistical tests and analyses were conducted using an alpha level of 0.05. Primary abundance indices used as management plan population objectives are described first in population-specific sections and graphed. This report was completed prior to final assessments of goose and swan reproduction for some populations; thus, information is the best available at the time of finalizing the report, but may differ from final estimates or observed conditions. Information on habitat conditions and productivity was primarily based on observations made during various waterfowl surveys and information from field biologists. These reports provide reliable information for specific locations, but may not provide an accurate assessment over the vast geographic range of goose and swan populations.

## Results and Discussion

### Conditions in the Arctic and Subarctic

Production of Arctic-nesting geese depends heavily upon the annual timing of snow and ice melt.


Figure 6. Important goose and swan nesting areas in arctic and subarctic North America.

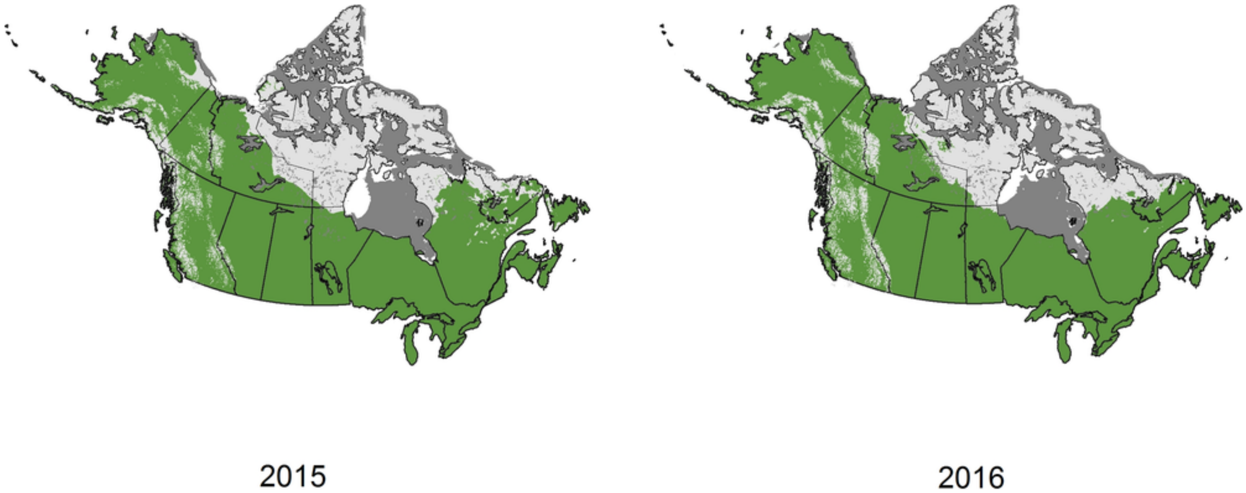



Figure 7. The extent of snow (light gray) and ice (dark gray) cover in North America on 2 June 2015 and 2 June 2016 (National Ice Center 2016).

In 2016, ice and snow melt was very early in Alaska and the western Arctic (record early in some areas), average to slightly early in the northcentral and southcentral Arctic, and average or variable in the eastern Arctic. Ice or snow cover on 2 June 2016 was similar in many areas compared to the same date in 2015, but coverage was less extensive along the northeastern coast of Alaska and the western coast of Hudson Bay, and more extensive in northern Quebec (National Ice Center 2016; Figure 7). Based on these early conditions, good to excellent nesting conditions were expected for goose and swan populations in Alaska and the western Arctic. Average or variable nesting conditions were expected for populations in the central and eastern Arctic.

## Conditions in Southern Canada and the United States

Conditions that influence the productivity of Canada geese vary less from year to year in temperate regions than in the Arctic and Subarctic. Given adequate wetland numbers and the absence of flooding, temperate-nesting Canada geese are reliably productive. Many temperate-nesting goose populations remain above management objective levels, despite efforts aimed to reduce abundance. In 2016, early spring phenology and fair habitat conditions were recorded across much of the Canadian and U.S. prairies, with poor conditions noted in some portions of eastern North Dakota and South Dakota and southern Alberta, Saskatchewan, and Manitoba (Figure 1). Habitat conditions in many portions of the western U.S. and Pacific Flyway states were improved relative to last year, but drought conditions still remain across much of the area. Biologists in the Central and Mississippi Flyways generally reported above-average or average nesting conditions and early production. Spring phenology was early in Atlantic Flyway provinces and northern states, and biologists reported unusual spring temperature fluctuations in many areas.

## Status of Canada Geese

*North Atlantic Population (NAP)*

NAP Canada geese principally nest in Newfoundland and Labrador. They commingle during winter with other Atlantic Flyway Canada goose populations, although NAP geese have a more coastal distribution than other populations (Appendix B.). In 2016, biologists revised the index used to monitor this population to a composite estimate that combines data from both the Canadian Wildlife Service (CWS) helicopter plot survey and the WBPHS (strata 66, 67, and 70; (Figure 9.1). In prior Status Reports, we

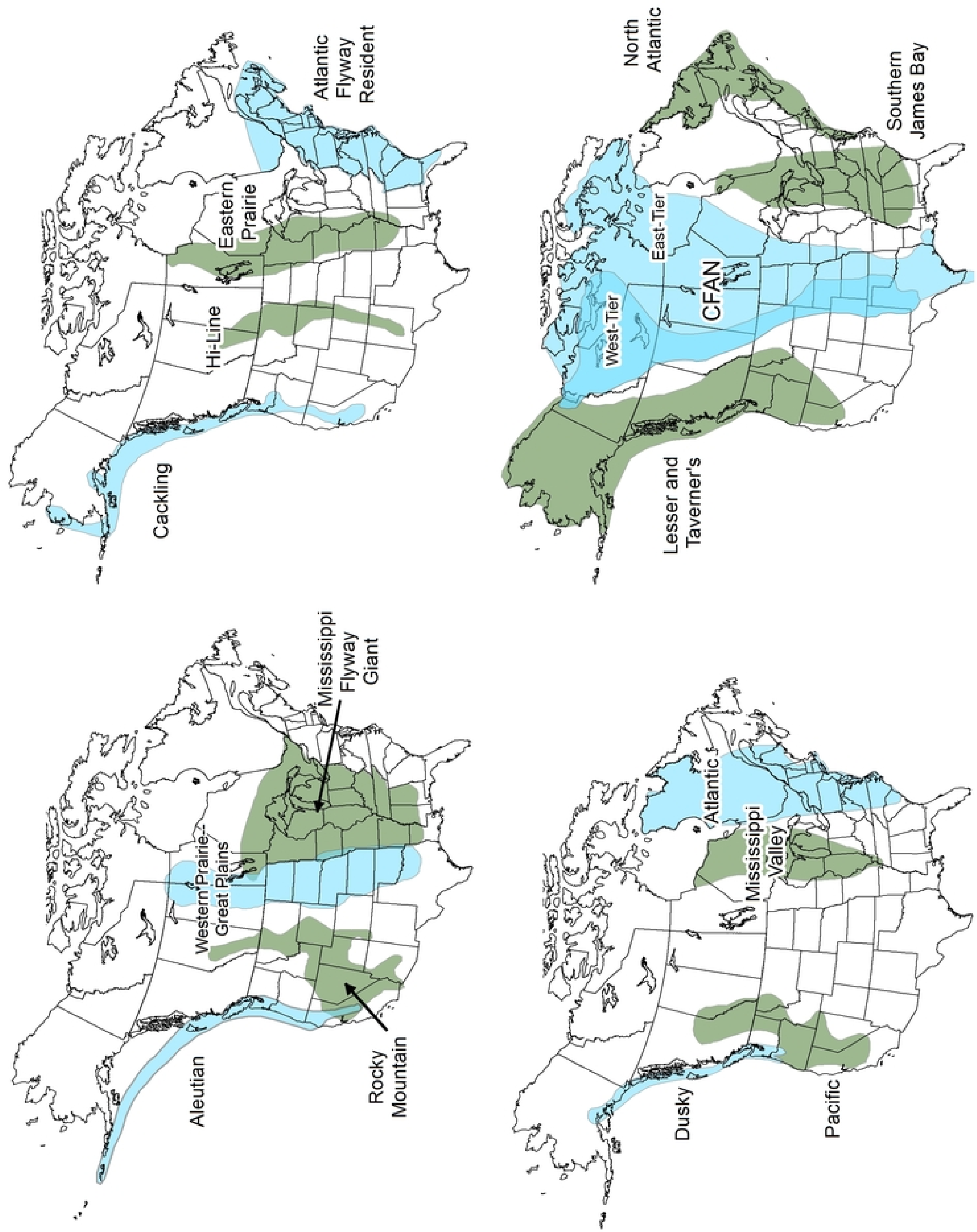



Figure 8. Approximate ranges of Canada goose populations in North America.

Table 14. Canada goose indices (in thousands) from primary monitoring surveys.

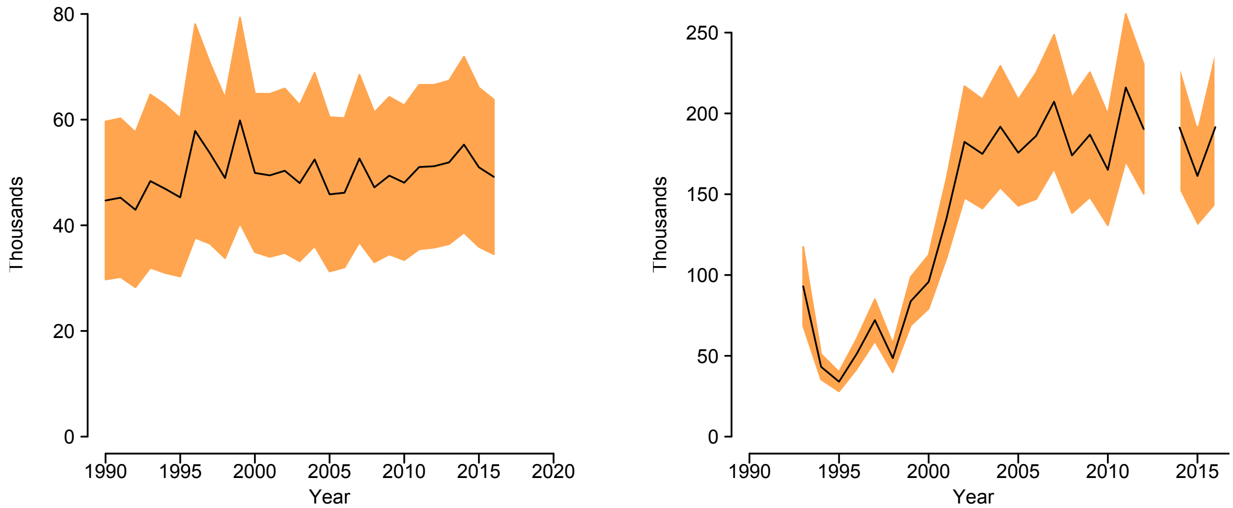
| Population | Estimate/Count | | Change from 2015 | | 10-year Trend | |
|---|---|---|---|---|---|---|
| | 2016 | 2015 | % | *P* | %/yr | *P* |
| North Atlantic | 49 | 51 | −3 | 0.889 | 0[a] | 0.432 |
| Atlantic | 191 | 161 | +19 | 0.308 | −1 | 0.641 |
| Atlantic Flyway Resident | 950 | 964 | −1 | 0.904 | −1 | 0.169 |
| Mississippi Flyway Interior | 70 | *n/s* | – | – | – | – |
| Mississippi Flyway Giant | 1,529 | 1,620 | −6 | – | +1 | 0.375 |
| Western Prairie and Great Plains | 1,852 | 1,484 | +25 | 0.005 | +4 | 0.010 |
| Central Flyway Arctic Nesting | 625 | 828 | −25 | – | −1 | 0.676 |
| Hi-Line | 464 | 379 | +23 | – | +3 | 0.188 |
| Rocky Mountain | 262 | 170 | +54 | – | +2 | 0.453 |
| Pacific | 247 | 255 | −3 | – | +2 | 0.464 |
| Dusky | 13 | 18 | −25 | 0.042 | +8 | 0.011 |
| Cackling | 328 | 347 | −6 | 0.564 | +3 | 0.184 |
| Lesser | 5 | 3 | +49 | – | −5 | 0.386 |
| Taverner's | 36 | 25 | +45 | – | −3 | 0.244 |
| Aleutian | 156 | 189 | −17 | 0.143 | +6 | 0.009 |

[a] Rounded values mask change in estimates.
*n/s* = No survey was conducted or survey data were not available.

included NAP goose estimates calculated from only the WBPHS strata 66–67 in Newfoundland and Labrador; thus, the new composite time series presented here is not comparable to prior reports. Additionally, the time series is revised and updated annually due to the estimation procedure, and estimates presented are medians, and 2.5% and 97.5% Bayesian credible intervals. In 2016, the composite estimate of total indicated pairs was 49,100 (36,400–70,300), similar to the 2015 estimate of 50,600 (37,500–72,500; $P \geq 0.899$; Table 14, Figure 9.1). During the past 10 years, the trend for these estimates was not significant ($P = 0.432$). Similarly, the previously reported indices of total indicated pairs and birds derived from only WBPHS strata 66–67 did not have a significant trend during 2007–2016 ($P = 0.656$ and 0.811, respectively). Habitat conditions in 2016 were classified as excellent in Newfoundland and good in Labrador. Spring phenology in both provinces was earlier than average. All wetlands and lakes at lower elevations and lower latitudes were ice-free at the time of the WBPHS, but larger and deeper lakes at higher elevations and latitudes were still ice-covered, although their fringes were ice-free.

### *Atlantic Population (AP)*

AP Canada geese nest throughout much of Quebec, especially along Ungava Bay, the eastern shore of Hudson Bay, and on the Ungava Peninsula (Figure 9.2). This population winters from New England to South Carolina, but the largest concentrations occur on the Delmarva Peninsula (Figure 8). This population is monitored via a spring survey of the Ungava Peninsula in northern Quebec (Atlantic Flyway Council 2008). The breeding pair estimate was 191,500 (142,700–240,300), similar ($P = 0.308$) to last year's estimate of 161,300 (129,900–192,700; Table 14, Figure 9.2). The total population estimate (breeding pairs and grouped birds) was 663,500 (506,500–820,500), which was similar to the 2015 estimate of 864,400 (689,200–1,039,500; $P = 0.094$). Over the past 10 years, breeding pair estimates have been stable ($P = 0.641$), and total population estimates have decreased 5% per year ($P = 0.010$). The total population estimate may contain large numbers of molt migrant geese and should be interpreted cautiously. Also,




9.1: North Atlantic Population

9.2: Atlantic Population

Figure 9. Estimated numbers (and 95% confidence intervals) of North Atlantic Population (indicated pairs) and Atlantic Population (breeding pairs) Canada geese.

estimates are uncorrected for visibility bias and thus represent an index to the population. Spring phenology was later than average in northern and central Quebec, and habitat conditions appeared below average for nesting. Most lakes and ponds remained frozen, and significant snow cover persisted into mid-June. A model that uses May temperatures and June snowfall to predict recruitment (Eric Reed, CWS, unpublished data) suggested slightly below-average production. However, a high proportion of single geese usually forecasts above-average production, and the proportion of indicated pairs observed as single geese in 2016 was 57%, which was above the long-term average of 51% (1993–2016; range = 34–63%).

*Atlantic Flyway Resident Population (AFRP)*

AFRP Canada geese were introduced and established throughout the Atlantic Flyway during the early 20$^{th}$ century and are composed of various subspecies. This population of large Canada geese inhabits all states of the Atlantic Flyway and southern portions of Quebec and the Maritime provinces (Figure 8). The breeding population is estimated during the spring via the Atlantic Flyway Breeding Waterfowl Plot Survey (Atlantic Flyway Council 1999). A breeding population of 950,000 (792,900–1,107,000) AFRP Canada geese was estimated during the spring of 2016, similar to the 2015 estimate of 963,800 (803,600–1,124,000; $P = 0.904$; Table 14, Figure 10). The 10-year trend for these estimates was not significant ($P = 0.169$). Spring phenology started early with warm temperatures in March across much of the AFRP range, but colder temperatures returned in April resulting in a near-average spring phenology. Many states and provinces reported unusual spring temperature fluctuations. Lower than average snowfall across the survey area and below-normal early spring precipitation contributed to average or below-average water levels in many states.

*Mississippi Flyway Interior Population (MFIP)*

In 2016, biologists modified the monitoring surveys of the Southern James Bay Population (SJBP; Mississippi and Atlantic Flyway Councils 2008), Mississippi Valley Population (MVP; Mississippi Flyway Council 1998), and Eastern Prairie Population (EPP; Mississippi Flyway Council 2008) of Canada geese. Biologists now conduct a combined survey along the southern and western portions of the Hudson and James bays and report indices for the Mississippi Flyway Interior Population of Canada geese (MFIP).


Figure 10. Estimated numbers (and 95% confidence intervals) of Atlantic Flyway Resident Population (breeding adults) Canada geese.

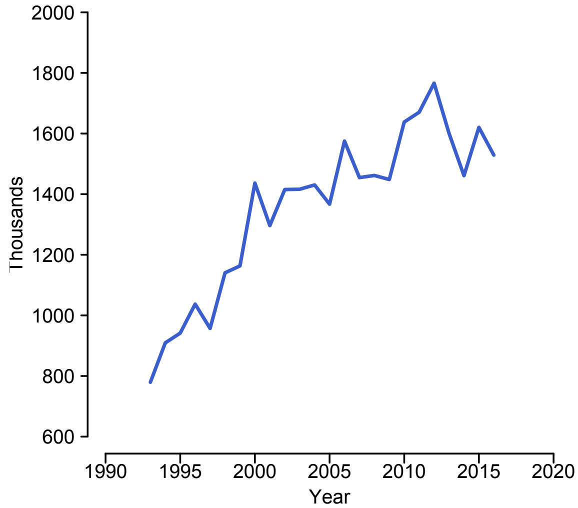
MFIP Canada geese nest in the Hudson Bay Lowlands, Akimiski Island, and along the eastern and southern portions of the Hudson and James bays, and concentrate during fall and winter throughout Manitoba, Ontario, and the Mississippi Flyway states (Figure 8). Indices from the new survey are not comparable to the prior SJBP, MVP, and EPP estimates because the survey design was changed. The 2016 preliminary breeding bird index from the new survey was 65,100 for the mainland, and 4,600 for Akimiski Island, (Figure 8). In 2016, spring phenology along the western Hudson and James bays was average, with a lower than average snow pack throughout most of the Hudson Bay Lowlands. Poor weather and high levels of precipitation occurred during nest initiation and hatching, which may have affected productivity.

*Mississippi Flyway Giant Population (MFGP)*

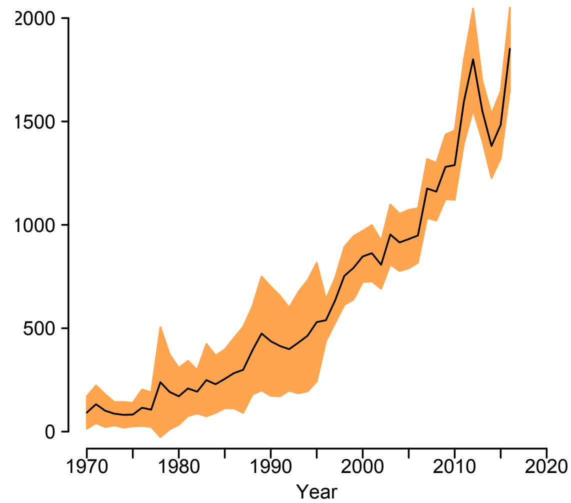
MFGP Canada geese nest in the Mississippi Flyway states and in southern Ontario and southern Manitoba (Table 14, Figure 8). Giant Canada geese were reestablished or introduced in all Mississippi Flyway states, and they now represent a large proportion of all Canada geese in the Mississippi Flyway. The total population is estimated during spring surveys within the Mississippi Flyway states and provinces (Mississippi Flyway Council 1996). In 2016, biologists estimated 1,528,800 MFGP geese, 6% lower than the 2015 estimate of 1,620,400 (Figure 11.1). Over the past 10 years, this population does not show a significant trend ($P = 0.375$) following many years of increasing abundance. Nesting conditions were generally good or excellent across most of the states and provinces of the MFGP range. Southern Ontario and Manitoba experienced good to excellent habitat conditions and average spring phenology. Biologists from Indiana and Michigan noted exceptionally high productivity this year, whereas low breeding numbers were reported in Ohio following low temperatures in late March and early April.

*Western Prairie and Great Plains Population (WPP/GPP)*

WPP Canada geese nest in eastern Saskatchewan and western Manitoba, and GPP Canada geese are composed of large Canada geese resulting from restoration efforts in Saskatchewan, North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, and Texas (Figure 8). Geese from these breeding populations commingle during migration with other Canada geese along the Missouri River in the Dakotas and on reservoirs from southwestern Kansas to Texas. These two populations are managed jointly, and the Midwinter Survey and WBPHS provide indices of this population within its primary wintering and breeding ranges, respectively. During the 2016 Midwinter Survey, 538,200 WPP/GPP geese were counted, 18% greater than the 455,800 recorded in 2015. Midwinter Survey indices have shown no trend from 2007 to 2016 ($P = 0.970$). In 2016, the estimated spring population in the portion of WPP/GPP range included in the WBPHS (strata 21–25, 30–40, 43–49) was 1,851,600 (1,652,200–2,051,100) geese, a 25% increase over last year's estimate of 1,483,700 (1,320,900–1,646,500; $P = 0.005$; Table 14, Figure 11.2). The WBPHS estimates have increased 4% per year since 2007 ($P \leq 0.010$). Southern Manitoba and southeastern Saskatchewan habitat conditions were fair or poor and drier in 2016 compared with




11.1: Mississippi Flyway Giant Population




11.2: Western Prairie/Great Plains Population

Figure 11. Numbers of Mississippi Flyway Giant Population (breeding adults) Canada geese and Western Prairie/Great Plains Population Canada geese (breeding index).

conditions the previous two springs, and spring temperatures were about 4–5°C above average in most areas. In North and South Dakota, spring phenology was advanced, and habitat conditions were generally fair, but poor in the eastern portions of those states. Biologists in North Dakota, South Dakota, Nebraska, Kansas, and Oklahoma noted that nesting and hatching were earlier than normal, in some instances by 2–3 weeks. Above-average or average production was recorded in all these states, except some areas of Kansas where slightly lower production was observed due to flooding.

*Central Flyway Arctic Nesting Canada Geese (CFAN)*

CFAN were previously managed separately as the Short Grass Prairie (SGPP) and Tall Grass Prairie (TGPP) populations of Canada geese, which are now referred to as West-tier and East-tier CFAN, respectively (Central and Mississippi Flyway Councils 2013). East-tier CFAN nest on Baffin (particularly on the Great Plain of the Koukdjuak), Southampton, and King William islands; north of the Maguse and McConnell Rivers on the Hudson Bay coast; and in the eastern Queen Maud Gulf region. East-tier CFAN winter mainly in Oklahoma, Texas, and northeastern Mexico (Figure 8). West-tier CFAN nest on Victoria and Jenny Lind islands and on the mainland from the Queen Maud Gulf west and south to the Mackenzie River and northern Alberta. These geese winter in southeastern Colorado, northeastern New Mexico, and the Oklahoma and Texas panhandles (Figure 8). Alternative nomenclature and delineation is used by the Mississippi Flyway, Canada, and others in specific reference to the subspecies *Branta hutchinsii hutchinsii* elsewhere. The population is referred to as Mid-continent cackling geese and defined as geese breeding north of the tree line in Canada. Indirect estimates of population size for Mid-continent cackling geese are reported in the "Population Status of Migratory Game Birds in Canada" annual report. The Midwinter Survey provides an index of CFAN within their winter range of the Central Flyway. Because East-tier CFAN nest outside of the area covered by the WBPHS, no breeding ground abundance estimates are available. A portion of the West-tier CFAN breeding range is covered by the WBPHS in the Northwest Territories (strata 13–18). In 2016, 625,200 CFAN were counted during the Midwinter Survey, 25% less than the 2015 index of 828,100 (Table 14, Figure 12). Over the past 10 years, Midwinter Survey counts have not

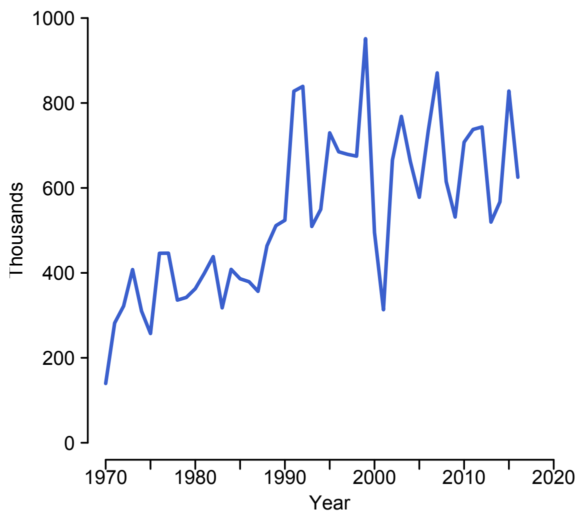



Figure 12. Numbers of Central Flyway Arctic Nesting Canada geese (winter counts).

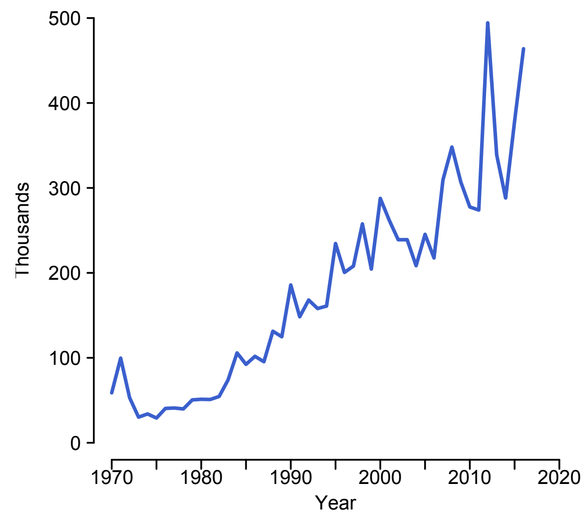
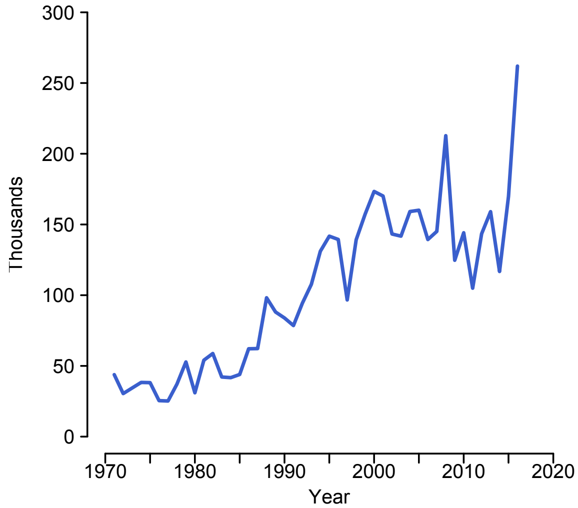



Figure 13. Numbers of Hi-line Population Canada geese (breeding index).

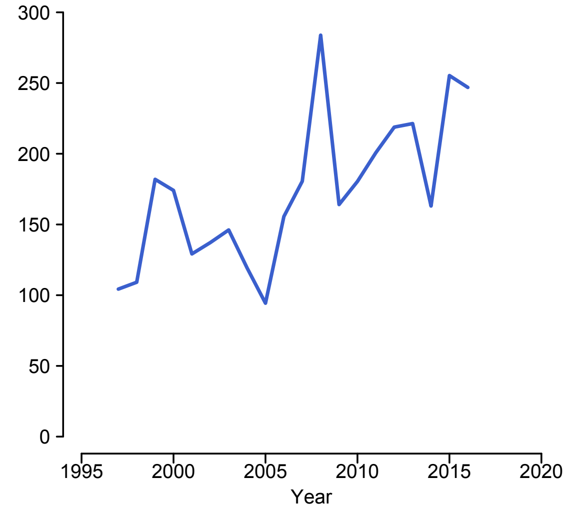
exhibited a significant trend ($P = 0.676$). In 2016, the estimated spring abundance of West-tier CFAN from the WBPHS was 251,800 (163,400–340,100), similar to last year's estimate of 291,300 (188,700–393,900, $P = 0.568$). WBPHS estimates have increased 6% per year since 2007 ($P = 0.047$). Habitat conditions in the northern Northwest Territories were excellent or good. Ice breakup was earlier than normal, and less ice was observed compared to most years. Water levels in the Mackenzie River were lower than normal, but most wetlands in the Mackenzie River Delta were in excellent condition. Breeding conditions were generally above-average to average across most of the western and central Arctic, and average or variable in the eastern Arctic.

*Hi-line Population (HLP)*

HLP Canada geese nest in southeastern Alberta, southwestern Saskatchewan, eastern Montana and Wyoming, and in Colorado. This population winters in these states and New Mexico (Figure 8). A winter index of HLP geese is based on Midwinter Survey counts in portions of Montana, Wyoming, Colorado, New Mexico, Nebraska, and Alberta, and Saskatchewan (Central Flyway Council 2010). A breeding index of HLP geese is based on the WBPHS estimates from portions of Alberta (strata 26–29), Saskatchewan (strata 30–33), and Montana (strata 41–42), and state surveys in Wyoming. No survey estimate was available for Wyoming in 2016, and the 2015 Wyoming survey count was used to estimate the total HLP index in 2016. Most (> 97%) HLP geese are counted on the WBPHS strata. In 2016, the WBPHS estimate for HLP geese was 453,900 (354,400–553,400), similar to last year's estimate of 368,500 (296,800–440,300, $P = 0.173$). When combined with the Wyoming count, the 2016 HLP goose count of 463,900 was a 23% increase over last year's value of 378,500 (Table 14, Figure 13). The WBPHS indices, either alone or when combined with Wyoming counts, have not shown significant trends over the 2007–2016 time frame ($P = 0.194$ and 0.188, respectively). The Midwinter Survey index for 2016 was 280,200, 17% greater than last year's count of 238,800. Over the past 10 years, Midwinter Survey indices for this population have not shown a significant trend ($P = 0.112$). Habitat conditions in Southern Alberta and Saskatchewan were poor or fair and drier than average, and spring phenology was earlier than normal. Alberta experienced some heavy rains in late May. In Montana, habitat conditions near the Rocky Mountains were dry and rated mostly poor or fair, whereas some areas in the central portion of the state were rated good due to above-average precipitation.




14.1: Rocky Mountain Population




14.2: Pacific population

**Figure 14.** Numbers of Rocky Mountain Population (breeding index) and Pacific Population (breeding index) Canada geese.

*Rocky Mountain Population (RMP)*

RMP Canada geese nest in southern Alberta and western Montana, and the inter-mountain regions of Utah, Idaho, eastern Nevada, Wyoming, and Colorado. This population winters mainly in central and southern California, Arizona, Nevada, Utah, Idaho, and Montana (Figure 8). An index of breeding RMP geese is based on WBPHS estimates from portions of Alberta (strata 26–29) and Montana (strata 41–42), plus state surveys in Arizona, Colorado, Idaho, Nevada, Utah, and Wyoming (Pacific Flyway Council 2000*b*). Most ($> 95\%$) RMP geese are counted on the WBPHS strata. In 2016, the WBPHS estimate for RMP geese was 251,600 (188,200–315,100), 59% greater than last year's estimate of 158,200 (115,100–201,300, $P = 0.017$). When combined with state survey counts, the 2016 RMP goose count of 262,000 was a 54% increase over the 169,800 geese recorded last year (Table 14, Figure 14.1). The WBPHS indices, alone or when combined with state counts, have not shown significant trends during the past ten years ($P = 0.469$ and 0.453, respectively). Habitat conditions were poor or fair in southern Alberta and western Montana. Many western states still experienced drought conditions in 2016, but conditions improved in some areas compared to last year.

*Pacific Population (PP)*

PP Canada geese nest and winter west of the Rocky Mountains from northern Alberta and British Columbia south through the Pacific Northwest to California (Figure 8). A total PP goose index is based on WBPHS estimates from portions of Alberta (WBPHS strata 76–77) plus additional surveys in British Columbia, Washington, Oregon, California, Nevada, Idaho, and Montana (Pacific Flyway Council 2000*a*). About 50% of PP geese are counted on the WBPHS strata in Alberta. The total PP goose index in 2016 was 246,900, 3% lower than the 255,300 counted in 2015 (Table 14, Figure 14.2). There was no trend in the total PP indices from 2007 to 2016 ($P = 0.464$). The 2016 WBPHS estimate in Alberta was 146,400 (94,600–198,200) geese, similar to the 2015 estimate of 153,900 (89,400–218,400; $P = 0.859$). The 10-year trend for PP geese counted on WBPHS strata in Alberta was not significant ($P = 0.436$). In British Columbia, habitat conditions were poor in the southern portion of the province and fair to good in northern portions of the interior. Conditions were fair or poor, and drier than normal in northern Alberta. Both provinces experienced an earlier than average spring phenology. Habitat conditions in California, Oregon, and Washington were improved relative to last year, but drought conditions still remain, particularly in southern portions of California and southcentral and southeast portions of Oregon.

*Dusky Canada Geese*

Dusky Canada geese predominantly nest on the Copper River Delta of southeastern Alaska, and winter in the Willamette and Lower Columbia River Valleys of Oregon and Washington (Figure 8). Dusky Canada geese are surveyed on their breeding grounds on the Copper River Delta and Middleton Island, Alaska (Pacific Flyway Council 2008). In 2016, the Dusky Canada goose population index was 13,200 (10,400–16,000), which was 25% lower than ($P = 0.042$) the 2015 estimate of 17,700 (14,400–21,000;Table 14, Figure 15). During the past 10 years, these estimates have increased 8% per year ($P = 0.011$). In 2016, southcentral Alaska experienced a warm and early spring compared to most years. For the third year in a row, no snow was observed on the survey area, which contrasts with past surveys where snow and ice were usually observed. Although spring conditions appeared favorable, preliminary productivity surveys indicated below–average production.

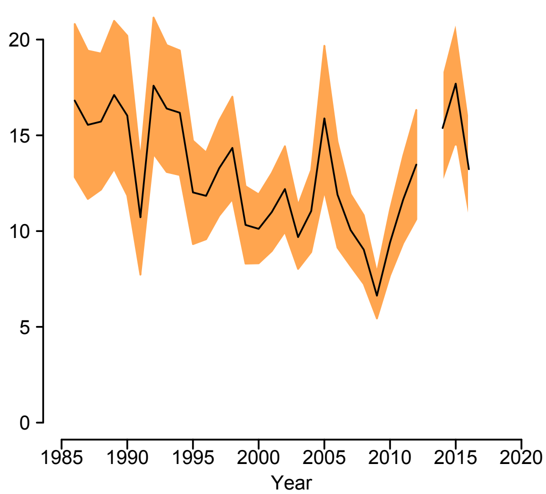



Figure 15. Estimated numbers (and 95% confidence intervals) of Dusky Canada geese (breeding index).

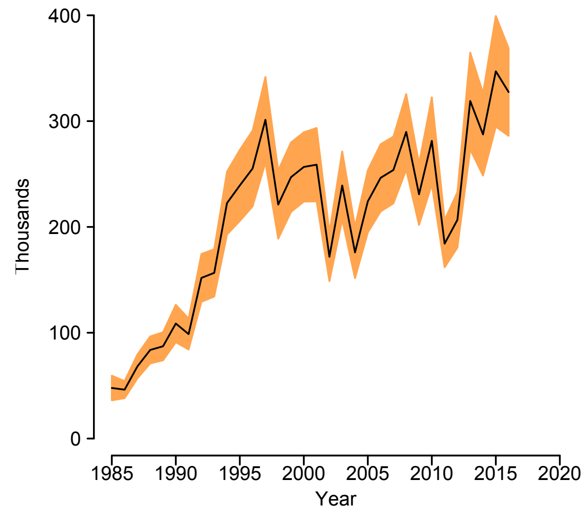


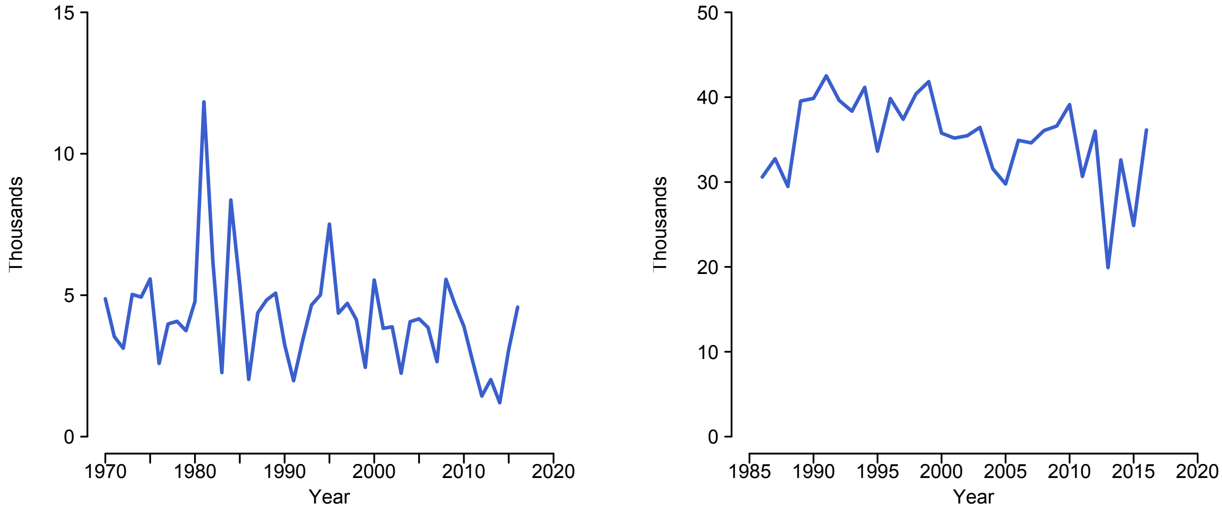

Figure 16. Estimated numbers (and 95% confidence intervals) of Cackling Canada geese (predicted fall population).

*Cackling Canada Geese*

Cackling Canada geese nest on the Yukon–Kuskokwim Delta (YKD) of western Alaska. This population primarily winters in the Willamette and Lower Columbia River Valleys of Oregon and Washington (Figure 8). The total fall population is estimated by counts of adults during the YKD Coastal Zone Survey during the spring, expanded by a ratio derived from neck collared individuals observed in the fall and winter (Pacific Flyway Council 1999). In 2016, the expansion ratio was updated, and the entire time series was revised; thus, the time series presented here differs from those previously presented. The fall estimate for 2016 was 327,500 (286,100–368,800) geese, similar to last year's estimate of 347,100 (294,800–399,400; $P = 0.564$; Table 14). Over the 2007–2016 time series, no significant trend ($P = 0.184$) was observed (Figure 16). Very early spring phenology and excellent habitat conditions were observed on the YKD in 2016. The YKD Coastal Zone Survey started on the earliest date recorded since the survey began in 1985 due to the early timing of snow melt, ice breakup, and nest initiation.

*Lesser and Taverner's Canada Geese*

Lesser and Taverner's Canada geese nest throughout Alaska, and winter in Washington,




17.1: Lesser Canada Geese

17.2: Taverner's Canada Geese

**Figure 17.** Numbers of Lesser (breeding index) and Taverner's (breeding index) Canada geese.

Oregon, and California (Figure 8). Nesting Taverner's geese are more strongly associated with tundra areas of the North Slope and western Alaska, whereas lesser Canada geese tend to nest in Alaska's interior and southcentral regions. Population indices for lesser Canada geese are based on WBPHS estimates in stratum 1 (Kenai-Susitna), stratum 2 (Nelchina), stratum 3 (Tanana-Kuskokwim), stratum 4 (Yukon Flats), and stratum 12 (Old Crow Flats). The 2016 lesser Canada goose breeding index was 4,600, 49% higher than the 2015 index of 3,100 (Table 14, Figure 17.1). The 2016 total index was 6,600, 64% higher than the 2015 index of 4,000. From 2007 to 2016, indices of total geese decreased by 10% per year ($P = 0.050$), whereas indices of breeding geese did not have a significant trend ($P = 0.386$). Population indices for Taverner's Canada geese are based on expanded counts from three breeding survey efforts: the Arctic Coastal Plain Breeding Pair Survey, the Yukon–Kuskokwim Delta (YKD) Coastal Zone Survey, and the WBPHS (stratum 9 [inland portions of the YKD], stratum 10 [Seward Peninsula], and stratum 11 [Kotzebue Sound]). The 2016 Taverner's goose breeding and total indices were 36,100 and 48,400, which were 45% and 37% greater than the 2015 estimates of 24,900 and 35,400, respectively (Table 14, Figure 17.2). Neither breeding nor total goose indices exhibited a significant trend during the past 10 years ($P = 0.244$ and 0.098, respectively). Alaska experienced an exceptionally early spring in 2016, and habitat conditions were excellent. Below-average winter precipitation, except in some portions of interior Alaska, combined with well-above-average spring temperatures led to an early snowmelt and record-setting early ice breakup dates in many parts of the state. Spring phenology on the Old Crow Flats in the Yukon Territory was about average.

### *Aleutian Canada Geese*

Aleutian Canada geese nest primarily on the Aleutian Islands and winter along the Pacific Coast as far south as central California (Figure 8). The Aleutian Canada goose was listed as endangered under the Endangered Species Act (ESA) in 1967 when abundance was less than 1,000 individuals. As abundance increased, it was downgraded to threatened in 1990 and removed from protection under the ESA in 2001. The total Aleutian goose population during the fall and winter is estimated from mark-resight observations of neck-banded geese in California (Pacific Flyway Council 2006*a*). Because of the estimation procedure, the time series is revised annually. The population estimate in 2016 was

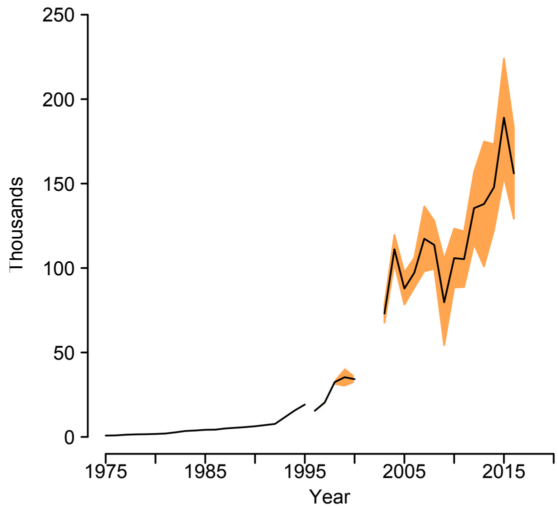



Figure 18. Estimated numbers (and 95% confidence intervals) of Aleutian Canada geese (fall-winter counts).

156,000 (129,200–182,900) geese, similar to the 2015 estimate of 189,000 (154,000–224,000; $P = 0.143$; Figure 18). These estimates have increased 6% per year since 2007 ($P = 0.009$), and the latest estimate is an order of magnitude greater than the 1996 estimate of 15,500 (14,400–16,500). Early spring conditions were reported on the Alaska Peninsula and Aleutian Islands.

## Status of Light Geese

The term light geese collectively refers to Ross's geese and both the lesser (*C. c. caerulescens*) and greater (*C. c. atlantica*) snow goose subspecies (including all hybrids, and both white and blue color phases). There are three populations of lesser snow geese based on their breeding ranges (Wrangel Island, Western Arctic, and Mid-continent), and one population based upon winter distribution (Western Central Flyway). Lesser snow geese and Ross's geese occur in many wintering areas together and are not typically differentiated during the Midwinter Survey, so we report indices of light geese from this survey. Most light goose populations exceed population objectives, and biologists remain concerned about their high abundance.

### *Ross's Geese*

Ross's geese nest primarily in the Queen Maud Gulf region, but increasing numbers are nesting on Southampton, Baffin, and Banks islands, and along the western coast of Hudson Bay. Ross's geese primarily winter in California, New Mexico, Texas, and Mexico, and in increasing numbers in Louisiana and Arkansas (Table 15, Figure 19). Ross's geese are annually surveyed at Karrak Lake in the Queen Maud Gulf region, their largest nesting colony. Since 2007, Ross's geese have outnumbered lesser snow geese at Karrak Lake, and abundance of nesting Ross's geese has been relatively stable around 700,000 (R. Alisauskas, unpublished data). Estimates from Karrak Lake are typically not available until after the publication of this report, so we present the previous year's estimate. The estimate of nesting Ross's geese at Karrak Lake during 2015 was 625,100 (588,400–661,700), which was similar to the 2014 estimate of 659,600 (594,200–724,900; $P = 0.367$; Figure 20). There was not a significant trend during 2006–2015 ($P = 0.640$). Spring phenology at Karrak Lake was average to slightly early in 2016. Ice breakup was two days earlier than the long-term (1995–2016) average, and goslings were first seen three days earlier than the long-term (1998–2016) average. Breeding conditions were average to above-average across most of the breeding range

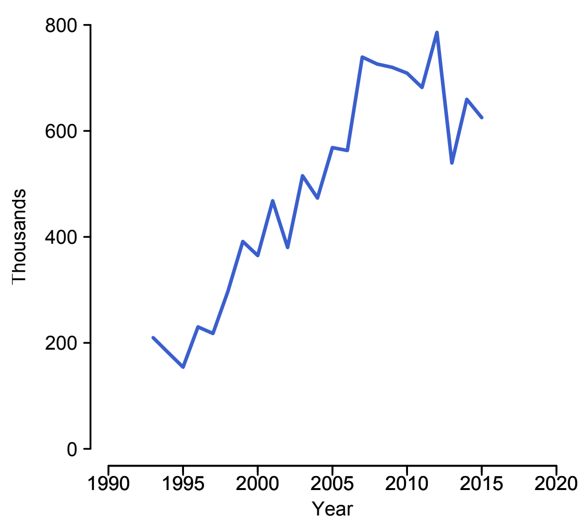



Figure 20. Numbers of Ross's geese at the Karrak Lake colony, Nunavut (nesting adults).

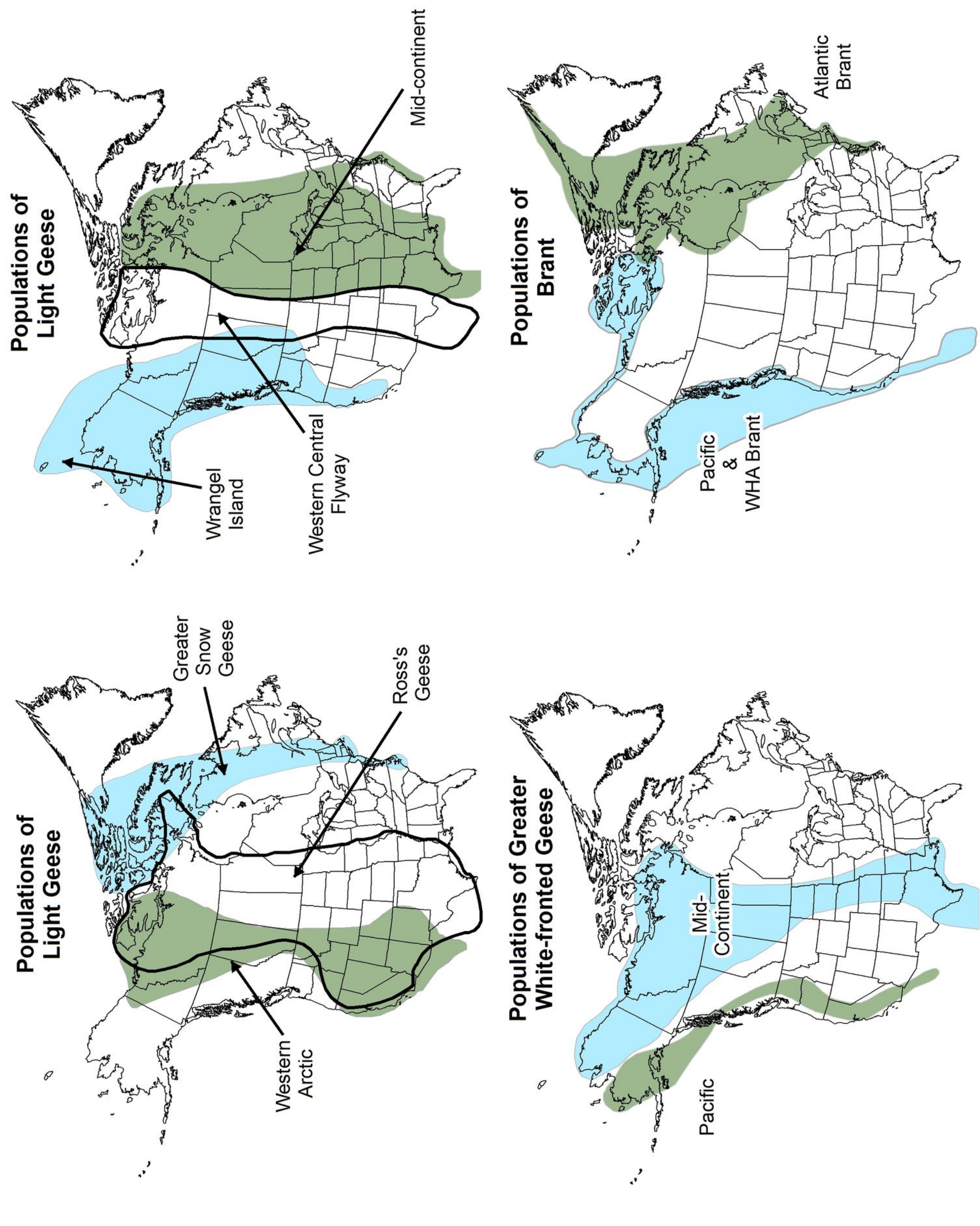



Figure 19. Approximate ranges of brant and snow, Ross's, and White-fronted goose populations in North America.

Table 15. Light goose (Ross's goose and lesser and greater snow goose) indices (in thousands) from primary monitoring surveys.

| | Estimate/Count | | Change from 2015 | | 10-year Trend | |
|---|---|---|---|---|---|---|
| Population | 2016 | 2015 | % | $P$ | %/yr | $P$ |
| Ross's geese[a] | 625 | 660 | −5 | 0.367 | −1 | 0.640 |
| Mid-continent Population light geese | 3,453 | 3,284 | +5 | – | +4 | 0.041 |
| Western Central Flyway Population light geese | 237 | 243 | −3 | – | +3 | 0.149 |
| Pacific Flyway Population light geese | *n/s* | 1,181 | – | – | +5 | 0.018 |
| Wrangel Island lesser snow geese | 300 | 240 | +25 | – | +8 | 0.002 |
| Greater snow geese | 915 | 818 | +12 | 0.112 | +1 | 0.657 |

[a] Years presented refer to year–1.
*n/s* = No survey was conducted or survey data were not available.

of Ross's geese.

*Mid-continent Population Light Geese (MCP)*

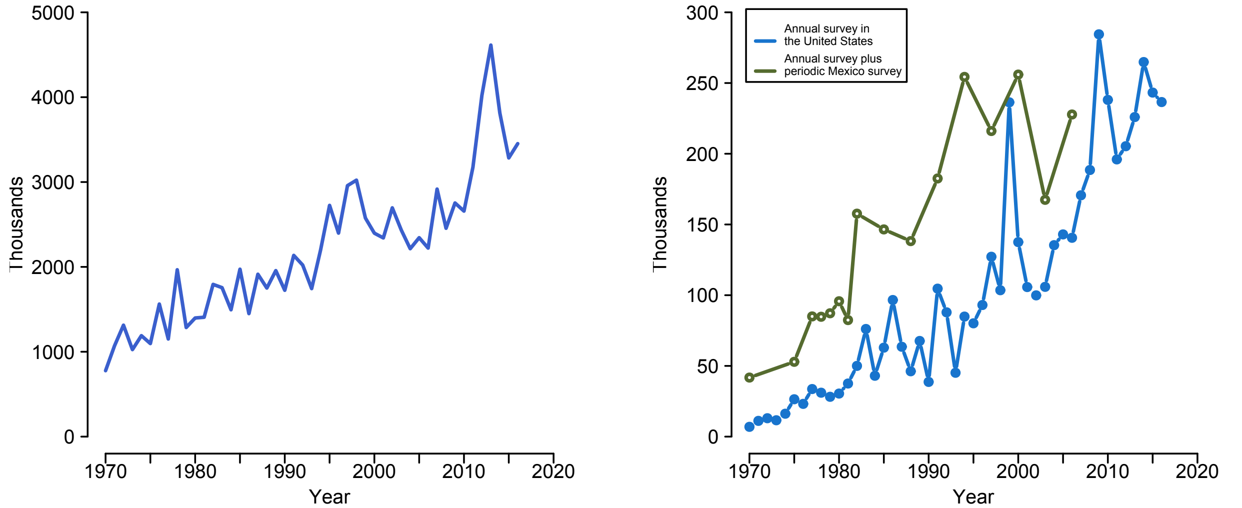
The MCP includes lesser snow geese and Ross's geese from the central Arctic. Mid-continent lesser snow geese nest on Baffin and Southampton islands, along the west coast of the Hudson Bay, and throughout the Queen Maud Gulf region in the central Arctic (Figure 19). These geese winter primarily in eastern Texas, Louisiana, and Arkansas and are indexed by the Midwinter Survey. In 2016, biologists counted 3,452,600 light geese in these wintering areas, a 5% increase relative to the 2015 index of 3,284,100 (Table 15, Figure 21.1). MCP winter indices increased 4% per year during 2007–2016 ($P = 0.041$). Indirect estimates of population size and other breeding survey data for Mid-continent lesser snow geese are reported in the "Population Status of Migratory Game Birds in Canada" annual report. Breeding conditions were generally average across most of the central and eastern Arctic in 2016, with average ice and snow conditions. Normal to slightly early spring phenology was noted in the Queen Maud Gulf region, Southampton Island, and western portions of the Hudson Bay. Biologists recorded high goose production on Southampton Island.

*Western Central Flyway Population (WCFP)*

The WCFP includes lesser snow geese and Ross's geese wintering in the western Central Flyway portions of southeastern Colorado, New Mexico, the Texas Panhandle, and the northern highlands of Mexico (Figure 19). Most of these geese nest in the western and central Arctic, with large nesting colonies near the Queen Maud Gulf and on Banks Island. Many of these geese stage during the fall in eastern Alberta and western Saskatchewan. WCFP geese wintering in the U.S. portion of their range are surveyed annually by the Midwinter Survey. Their entire winter range, including Mexico, was historically surveyed once every three years, but Mexico surveys have not been conducted since 2006. During the 2016 Midwinter Survey in the U.S. portion of the WCFP range, 236,600 light geese were counted, 3% less than the 243,300 counted in 2015 (Table 15, Figure 21.2). These indices did not have a significant trend during 2007–2016 ($P = 0.149$). In 2016, breeding conditions were generally average to above-average across most of the central and western Arctic.

*Western Arctic (WA) and Wrangel Island (WI) Populations*

Lesser snow geese in the Pacific Flyway originate from nesting colonies in the western and central Arctic, and on Wrangel Island in Russia. WA lesser snow geese nest primarily in the Egg River colony on Banks Island, with smaller colonies in coastal areas of the Northwest Territories on the Anderson and Mackenzie River deltas and Kendall Island, and along the Alaskan




21.1: Mid-continent Population light geese

21.2: Western Central Flyway Population light geese

**Figure 21.** Numbers of Mid-continent Population light geese (winter counts) and Western Central Flyway Population light geese (winter counts).

Arctic Coastal Plain. WI lesser snow geese nest on Wrangel Island, Russia. WA and WI lesser snow geese mix during winter and also occur with MCP lesser snow geese and Ross's geese. WA lesser snow geese primarily winter in central and southern California, the Western Central Flyway areas of southeastern Colorado, New Mexico, the Texas Panhandle, and the northern highlands of Mexico. WI lesser snow geese principally winter in the Puget Sound area of Washington and in northern and central California (Figure 19). Light geese in the Pacific Flyway are indexed by surveys in California and the Skagit/Fraser area in Washington and British Columbia during the fall and December. Comprehensive fall and December surveys were not conducted during 2015; thus, no estimate was available for the most recent year. Based on the most recent available data, light goose indices in the Pacific Flyway increased 5% per year during 2005–2014 ($P = 0.018$). Breeding ground surveys are periodically conducted for WA (Pacific Flyway Council 2013) and WI lesser snow geese (Pacific Flyway Council 2006*c*), and indirect estimates of population size for WA and WI lesser snow geese are reported in the "Population Status of Migratory Game Birds in Canada" annual report. In recent years, increasing numbers of lesser snow geese have been documented in northern Alaska and the western Arctic, and have heightened management concern in this area. In 2016, the lesser snow goose total bird index from the Arctic Coastal Plain survey was 26,000 (4,000–48,000), and these indices have increased 38% per year since 1986 ($P < 0.001$). Photographic breeding ground surveys for WA lesser snow geese on Banks Island were not conducted in 2016, but the last survey in 2013 recorded 419,800 lesser snow geese. The preliminary 2016 WI lesser snow goose estimate of total birds was 300,000, 25% above the 2015 estimate of 240,000 (Table 15, Figure 22). These indices have increased 8% per year since 2007 ($P = 0.002$). With low winter snowfall and early snow melt, favorable nesting conditions were observed across much of the Arctic Coastal Plain, western Arctic, and Wrangel Island, Russia. Biologists in Northern Alaska noted that timing of goose nesting was similar to last year but earlier than many past years. Early nesting success was high for lesser snow geese at the Colville River Delta (91%) and Ikpikpuk River (81%) colonies in Northern Alaska and at Wrangel Island, Russia (89%).

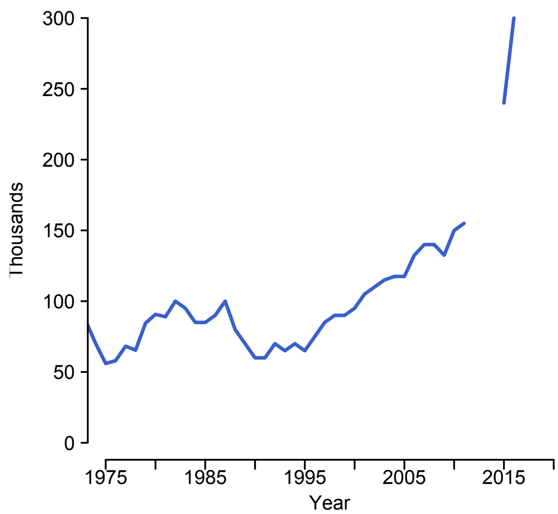



Figure 22. Numbers of Wrangel Island Population lesser snow geese (spring index).

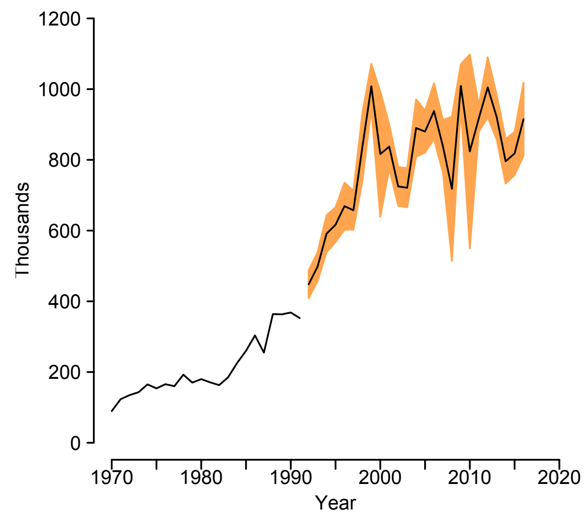



Figure 23. Estimated numbers (and 95% confidence intervals) of greater snow geese (spring index).

*Greater Snow Geese*

Greater snow geese nest on Bylot, Axel Heiberg, Ellesmere, and Baffin islands and in Greenland, and winter along the Atlantic coast from New Jersey to North Carolina (Figure 19). This population is monitored on spring staging areas near the St. Lawrence Valley in Quebec from an annual aerial photographic survey (Atlantic Flyway Council 2009). The preliminary 2016 spring survey estimate was 915,000 (812,000–1,018,000) geese, similar to the 818,000 (757,000–879,000; $P = 0.112$) estimated last year (Table 15, Figure 23). Spring estimates of greater snow geese have shown no trend over the past 10 years ($P = 0.657$), which provides some evidence that this over-abundant population is stabilizing following many years of rapid increase. Comprehensive Midwinter Surveys for light geese in the Atlantic Flyway were not conducted during 2016; thus, no count was available for the most recent year. Breeding conditions for greater snow geese at Bylot Island were fair in 2016. There was a very thick snow pack last winter, which delayed snow melt in June, but spring weather was average and dry. Greater snow geese arrived later compared to the past few years, and colony density and clutch size were lower than average. Predation levels were high during egg laying, low during incubation, and moderate overall. Mean nest initiation date (13 June) and estimated mean hatching date (9 July) were similar to the 20-year averages (12 June and 9 July, respectively). Mean clutch size was 3.3 eggs/nest in 2016, slightly lower than the 20-year average of 3.7.

## Status of Greater White-fronted Geese

*Pacific Population White-fronted Geese*

Pacific Population White-fronted geese primarily nest on the Yukon–Kuskokwim Delta (YKD) in Alaska and winter in the Central Valley of California (Figure 19). This population is monitored using a predicted fall population index based on the number of indicated total birds from the YKD Coastal Zone Survey and the WBPHS in the Bristol Bay area (stratum 8) and interior portions of the YKD (stratum 9), expanded by a factor derived from the correlation of these indices with past fall counts in Oregon and California (Pacific Flyway Council 2003). The 2016 predicted fall population index was 685,500, 43% greater than the 2015 estimate of 479,100, Table 16, Figure 24). The prior 10-year trend was not significant ($P = 0.946$). Very early spring phenology and excellent habitat conditions were observed on the YKD in 2016. The YKD Coastal Zone Survey started on the earliest date recorded since the survey began in 1985 due to

Table 16. White-fronted goose, emperor goose, brant, and tundra swan indices (in thousands) from primary monitoring surveys.

| Population | Estimate/Count 2016 | Estimate/Count 2015 | % Change from 2015 | 10-year Trend %/yr | 10-year Trend $P$ |
|---|---|---|---|---|---|
| Pacific Population white-fronted geese | 686 | 479 | +43 | $0^b$ | 0.946 |
| Mid-continent Population white-fronted geese[a] | 977 | 1,006 | –3 | +4 | 0.068 |
| Emperor geese | 79 | 98 | –19 | +2 | 0.311 |
| Atlantic brant | 158 | 111 | +42 | −2 | 0.161 |
| Pacific and Western High Arctic brant | 140 | 137 | +3 | $0^b$ | 0.901 |
| Western Swans | *n/s* | 68 | – | −5 | 0.095 |
| Eastern Swans | 114 | 117 | –3 | +1 | 0.157 |

[a] Years presented refer to year–1.
[b] Rounded values mask change in estimates.
*n/s* = No survey was conducted or survey data were not available.

the early timing of snow melt, ice breakup, and nest initiation.

*Mid-continent Population White-fronted Geese*

Mid-continent Population white-fronted geese nest from central and northwestern Alaska to Foxe Basin on Baffin Island. This population concentrates in southern Saskatchewan and Alberta during the fall and in Texas, Louisiana, Arkansas, and Mexico during winter (Figure 19). This population is monitored by a fall staging survey in Saskatchewan and Alberta and via the Midwinter Survey in Central and Mississippi flyway states (Central, Mississippi, and Pacific Flyway Councils 2005). In 2015, 977,100 geese were counted during the fall staging survey, a 3% decrease from the 2014 count of 1,005,600 (Table 16, Figure 24). During 2006–2015, fall survey counts did not exhibit a significant trend ($P$ = 0.068). The 2016 Midwinter Survey index in Central and Mississippi flyway states was 589,600, a 30% increase over the 2015 count of 455,200. There was not a significant trend in Midwinter Survey indices during the past 10 years ($P$ = 0.517). Indirect estimates of population size for Mid-continent Population white-fronted geese are reported in the "Population Status of Migratory Game Birds in Canada" annual report. In 2016, breeding conditions were average to above-average across most of the breeding range of Mid-continent Population white-fronted geese.

## Status of Brant

*Atlantic Brant (ATLB)*

Atlantic brant primarily nest on islands of the eastern Canadian Arctic and winter along the Atlantic Coast from Massachusetts to North Carolina. The Midwinter Survey provides an index of this population within its winter range of the Atlantic Flyway (Atlantic Flyway Council 2002; Figure 19). The 2016 Midwinter Survey index was 157,900 brant, 42% greater than the 2015 count of 111,400 (Table 16, Figure 25). These indices did not exhibit a significant trend during the 2007–2016 time period ($P$ = 0.161). Productivity from the previous year is estimated by the proportion of juveniles in the population during November and December. Juveniles comprised 9.2% of the population in 2015. For the past 4 years, the percentage of juveniles has been below 10% and well below the long-term average of 18%. In 2016, breeding conditions were generally average or variable across most of the eastern Arctic. Biologists recorded high early successful nesting by brant on Southampton Island in northern Hudson Bay.

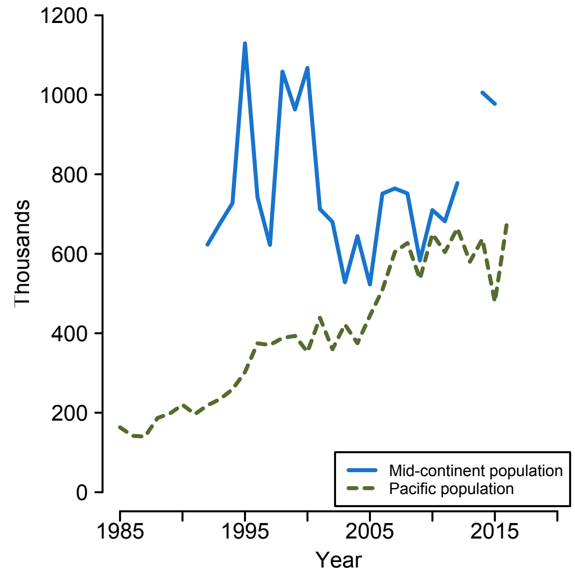



Figure 24. Numbers of Mid-continent Population (fall counts) and Pacific Population (predicted fall population) white-fronted geese.

*Pacific Brant (PACB) and Western High Arctic Brant (WHAB)*

PACB nest across Alaska's Yukon–Kuskokwim Delta (YKD) and North Slope, on Banks Island, and other islands of the western and central Arctic, the Queen Maud Gulf, and in Russia. They stage during fall at Izembek Lagoon, Alaska, and winter as far south as Baja California and the west coast of Mexico (Figure 19). WHAB nest on the Parry Islands of the Northwest Territories and Nunavut (Figure 19). They stage during fall at Izembek Lagoon, Alaska, and predominantly winter in Padilla, Samish, and Fidalgo bays of Washington and near Boundary Bay, British Columbia, although some individuals have been observed as far south as Mexico. For many years PACB and WHAB were surveyed and managed separately. However, they cannot be reliably distinguished while on staging and wintering grounds. Therefore, the current index combines PACB and WHAB. The Alaska portion of the index has been revised entirely in 2015, and counts in Mexico traditionally obtained from aerial surveys have been replaced with ground counts. Thus the time series presented here differs from previous reports (Olson, S. M., compiler 2015). In 2016,

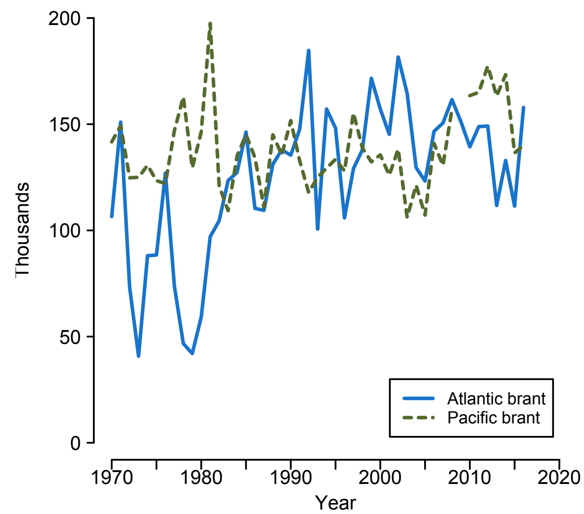



Figure 25. Numbers of Atlantic and Pacific brant (winter counts).

fall and winter surveys recorded 140,000 brant, which was 3% greater than the 2015 estimate of 136,500 (Table 16, Figure 25). The prior 10-year trend of these indices was not significant ($P = 0.901$). In recent decades, brant abundance has increased in Alaska during the winter, primarily at Izembek Lagoon, and decreased at primary breeding colonies on the YKD. Midwinter Surveys of brant in Alaska increased 8% ($P < 0.001$) since 1986, from less than 10,000 brant to about 50,000 currently. Based on photographic surveys of the five primary brant breeding colonies on the YKD, abundance decreased 4% per year ($P < 0.001$) during 1992–2014. Brant indices for breeding and total birds from the YKD Coastal Zone Survey were 13,500 (6,600–20,400) and 30,000 (22,700–37,300), respectively, in 2016, and these indices have not shown a significant trend during the past ten years ($P = 0.469$ and 0.498, respectively). Early spring phenology and excellent to good breeding conditions were observed throughout Alaska and the western Arctic in 2016. Biologists noted high (71%) early nest survival for brant on the Colville Delta in Northern Alaska.

## Status of Emperor Geese

Emperor geese breed along coastal areas of the Bering Sea, with the largest concentration on the Yukon–Kuskokwim Delta (YKD), Alaska.

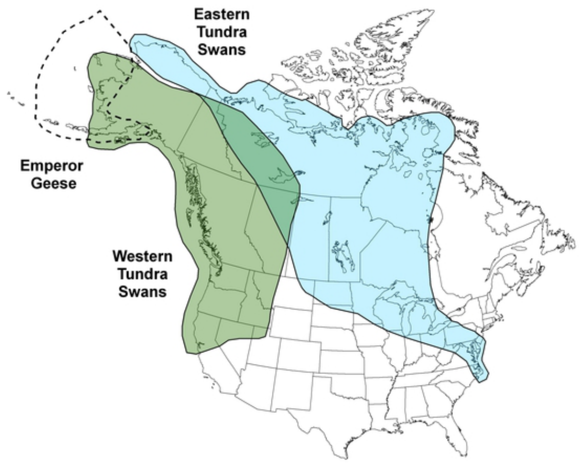



Figure 26. Approximate ranges of emperor geese, and Eastern and Western Populations of tundra swans in North America.

Emperor geese stage along the Alaska Peninsula during the fall and spring, and they winter along the Aleutian Islands (Figure 26). Emperor geese are surveyed annually at spring and fall staging areas in southwestern Alaska and at the breeding grounds on the YKD. The spring survey is the current management index (Pacific Flyway Council 2006*b*; Figure 27.1). However, biologists are currently reviewing emperor goose survey programs. The 2016 spring count of emperor geese was 79,348, a 19% decrease from last year's count of 98,100. The 10-year trend of the spring survey indices was not significant ($P = 0.311$). In 2016, emperor goose breeding and total bird indices from the YKD Coastal Zone survey were 27,100 (24,400–29,700) and 34,100 (29,200–39,000), respectively, which were 85% ($P < 0.001$) and 30% ($P = 0.008$) greater than the counts of 14,600 (13,000–16,300) and 26,200 (23,100–29,300) in 2015. During the past ten years, these indices increased 4% and 5% per year, respectively ($P = 0.057$ and 0.025). Very early spring phenology and excellent habitat conditions were observed on the YKD in 2016. The YKD Coastal Zone Survey started on the earliest date recorded since the survey began in 1985 due to the early timing of snow melt, ice breakup, and nest initiation.

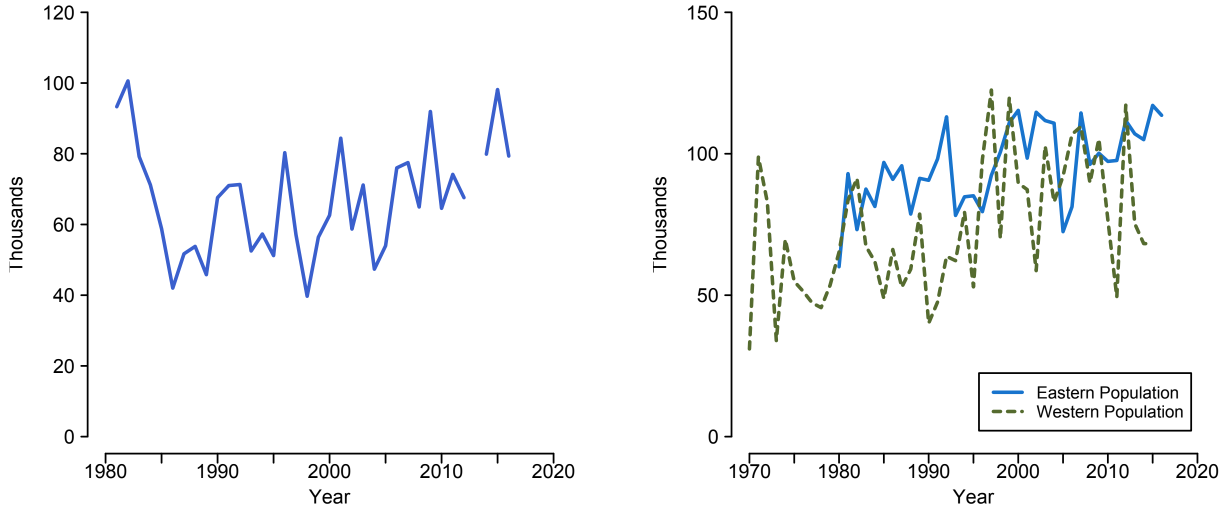
## Status of Swans

### *Western Population Tundra Swans*

Western Population tundra swans nest along the coastal lowlands of western Alaska, and the Yukon–Kuskokwim Delta (YKD) is this population's primary breeding area. Western Population tundra swans primarily winter in California, Utah, and the Pacific Northwest (Figure 26). The Midwinter Survey provides an index of this population within its winter range of the Pacific Flyway (Pacific Flyway Council 2001). Comprehensive Midwinter Surveys for this population were not conducted during 2016; thus, no count was available for the most recent year. The most recent Midwinter Survey index in 2015 was 68,200 swans (Table 16, Figure 27.2). Midwinter Survey indices exhibited no significant trend during 2006–2015 ($P = 0.095$). In 2016, Western Population tundra swan breeding and total bird indices from the YKD Coastal Zone survey were 20,100 (16,700–23,400) and 31,300 (19,600–42,900), respectively, which were 81% and 36% greater than the counts of 11,100 and 23,000 recorded in 2015. During the past 10 years, these indices have not shown a significant trend ($P = 0.203$ and 0.327, respectively). Very early spring phenology and excellent habitat conditions were observed on the YKD in 2016. The YKD Coastal Zone Survey started on the earliest date recorded since the survey began in 1985 due to the early timing of snow melt, ice breakup, and nest initiation.

### *Eastern Population Tundra Swans*

Eastern Population tundra swans nest from the Seward Peninsula of Alaska to the northeast shore of Hudson Bay and Baffin Island. The Mackenzie River Delta and adjacent areas in the Northwest Territories are of particular importance. This population winters in coastal areas from Maryland to North Carolina (Figure 26). The Midwinter Survey provides an index of this population within its winter range in the Atlantic and Mississippi Flyways (Atlantic, Mississippi, Central, and Pacific Flyway Councils 2007). During the 2016 Midwinter Survey, 113,600 swans were observed, 3% fewer than the 117,100




27.1: Emperor geese

27.2: Tundra swans

Figure 27. Numbers of emperor geese (spring index) and Eastern and Western Populations of tundra swans (winter counts).

counted in 2015 (Table 16, Figure 27.2). These indices have not exhibited a significant trend during the 2006–2015 time frame ($P = 0.157$). Productivity from the previous year is estimated by the proportion of juveniles in the population during November and December. Juveniles comprised 11.3% of the population in 2015, which was 5% above the estimate of 10.8% in 2014, but below the long-term average of 13.5%. Early spring phenology and favorable breeding conditions were observed in many important nesting areas across Alaska, Yukon Territory, and the Northwest Territories. Water levels in the Mackenzie River were lower than normal, but most wetlands in the Mackenzie River Delta were in excellent condition.

*Trumpeter Swans*

Trumpeter swans nest in Alaska from south of the Brooks Range and east of the Yukon-Kuskokwim Delta, and within localized areas of Yukon Territory, western Northwest Territories, from British Columbia to Quebec, and some northern U.S. States from Washington to New York. There are three recognized North American populations: the Pacific Coast, Rocky Mountain, and Interior populations. Trumpeter swan abundance and productivity is comprehensively monitored through the North American Trumpeter Swan Survey. This range-wide survey was first conducted in 1968, repeated in 1975, and has continued at 5-year intervals thereafter, with the most recent survey completed in 2015. Information from this, and other, trumpeter swan surveys can be found at: `http://www.fws.gov/migratorybirds/`.

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| Rhode Island | Agency personnel and cooperators |
| Vermont | Agency personnel and cooperators |

Virginia — P. Acker[b], B. Bassinger[b], J. Blevins[b], A. Bourgeois[b], A. Bouton[b], J. Bowman[b], G. Costanzo[b], C. Dobyns[b], D. Ellinghausen[b], C. Faller[b], M. Frank[b], F. Frenzel[b], M. Gautier[b], D. Johnson[b], D. Kocka[b], B. Lewis[b], D. Lovelace[b], K. Martin[b], B. Mohler[b], T. Moss[b], A. Proctor[b], K. Rose[b], G. Sours[b], J. Watson[b], and T. Willingham[b]

**Oregon**

Air — T. Collom[b], J. Journey[b], M. Kirsh[b], R. Klus[b], N. Leonnetti[b], P. Perrine[b], B. Reishus[b], C. Sponseller[b], M. St. Louis[b], and JL Aviation, Inc.[d]

**Wisconsin**

Air — L. Waskow[b], N. Hayden[b], C. Cold[b], C. Milestone[b], and R. Lichtie[b]

Ground — R. Bowman[b], M. Bicanic[b], T. Carlson[b], M. Carlisle[b], J. Carstens[b], N. Christel[b], J. Christian[b], J. Christopoulos[b] C. Cole[b], E. Eilert[b], M. Engel[b], T. Finger[b], R. Gatti[b], D. Goltz[b], R. Goodmanson[b], R. Haffele[b], N. Hayden[b], J. Hopp[b], J. Huff[b], A. Jahns[b], D. Ladwig[b], K. LaZotte[b], R. McDonough[b], C. Mogen[b], K. Morgen[b], J. Pritzl[b], C. Rollman[b], M. Schmidt[b], M. Soergel[b], M. Sparrow[b], K. Van Horn[b], J. Wanner[b], D. Weidert[b], M. Woodford[b], D. Bolin, M. Engel, A. Manwaring, and S. Otto

[a] Canadian Wildlife Service
[b] State, Provincial or Tribal Conservation Agency
[c] Ducks Unlimited Canada
[d] Other Organization
[e] U.S. Fish & Wildlife Service Retired
All others—U.S. Fish & Wildlife Service

A.2: Individuals who supplied information on the status of geese and swans.

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**Flyway-wide and Regional Survey Reports**

A. Anderson, C. Dau, J. Dubovsky, J. Fischer, D. Fronczak, D. Groves, J. Leafloor[a], S. Olson, P. Padding, A. Roberts, T. Sanders, D. Safine, E. Taylor, and H. Wilson

**Information from the Breeding Population and Habitat Survey**

See Appendix A.1

**North Atlantic Population of Canada Geese**

J. Bidwell, M. Koneff, M. Huang[b], B. Lubinski, B. Rogers, R. Wells[a], J. Wortham, and G. Zimmerman

**Atlantic Population of Canada Geese**

R. Cotter[a], S. Earsom, B. Harvey[b], and J. Rodrigue[a]

**Atlantic Flyway Resident Population of Canada Geese**

T. Nichols[b], G. Costanzo[b], W. Crenshaw[b], M. DiBona[b], J. Dunn[b], B. Evans[b], I. Gregg[b], B. Harvey[b], H. Heusmann[b], L. Hindman[b], R. Hossler[b], M. Huang[b], K. Jacobs[b], K. Kubik[b], J. Osenkowski[b], P. Ricard[b], A. Roberts, M. Siegesi, D. Sausville[b], G. Somogie[b], and B. Swift[b]

**Mississippi Flyway Interior Population of Canada Geese**

S. Badzinski[a], K. Bennett[b], R. Brook[b], G. Brown[b], G. Dibben[a], G. Kelsey[a], and J. Wollenberg[b],

**Mississippi Flyway Population Giant Canada Geese**

B. Avers[b], J. Benedict[b], R. Brook[b], J. Brunjes[b], F. Baldwin[b], S. Cordts[b], R. Domazlicky[b], M. Ervin[b], J. Feddersen[b], H. Havens[b], O. Jones[b], J. Leafloor[a], D. Luukkonen[b], S. Maddox[b] L. Naylor[b], A. Phelps[b], A. Radeke[b], L. Reynolds[b], R. Smith[b], and K. Van Horn[b]

**Western Prairie and Great Plains Populations of Canada Geese**

J. Bidwell[e], K. Fox, S. Chandler, D. Fronczak, B. Kelly[b], T. Liddick, W. Rhodes, D. Head II, R. Spangler, P. Thorpe, B. Bartzen[a], K. Dufour[a], K. Warner[a], P. Bergen[c], J. Brewster[a], A. Raquel[d], H. Fehr [a], M. Schuster[a], J. Leafloor[a], D. Walker[c], G. Ball[c], M. Ross[a], R. Bazin[a], R. Buss[c], P. Garrettson, A. Roberts, K. Kruse, S. LeJeune, H. Alvarez, C. Reighn[b], M. Vritiska[b], M. Szymanski[b], T. Bidrowski[b], J. Richardson[b], and R. Murano[b]

**Central Flyway Arctic Nesting Canada Geese**

D. Dubovsky, J. Leafloor[a], S. Olson, and F. Roetker

**Hi-Line Population of Canada Geese**

J. Bredy, S. Chandler, B. Kelly[b], J. Sands, P. Thorpe, E. Silverman, N. Huck[b], R. Spangler, G. Raven[a], M. Gillespie[c], J. Caswell[b], K. Zimmer[a], M. Watmough[a], M. Tanguay[a],D.Knop,[a], N. Clements[d], B. Bartzen[a], K. Dufour[a], K. Warner[a], P. Bergen[c], A. Raquel[d], H. Fehr [a], J. Brewster[a], P. Garrettson, and A. Roberts

**Rocky Mountain Population of Canada Geese**

J. Bredy, B. Kelly[b], R. Spangler, J. Sands, E. Silverman, R. Woolstenhulme[b], N. Huck[b], J. Gammonley[b], B. Stringham[b], G. Raven[a], M. Gillespie[c], J. Caswell[b], K. Zimmer[a], M. Watmough[a], M. Tanguay[a],D.Knop,[a], N. Clements[d], P. Garrettson, and A. Roberts

**Pacific Population of Canada Geese**

A. Breault[b], J. Bredy, D. Kraege[b], S. Olson, C. Gower[b], B. Reishus[b], J. Sands, M. Weaver[b], J. Knetter[b], R. Woolstenhulme[b], G. Raven[a], M. Gillespie[c], J. Caswell[b], K. Zimmer[a], M. Watmough[a], M. Tanguay[a], D.Knop[a], and N. Clements[d]

**Dusky Canada Geese**

E. Cooper[d], M. Gabrielson[d], N. Docken[d], D. Marks, H. Wilson, E. Taylor, J. Fischer, T. Sanders, J. Hodges[e], B. Eldridge[e], B. Stehn[e], and D. Rosenberg

**Lesser and Taverner's Canada Geese**

D. Groves and B. Shults

**Cackling Canada Geese**

A. Anderson, J. Fischer, J. Hodges[e], T. Sanders, D. Safine, M. Swaim, C. Rodgers, E. Taylor, and H. Wilson

**Aleutian Canada Geese**

K. Griggs, E. Hopson, R. Lowe, E. Nelson, S. Olson, B. Reishus[b], T. Sanders, S. Stephensen, M. Weaver[b], D. Skalos[b], J. Sands, E. Taylor, H. Renner, D. Brazil[d] K. Guerena, E. Davis, D. Brazil[d],and B. Henry[d]

**Greater Snow Geese**

J. Bachand[d], F. Bolduc[a], R. Cotter[a], G. Gauthier[d], M. Labonté[d], J. Lefebvre[a], C. Maurice[a], J. Rodrigue[a], and F. Saint-Pierre[d]

**Mid-continent Population Light Geese**

R. Alisauskas[a], D. Kellett[a], K. Abraham[d], C. Nissley[d], C. Williams[d], J. Dubovsky, and D. Fronczak

**Western Central Flyway Population Light Geese**

R. Alisauskas[a], D. Kellett[a], and J. Dubovsky

**Western Arctic/Wrangel Island Population of Lesser Snow Geese**

V. Baranyuk[d], B. Burgess[d], J. Hupp[d], D. Kraege[b], C. Langner[b], S. Olson, B. Reishus[b], B. Ritchie[d], and T. Sanders,

**Ross's Geese**

K. Abraham[d], C. Nissley [d], C. Williams[d], R. Alisauskas[a], and D. Kellett[a]

**Pacific Population White-fronted Geese**

A. Anderson, J. Fischer, J. Hodges[e], D. Safine, M. Swaim, C. Rodgers, and H. Wilson

**Mid-continent Population White-fronted Geese**

R. Alisauskas[a], B. Bartzen[a], E. Beck[a], P. Bergen[a], K. Conkin[b], K. Dufour[a], M. Gollop[b], J. Hupp[d], J. Fischer, D. Kellett[a], D. Groves, J. Jackson[b], K. Kraii[b], J. Leafloor[a], T. Liddick, M. Robertson, F. Roetker, B. Shults, M. Spindler, R.Spangler, K. Warner[a], and H. Wilson

**Pacific Brant**

A. Anderson, C. Dau, J. Fischer, J. Hupp[d], J. Hodges[e], D. Kraege[b], E. Palacios[d], and H. Wilson

**Atlantic Brant**

K. Abraham[d], S. Campbell, M. DiBona[b], D. Faith, M. Fisher, J. Fuller[b], G. Gilchrist[a], I. Gregg[b], W. Harper, J. Heise, M. Hoff, D. Howell[b], P. Jayne, O. Jones[b], S. Meyer, T. Nichols[b], P. Padding, A. Roberts, W. Stanton, J. Stanton, D. Stewart, B. Swift[b], H. Walbridge, D. Webster, M. Whitbeck, T. Willis, C. Nissley[d], and C. Williams[d]

**Emperor Geese**

A. Anderson, C. Dau, J. Fischer, J. Hodges[e], and H. Wilson

**Western Population of Tundra Swans**

A. Anderson, J. Fischer, J. Hodges[e], D. Safine, M. Swaim, C. Rodgers, and H. Wilson and S. Olson

**Eastern Population of Tundra Swans**

S. Campbell, M. DiBona[b], D. Faith, M. Fisher, D. Fronzcak, J. Fuller[b], I. Gregg[b], W. Harper, K. Hamilton, J. Heise, M. Hoff, D. Howell[b], P. Jayne, O. Jones[b], S. Meyer, T. Nichols[b], P. Padding, A. Roberts, W. Stanton, J. Stanton, D. Stewart, B. Swift[b], H. Walbridge, D. Webster, M. Whitbeck, and T. Willis

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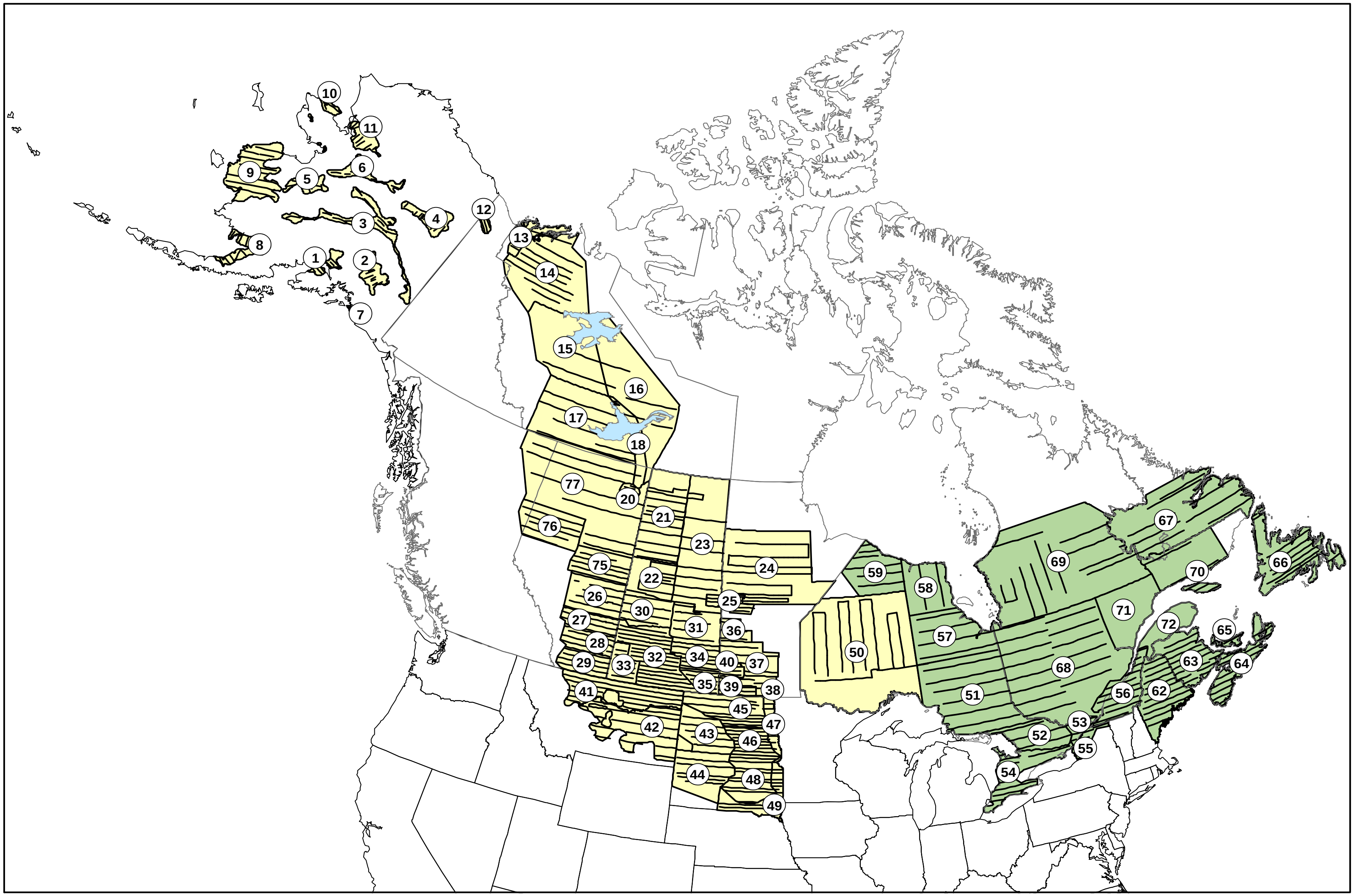
[a]Canadian Wildlife Service
[b]State, Provincial or Tribal Conservation Agency
[c]Ducks Unlimited Canada
[d]Other Organization
[e]U.S. Fish and Wildlife Service Retired
All others–U.S. Fish and Wildlife Service

## B. Waterfowl Breeding Population and Habitat Survey map




Strata and transects of the Waterfowl Breeding Population and Habitat Survey (yellow = traditional survey area, green = eastern survey area).

# C. Historical estimates of May ponds and regional waterfowl populations

Table C.1. Estimated number of May ponds and standard errors (in thousands) in portions of Prairie Canada and the northcentral U.S.

| | Prairie Canada | | Northcentral U.S.[a] | | Total | |
|---|---|---|---|---|---|---|
| Year | $\widehat{N}$ | $\widehat{SE}$ | $\widehat{N}$ | $\widehat{SE}$ | $\widehat{N}$ | $\widehat{SE}$ |
| 1961 | 1,977.20 | 165.40 | | | | |
| 1962 | 2,369.10 | 184.60 | | | | |
| 1963 | 2,482.00 | 129.30 | | | | |
| 1964 | 3,370.70 | 173.00 | | | | |
| 1965 | 4,378.80 | 212.20 | | | | |
| 1966 | 4,554.50 | 229.30 | | | | |
| 1967 | 4,691.20 | 272.10 | | | | |
| 1968 | 1,985.70 | 120.20 | | | | |
| 1969 | 3,547.60 | 221.90 | | | | |
| 1970 | 4,875.00 | 251.20 | | | | |
| 1971 | 4,053.40 | 200.40 | | | | |
| 1972 | 4,009.20 | 250.90 | | | | |
| 1973 | 2,949.50 | 197.60 | | | | |
| 1974 | 6,390.10 | 308.30 | 1,840.80 | 197.20 | 8,230.90 | 366.00 |
| 1975 | 5,320.10 | 271.30 | 1,910.80 | 116.10 | 7,230.90 | 295.10 |
| 1976 | 4,598.80 | 197.10 | 1,391.50 | 99.20 | 5,990.30 | 220.70 |
| 1977 | 2,277.90 | 120.70 | 771.10 | 51.10 | 3,049.10 | 131.10 |
| 1978 | 3,622.10 | 158.00 | 1,590.40 | 81.70 | 5,212.40 | 177.90 |
| 1979 | 4,858.90 | 252.00 | 1,522.20 | 70.90 | 6,381.10 | 261.80 |
| 1980 | 2,140.90 | 107.70 | 761.40 | 35.80 | 2,902.30 | 113.50 |
| 1981 | 1,443.00 | 75.30 | 682.80 | 34.00 | 2,125.80 | 82.60 |
| 1982 | 3,184.90 | 178.60 | 1,458.00 | 86.40 | 4,642.80 | 198.40 |
| 1983 | 3,905.70 | 208.20 | 1,259.20 | 68.70 | 5,164.90 | 219.20 |
| 1984 | 2,473.10 | 196.60 | 1,766.20 | 90.80 | 4,239.30 | 216.50 |
| 1985 | 4,283.10 | 244.10 | 1,326.90 | 74.00 | 5,610.00 | 255.10 |
| 1986 | 4,024.70 | 174.40 | 1,734.80 | 74.40 | 5,759.50 | 189.60 |
| 1987 | 2,523.70 | 131.00 | 1,347.80 | 46.80 | 3,871.50 | 139.10 |
| 1988 | 2,110.10 | 132.40 | 790.70 | 39.40 | 2,900.80 | 138.10 |
| 1989 | 1,692.70 | 89.10 | 1,289.90 | 61.70 | 2,982.70 | 108.40 |
| 1990 | 2,817.30 | 138.30 | 691.20 | 45.90 | 3,508.50 | 145.70 |
| 1991 | 2,493.90 | 110.20 | 706.10 | 33.60 | 3,200.00 | 115.20 |
| 1992 | 2,783.90 | 141.60 | 825.00 | 30.80 | 3,608.90 | 144.90 |
| 1993 | 2,261.10 | 94.00 | 1,350.60 | 57.10 | 3,611.70 | 110.00 |
| 1994 | 3,769.10 | 173.90 | 2,215.60 | 88.80 | 5,984.80 | 195.30 |
| 1995 | 3,892.50 | 223.80 | 2,442.90 | 106.80 | 6,335.40 | 248.00 |
| 1996 | 5,002.60 | 184.90 | 2,479.70 | 135.30 | 7,482.20 | 229.10 |

Table C.1. Continued.

| | Prairie Canada | | Northcentral U.S.[a] | | Total | |
|---|---|---|---|---|---|---|
| Year | $\widehat{N}$ | $\widehat{SE}$ | $\widehat{N}$ | $\widehat{SE}$ | $\widehat{N}$ | $\widehat{SE}$ |
| 1997 | 5,061.00 | 180.30 | 2,397.20 | 94.40 | 7,458.20 | 203.50 |
| 1998 | 2,521.70 | 133.80 | 2,065.30 | 89.20 | 4,586.90 | 160.80 |
| 1999 | 3,862.00 | 157.20 | 2,842.20 | 256.80 | 6,704.30 | 301.20 |
| 2000 | 2,422.50 | 96.10 | 1,524.50 | 99.90 | 3,946.90 | 138.60 |
| 2001 | 2,747.20 | 115.60 | 1,893.20 | 91.50 | 4,640.40 | 147.40 |
| 2002 | 1,439.00 | 105.00 | 1,281.00 | 63.40 | 2,720.00 | 122.70 |
| 2003 | 3,522.30 | 151.80 | 1,667.80 | 67.40 | 5,190.10 | 166.10 |
| 2004 | 2,512.60 | 131.00 | 1,407.00 | 101.70 | 3,919.60 | 165.80 |
| 2005 | 3,920.50 | 196.70 | 1,460.70 | 79.70 | 5,381.20 | 212.20 |
| 2006 | 4,449.50 | 221.50 | 1,644.40 | 85.40 | 6,093.90 | 237.40 |
| 2007 | 5,040.20 | 261.80 | 1,962.50 | 102.50 | 7,002.70 | 281.20 |
| 2008 | 3,054.80 | 147.60 | 1,376.60 | 71.90 | 4,431.40 | 164.20 |
| 2009 | 3,568.10 | 148.00 | 2,866.00 | 123.10 | 6,434.00 | 192.50 |
| 2010 | 3,728.70 | 203.40 | 2,936.30 | 142.30 | 6,665.00 | 248.20 |
| 2011 | 4,892.70 | 197.50 | 3,239.50 | 127.40 | 8,132.20 | 235.00 |
| 2012 | 3,885.10 | 146.50 | 1,658.90 | 52.70 | 5,544.00 | 155.60 |
| 2013 | 4,550.50 | 185.50 | 2,341.20 | 99.00 | 6,891.70 | 210.20 |
| 2014 | 4,629.90 | 168.30 | 2,551.30 | 106.50 | 7,181.20 | 199.20 |
| 2015 | 4,151.00 | 146.30 | 2,156.80 | 86.00 | 6,307.70 | 169.70 |
| 2016 | 3,494.50 | 147.20 | 1,518.00 | 52.70 | 5,012.50 | 156.40 |

[a] No comparable survey data available for the northcentral U.S. during 1961–1973.

Table C.2. Breeding population estimates (in thousands) for total ducks[a] and mallards for states, provinces, or regions that conduct spring surveys.

| | British Columbia | | California | | Michigan | | Minnesota | |
|---|---|---|---|---|---|---|---|---|
| Year | Total ducks | Mallards | Total ducks | Mallards | Total ducks | Mallards | Total ducks | Mallards |
| 1955 | | | | | | | | |
| 1956 | | | | | | | | |
| 1957 | | | | | | | | |
| 1958 | | | | | | | | |
| 1959 | | | | | | | | |
| 1960 | | | | | | | | |
| 1961 | | | | | | | | |
| 1962 | | | | | | | | |
| 1963 | | | | | | | | |
| 1964 | | | | | | | | |
| 1965 | | | | | | | | |
| 1966 | | | | | | | | |
| 1967 | | | | | | | | |
| 1968 | | | | | | | 321.0 | 83.7 |
| 1969 | | | | | | | 323.2 | 88.8 |
| 1970 | | | | | | | 324.2 | 113.9 |
| 1971 | | | | | | | 277.1 | 78.5 |
| 1972 | | | | | | | 217.2 | 62.2 |
| 1973 | | | | | | | 389.5 | 99.8 |
| 1974 | | | | | | | 281.6 | 72.8 |
| 1975 | | | | | | | 471.6 | 175.8 |
| 1976 | | | | | | | 684.1 | 117.8 |
| 1977 | | | | | | | 501.1 | 134.2 |
| 1978 | | | | | | | 462.5 | 146.8 |
| 1979 | | | | | | | 552.4 | 158.7 |
| 1980 | | | | | | | 690.6 | 172.0 |
| 1981 | | | | | | | 439.8 | 154.8 |
| 1982 | | | | | | | 465.2 | 120.5 |
| 1983 | | | | | | | 367.1 | 155.8 |
| 1984 | | | | | | | 529.7 | 188.1 |
| 1985 | | | | | | | 562.9 | 216.9 |
| 1986 | | | | | | | 520.8 | 233.6 |
| 1987 | | | | | | | 589.0 | 192.3 |
| 1988 | | | | | | | 725.2 | 271.7 |
| 1989 | | | | | | | 813.6 | 273.0 |
| 1990 | | | | | | | 807.9 | 232.1 |
| 1991 | | | | | 408.4 | 289.3 | 753.7 | 225.0 |
| 1992 | | | 497.4 | 375.8 | 867.5 | 385.8 | 973.3 | 360.9 |
| 1993 | | | 666.7 | 359.0 | 742.8 | 437.2 | 837.2 | 305.8 |
| 1994 | | | 483.2 | 311.7 | 683.1 | 420.5 | 1,115.6 | 426.5 |
| 1995 | | | 589.7 | 368.5 | 791.9 | 524.1 | 797.1 | 319.4 |
| 1996 | | | 843.7 | 536.7 | 680.5 | 378.2 | 889.1 | 314.8 |
| 1997 | | | 824.3 | 511.3 | 784.0 | 489.3 | 868.1 | 407.4 |
| 1998 | | | 706.8 | 353.9 | 1,068.5 | 523.0 | 693.1 | 368.5 |
| 1999 | | | 851.0 | 560.1 | 744.6 | 466.1 | 680.5 | 316.4 |

Table C.2. Continued.

| | British Columbia | | California | | Michigan | | Minnesota | |
|---|---|---|---|---|---|---|---|---|
| Year | Total ducks | Mallards | Total ducks | Mallards | Total ducks | Mallards | Total ducks | Mallards |
| 2000 | | | 562.4 | 347.6 | 793.9 | 427.2 | 747.8 | 318.1 |
| 2001 | | | 413.5 | 302.2 | 497.8 | 324.2 | 716.4 | 320.6 |
| 2002 | | | 392.0 | 265.3 | 742.5 | 323.2 | 1,171.5 | 366.6 |
| 2003 | | | 533.7 | 337.1 | 535.4 | 298.9 | 721.8 | 280.5 |
| 2004 | | | 412.8 | 262.4 | 624.5 | 342.0 | 1,008.3 | 375.3 |
| 2005 | | | 615.2 | 317.9 | 468.3 | 258.1 | 632.0 | 238.5 |
| 2006 | 407.8 | 101.1 | 649.4 | 399.4 | 412.2 | 244.6 | 521.1 | 160.7 |
| 2007 | 384.1 | 101.5 | 627.6 | 388.3 | 641.9 | 337.7 | 488.5 | 242.5 |
| 2008 | 375.1 | 80.6 | 554.3 | 297.1 | 437.5 | 200.5 | 739.6 | 297.6 |
| 2009 | 350.1 | 73.2 | 510.8 | 302.0 | 493.6 | 258.9 | 541.3 | 236.4 |
| 2010 | 339.6 | 81.2 | 541.3 | 367.9 | 595.3 | 338.3 | 530.7 | 241.9 |
| 2011 | 278.1 | 70.1 | 558.6 | 314.7 | 471.4 | 258.6 | 687.5 | 283.3 |
| 2012 | 322.0 | 83.3 | 529.7 | 387.1 | 860.1 | 439.3 | 468.6 | 225.0 |
| 2013 | 330.6 | 82.7 | 451.3 | 298.6 | 678.6 | 288.4 | 682.9 | 293.2 |
| 2014 | 352.7 | 82.6 | 448.7 | 238.7 | 395.3 | 230.1 | 474.4 | 257.0 |
| 2015 | 363.3 | 81.3 | 315.6 | 173.9 | 431.1 | 237.8 | 524.2 | 206.2 |
| 2016 | 318.7 | 73.9 | 410.5 | 263.8 | 502.6 | 278.1 | 768.2 | 243.2 |

[a] Species composition for the total duck estimate varies by region.

Table C.2. Continued.

| | Nevada[b] | Northeast U.S.[c] | | Oregon | | Washington | | Wisconsin | |
|---|---|---|---|---|---|---|---|---|---|
| Year | Mallards | Total ducks | Mallards | Total ducks | Mallards | Total ducks | Mallards | Total ducks | Mallards |
| 1955 | | | | | | | | | |
| 1956 | | | | | | | | | |
| 1957 | | | | | | | | | |
| 1958 | | | | | | | | | |
| 1959 | 2.1 | | | | | | | | |
| 1960 | 2.1 | | | | | | | | |
| 1961 | 2.0 | | | | | | | | |
| 1962 | 1.7 | | | | | | | | |
| 1963 | 2.2 | | | | | | | | |
| 1964 | 3.0 | | | | | | | | |
| 1965 | 3.5 | | | | | | | | |
| 1966 | 3.4 | | | | | | | | |
| 1967 | 1.5 | | | | | | | | |
| 1968 | 1.2 | | | | | | | | |
| 1969 | 1.4 | | | | | | | | |
| 1970 | 1.5 | | | | | | | | |
| 1971 | 1.1 | | | | | | | | |
| 1972 | 0.9 | | | | | | | | |
| 1973 | 0.7 | | | | | | | 412.7 | 107.0 |
| 1974 | 0.7 | | | | | | | 435.2 | 94.3 |
| 1975 | 0.6 | | | | | | | 426.9 | 120.5 |
| 1976 | 0.6 | | | | | | | 379.5 | 109.9 |
| 1977 | 1.0 | | | | | | | 323.3 | 91.7 |
| 1978 | 0.6 | | | | | | | 271.3 | 61.6 |
| 1979 | 0.6 | | | | | 98.6 | 32.1 | 265.7 | 78.6 |
| 1980 | 0.9 | | | | | 113.7 | 34.1 | 248.1 | 116.5 |
| 1981 | 1.6 | | | | | 148.3 | 41.8 | 505.0 | 142.8 |
| 1982 | 1.1 | | | | | 146.4 | 49.8 | 218.7 | 89.5 |
| 1983 | 1.5 | | | | | 149.5 | 47.6 | 202.3 | 119.5 |
| 1984 | 1.4 | | | | | 196.3 | 59.3 | 210.0 | 104.8 |
| 1985 | 1.5 | | | | | 216.2 | 63.1 | 192.8 | 73.9 |
| 1986 | 1.3 | | | | | 203.8 | 60.8 | 262.0 | 110.8 |
| 1987 | 1.5 | | | | | 183.6 | 58.3 | 389.8 | 136.9 |
| 1988 | 1.3 | | | | | 241.8 | 67.2 | 287.1 | 148.9 |
| 1989 | 1.3 | | | | | 162.3 | 49.8 | 462.5 | 180.7 |
| 1990 | 1.3 | | | | | 168.9 | 56.9 | 328.6 | 151.4 |
| 1991 | 1.4 | | | | | 140.8 | 43.7 | 435.8 | 172.4 |
| 1992 | 0.9 | | | | | 116.3 | 41.0 | 683.8 | 249.7 |
| 1993 | 1.2 | 1,158.1 | 686.6 | | | 149.8 | 55.0 | 379.4 | 174.5 |
| 1994 | 1.4 | 1,297.3 | 856.3 | 323.6 | 116.4 | 123.9 | 52.7 | 571.2 | 283.4 |
| 1995 | 1.0 | 1,408.5 | 864.1 | 215.9 | 77.5 | 147.3 | 58.9 | 592.4 | 242.2 |
| 1996 | 1.7 | 1,430.9 | 848.6 | 288.4 | 102.2 | 163.3 | 61.6 | 536.3 | 314.4 |

Table C.2. Continued.

| Year | Nevada[b] Mallards | Northeast U.S.[c] Total ducks | Northeast U.S.[c] Mallards | Oregon Total ducks | Oregon Mallards | Washington Total ducks | Washington Mallards | Wisconsin Total ducks | Wisconsin Mallards |
|---|---|---|---|---|---|---|---|---|---|
| 1997 | 2.5 | 1,423.5 | 795.2 | 359.5 | 121.2 | 172.8 | 67.0 | 409.3 | 181.0 |
| 1998 | 2.1 | 1,444.0 | 775.2 | 345.1 | 124.9 | 185.3 | 79.0 | 412.8 | 186.9 |
| 1999 | 2.3 | 1,522.7 | 880.0 | 320.0 | 125.6 | 200.2 | 86.2 | 476.6 | 248.4 |
| 2000 | 2.1 | 1,933.5 | 762.6 | 314.9 | 110.9 | 143.6 | 47.7 | 744.4 | 454.0 |
| 2001 | 2.0 | 1,397.4 | 809.4 | | | 146.4 | 50.5 | 440.1 | 183.5 |
| 2002 | 0.7 | 1,466.2 | 833.7 | 364.6 | 104.5 | 133.3 | 44.7 | 740.8 | 378.5 |
| 2003 | 1.7 | 1,266.2 | 731.9 | 246.1 | 89.0 | 127.8 | 39.8 | 533.5 | 261.3 |
| 2004 | 1.7 | 1,416.9 | 805.9 | 229.8 | 82.5 | 114.9 | 40.0 | 651.5 | 229.2 |
| 2005 | 0.7 | 1,416.2 | 753.6 | 210.4 | 74.1 | 111.5 | 40.8 | 724.3 | 317.2 |
| 2006 | 1.8 | 1,384.2 | 725.2 | 251.2 | 81.1 | 135.4 | 45.5 | 522.6 | 219.5 |
| 2007 | 2.1 | 1,500.1 | 687.6 | 319.1 | 92.5 | 128.3 | 46.1 | 470.6 | 210.0 |
| 2008 | 1.9 | 1,197.1 | 619.1 | 224.3 | 75.4 | 120.9 | 50.6 | 626.9 | 188.4 |
| 2009 | 12.7 | 1,271.1 | 666.8 | 186.0 | 72.6 | 116.5 | 47.5 | 502.4 | 200.5 |
| 2010 | 8.9 | 1,302.0 | 651.7 | 205.1 | 66.8 | 197.8 | 91.8 | 386.5 | 199.1 |
| 2011 | 2.3 | 1,265.0 | 586.1 | 158.4 | 61.6 | 157.1 | 71.4 | 513.7 | 187.9 |
| 2012 | 4.1 | 1,309.9 | 612.6 | 263.5 | 88.8 | 168.9 | 89.4 | 521.1 | 197.0 |
| 2013 | 8.8 | 1,281.8 | 604.2 | 251.7 | 84.3 | 156.5 | 74.1 | 527.3 | 181.2 |
| 2014 | 4.2 | 1,343.8 | 634.6 | 315.2 | 85.3 | 117.2 | 86.5 | 395.1 | 158.7 |
| 2015 | 5.5 | 1,197.2 | 540.1 | 279.7 | 87.4 | 193.1 | 86.4 | 372.8 | 176.2 |
| 2016 | | 1,240.8 | 551.3 | 213.6 | 87.3 | 121.5 | 59.9 | 390.5 | 164.1 |

[b] Survey redesigned in 2009, and not comparable with previous years.

[c] Includes all or portions of Connecticut, Delaware, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, and Virginia.

Table C.3. Breeding population estimates and standard errors (in thousands) for 10 species of ducks from the traditional survey area (strata 1–18, 20–50, 75–77; 1955–2016).

| | Mallard | | Gadwall | | American wigeon | | Green-winged teal | | Blue-winged teal | |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | $\widehat{N}$ | $\widehat{SE}$ | $\widehat{N}$ | $\widehat{SE}$ | $\widehat{N}$ | $\widehat{SE}$ | $\widehat{N}$ | $\widehat{SE}$ | $\widehat{N}$ | $\widehat{SE}$ |
| 1955 | 8,777.3 | 457.1 | 651.5 | 149.5 | 3,216.8 | 297.8 | 1,807.2 | 291.5 | 5,305.2 | 567.6 |
| 1956 | 10,452.7 | 461.8 | 772.6 | 142.4 | 3,145.0 | 227.8 | 1,525.3 | 236.2 | 4,997.6 | 527.6 |
| 1957 | 9,296.9 | 443.5 | 666.8 | 148.2 | 2,919.8 | 291.5 | 1,102.9 | 161.2 | 4,299.5 | 467.3 |
| 1958 | 11,234.2 | 555.6 | 502.0 | 89.6 | 2,551.7 | 177.9 | 1,347.4 | 212.2 | 5,456.6 | 483.7 |
| 1959 | 9,024.3 | 466.6 | 590.0 | 72.7 | 3,787.7 | 339.2 | 2,653.4 | 459.3 | 5,099.3 | 332.7 |
| 1960 | 7,371.7 | 354.1 | 784.1 | 68.4 | 2,987.6 | 407.0 | 1,426.9 | 311.0 | 4,293.0 | 294.3 |
| 1961 | 7,330.0 | 510.5 | 654.8 | 77.5 | 3,048.3 | 319.9 | 1,729.3 | 251.5 | 3,655.3 | 298.7 |
| 1962 | 5,535.9 | 426.9 | 905.1 | 87.0 | 1,958.7 | 145.4 | 722.9 | 117.6 | 3,011.1 | 209.8 |
| 1963 | 6,748.8 | 326.8 | 1,055.3 | 89.5 | 1,830.8 | 169.9 | 1,242.3 | 226.9 | 3,723.6 | 323.0 |
| 1964 | 6,063.9 | 385.3 | 873.4 | 73.7 | 2,589.6 | 259.7 | 1,561.3 | 244.7 | 4,020.6 | 320.4 |
| 1965 | 5,131.7 | 274.8 | 1,260.3 | 114.8 | 2,301.1 | 189.4 | 1,282.0 | 151.0 | 3,594.5 | 270.4 |
| 1966 | 6,731.9 | 311.4 | 1,680.4 | 132.4 | 2,318.4 | 139.2 | 1,617.3 | 173.6 | 3,733.2 | 233.6 |
| 1967 | 7,509.5 | 338.2 | 1,384.6 | 97.8 | 2,325.5 | 136.2 | 1,593.7 | 165.7 | 4,491.5 | 305.7 |
| 1968 | 7,089.2 | 340.8 | 1,949.0 | 213.9 | 2,298.6 | 156.1 | 1,430.9 | 146.6 | 3,462.5 | 389.1 |
| 1969 | 7,531.6 | 280.2 | 1,573.4 | 100.2 | 2,941.4 | 168.6 | 1,491.0 | 103.5 | 4,138.6 | 239.5 |
| 1970 | 9,985.9 | 617.2 | 1,608.1 | 123.5 | 3,469.9 | 318.5 | 2,182.5 | 137.7 | 4,861.8 | 372.3 |
| 1971 | 9,416.4 | 459.5 | 1,605.6 | 123.0 | 3,272.9 | 186.2 | 1,889.3 | 132.9 | 4,610.2 | 322.8 |
| 1972 | 9,265.5 | 363.9 | 1,622.9 | 120.1 | 3,200.1 | 194.1 | 1,948.2 | 185.8 | 4,278.5 | 230.5 |
| 1973 | 8,079.2 | 377.5 | 1,245.6 | 90.3 | 2,877.9 | 197.4 | 1,949.2 | 131.9 | 3,332.5 | 220.3 |
| 1974 | 6,880.2 | 351.8 | 1,592.4 | 128.2 | 2,672.0 | 159.3 | 1,864.5 | 131.2 | 4,976.2 | 394.6 |
| 1975 | 7,726.9 | 344.1 | 1,643.9 | 109.0 | 2,778.3 | 192.0 | 1,664.8 | 148.1 | 5,885.4 | 337.4 |
| 1976 | 7,933.6 | 337.4 | 1,244.8 | 85.7 | 2,505.2 | 152.7 | 1,547.5 | 134.0 | 4,744.7 | 294.5 |
| 1977 | 7,397.1 | 381.8 | 1,299.0 | 126.4 | 2,575.1 | 185.9 | 1,285.8 | 87.9 | 4,462.8 | 328.4 |
| 1978 | 7,425.0 | 307.0 | 1,558.0 | 92.2 | 3,282.4 | 208.0 | 2,174.2 | 219.1 | 4,498.6 | 293.3 |
| 1979 | 7,883.4 | 327.0 | 1,757.9 | 121.0 | 3,106.5 | 198.2 | 2,071.7 | 198.5 | 4,875.9 | 297.6 |
| 1980 | 7,706.5 | 307.2 | 1,392.9 | 98.8 | 3,595.5 | 213.2 | 2,049.9 | 140.7 | 4,895.1 | 295.6 |
| 1981 | 6,409.7 | 308.4 | 1,395.4 | 120.0 | 2,946.0 | 173.0 | 1,910.5 | 141.7 | 3,720.6 | 242.1 |
| 1982 | 6,408.5 | 302.2 | 1,633.8 | 126.2 | 2,458.7 | 167.3 | 1,535.7 | 140.2 | 3,657.6 | 203.7 |
| 1983 | 6,456.0 | 286.9 | 1,519.2 | 144.3 | 2,636.2 | 181.4 | 1,875.0 | 148.0 | 3,366.5 | 197.2 |
| 1984 | 5,415.3 | 258.4 | 1,515.0 | 125.0 | 3,002.2 | 174.2 | 1,408.2 | 91.5 | 3,979.3 | 267.6 |
| 1985 | 4,960.9 | 234.7 | 1,303.0 | 98.2 | 2,050.7 | 143.7 | 1,475.4 | 100.3 | 3,502.4 | 246.3 |
| 1986 | 6,124.2 | 241.6 | 1,547.1 | 107.5 | 1,736.5 | 109.9 | 1,674.9 | 136.1 | 4,478.8 | 237.1 |
| 1987 | 5,789.8 | 217.9 | 1,305.6 | 97.1 | 2,012.5 | 134.3 | 2,006.2 | 180.4 | 3,528.7 | 220.2 |
| 1988 | 6,369.3 | 310.3 | 1,349.9 | 121.1 | 2,211.1 | 139.1 | 2,060.8 | 188.3 | 4,011.1 | 290.4 |
| 1989 | 5,645.4 | 244.1 | 1,414.6 | 106.6 | 1,972.9 | 106.0 | 1,841.7 | 166.4 | 3,125.3 | 229.8 |
| 1990 | 5,452.4 | 238.6 | 1,672.1 | 135.8 | 1,860.1 | 108.3 | 1,789.5 | 172.7 | 2,776.4 | 178.7 |
| 1991 | 5,444.6 | 205.6 | 1,583.7 | 111.8 | 2,254.0 | 139.5 | 1,557.8 | 111.3 | 3,763.7 | 270.8 |
| 1992 | 5,976.1 | 241.0 | 2,032.8 | 143.4 | 2,208.4 | 131.9 | 1,773.1 | 123.7 | 4,333.1 | 263.2 |
| 1993 | 5,708.3 | 208.9 | 1,755.2 | 107.9 | 2,053.0 | 109.3 | 1,694.5 | 112.7 | 3,192.9 | 205.6 |
| 1994 | 6,980.1 | 282.8 | 2,318.3 | 145.2 | 2,382.2 | 130.3 | 2,108.4 | 152.2 | 4,616.2 | 259.2 |
| 1995 | 8,269.4 | 287.5 | 2,835.7 | 187.5 | 2,614.5 | 136.3 | 2,300.6 | 140.3 | 5,140.0 | 253.3 |
| 1996 | 7,941.3 | 262.9 | 2,984.0 | 152.5 | 2,271.7 | 125.4 | 2,499.5 | 153.4 | 6,407.4 | 353.9 |

Table C.3. Continued.

| Year | Mallard $\widehat{N}$ | Mallard $\widehat{SE}$ | Gadwall $\widehat{N}$ | Gadwall $\widehat{SE}$ | American wigeon $\widehat{N}$ | American wigeon $\widehat{SE}$ | Green-winged teal $\widehat{N}$ | Green-winged teal $\widehat{SE}$ | Blue-winged teal $\widehat{N}$ | Blue-winged teal $\widehat{SE}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| 1997 | 9,939.7 | 308.5 | 3,897.2 | 264.9 | 3,117.6 | 161.6 | 2,506.6 | 142.5 | 6,124.3 | 330.7 |
| 1998 | 9,640.4 | 301.6 | 3,742.2 | 205.6 | 2,857.7 | 145.3 | 2,087.3 | 138.9 | 6,398.8 | 332.3 |
| 1999 | 10,805.7 | 344.5 | 3,235.5 | 163.8 | 2,920.1 | 185.5 | 2,631.0 | 174.6 | 7,149.5 | 364.5 |
| 2000 | 9,470.2 | 290.2 | 3,158.4 | 200.7 | 2,733.1 | 138.8 | 3,193.5 | 200.1 | 7,431.4 | 425.0 |
| 2001 | 7,904.0 | 226.9 | 2,679.2 | 136.1 | 2,493.5 | 149.6 | 2,508.7 | 156.4 | 5,757.0 | 288.8 |
| 2002 | 7,503.7 | 246.5 | 2,235.4 | 135.4 | 2,334.4 | 137.9 | 2,333.5 | 143.8 | 4,206.5 | 227.9 |
| 2003 | 7,949.7 | 267.3 | 2,549.0 | 169.9 | 2,551.4 | 156.9 | 2,678.5 | 199.7 | 5,518.2 | 312.7 |
| 2004 | 7,425.3 | 282.0 | 2,589.6 | 165.6 | 1,981.3 | 114.9 | 2,460.8 | 145.2 | 4,073.0 | 238.0 |
| 2005 | 6,755.3 | 280.8 | 2,179.1 | 131.0 | 2,225.1 | 139.2 | 2,156.9 | 125.8 | 4,585.5 | 236.3 |
| 2006 | 7,276.5 | 223.7 | 2,824.7 | 174.2 | 2,171.2 | 115.7 | 2,587.2 | 155.3 | 5,859.6 | 303.5 |
| 2007 | 8,307.3 | 285.8 | 3,355.9 | 206.2 | 2,806.8 | 152.0 | 2,890.3 | 196.1 | 6,707.6 | 362.2 |
| 2008 | 7,723.8 | 256.8 | 2,727.7 | 158.9 | 2,486.6 | 151.3 | 2,979.7 | 194.4 | 6,640.1 | 337.3 |
| 2009 | 8,512.4 | 248.3 | 3,053.5 | 166.3 | 2,468.6 | 135.4 | 3,443.6 | 219.9 | 7,383.8 | 396.8 |
| 2010 | 8,430.1 | 284.9 | 2,976.7 | 161.6 | 2,424.6 | 131.5 | 3,475.9 | 207.2 | 6,328.5 | 382.6 |
| 2011 | 9,182.6 | 267.8 | 3,256.9 | 196.9 | 2,084.0 | 110.1 | 2,900.1 | 170.7 | 8,948.5 | 418.2 |
| 2012 | 10,601.5 | 324.0 | 3,585.6 | 208.7 | 2,145.0 | 145.6 | 3,471.2 | 207.9 | 9,242.3 | 425.1 |
| 2013 | 10,371.9 | 360.6 | 3,351.4 | 204.5 | 2,644.3 | 169.2 | 3,053.4 | 173.7 | 7,731.7 | 363.2 |
| 2014 | 10,899.8 | 347.6 | 3,811.0 | 206.0 | 3,116.7 | 190.4 | 3,439.9 | 247.4 | 8,541.5 | 461.9 |
| 2015 | 11,643.3 | 361.8 | 3,834.1 | 219.4 | 3,037.0 | 199.2 | 4,080.9 | 269.8 | 8,547.3 | 401.1 |
| 2016 | 11,792.5 | 367.4 | 3,712.0 | 197.3 | 3,411.3 | 196.4 | 4,275.4 | 329.8 | 6,689.4 | 340.1 |

Table C.3. Breeding population estimates and standard errors (in thousands) for 10 species of ducks from the traditional survey area (strata 1–18, 20–50, 75–77). *(continued)*

| | Northern shoveler | | Northern pintail | | Redhead | | Canvasback | | Scaup | |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | $\widehat{N}$ | $\widehat{SE}$ | $\widehat{N}$ | $\widehat{SE}$ | $\widehat{N}$ | $\widehat{SE}$ | $\widehat{N}$ | $\widehat{SE}$ | $\widehat{N}$ | $\widehat{SE}$ |
| 1955 | 1,642.8 | 218.7 | 9,775.1 | 656.1 | 539.9 | 98.9 | 589.3 | 87.8 | 5,620.1 | 582.1 |
| 1956 | 1,781.4 | 196.4 | 10,372.8 | 694.4 | 757.3 | 119.3 | 698.5 | 93.3 | 5,994.1 | 434.0 |
| 1957 | 1,476.1 | 181.8 | 6,606.9 | 493.4 | 509.1 | 95.7 | 626.1 | 94.7 | 5,766.9 | 411.7 |
| 1958 | 1,383.8 | 185.1 | 6,037.9 | 447.9 | 457.1 | 66.2 | 746.8 | 96.1 | 5,350.4 | 355.1 |
| 1959 | 1,577.6 | 301.1 | 5,872.7 | 371.6 | 498.8 | 55.5 | 488.7 | 50.6 | 7,037.6 | 492.3 |
| 1960 | 1,824.5 | 130.1 | 5,722.2 | 323.2 | 497.8 | 67.0 | 605.7 | 82.4 | 4,868.6 | 362.5 |
| 1961 | 1,383.0 | 166.5 | 4,218.2 | 496.2 | 323.3 | 38.8 | 435.3 | 65.7 | 5,380.0 | 442.2 |
| 1962 | 1,269.0 | 113.9 | 3,623.5 | 243.1 | 507.5 | 60.0 | 360.2 | 43.8 | 5,286.1 | 426.4 |
| 1963 | 1,398.4 | 143.8 | 3,846.0 | 255.6 | 413.4 | 61.9 | 506.2 | 74.9 | 5,438.4 | 357.9 |
| 1964 | 1,718.3 | 240.3 | 3,291.2 | 239.4 | 528.1 | 67.3 | 643.6 | 126.9 | 5,131.8 | 386.1 |
| 1965 | 1,423.7 | 114.1 | 3,591.9 | 221.9 | 599.3 | 77.7 | 522.1 | 52.8 | 4,640.0 | 411.2 |
| 1966 | 2,147.0 | 163.9 | 4,811.9 | 265.6 | 713.1 | 77.6 | 663.1 | 78.0 | 4,439.2 | 356.2 |
| 1967 | 2,314.7 | 154.6 | 5,277.7 | 341.9 | 735.7 | 79.0 | 502.6 | 45.4 | 4,927.7 | 456.1 |
| 1968 | 1,684.5 | 176.8 | 3,489.4 | 244.6 | 499.4 | 53.6 | 563.7 | 101.3 | 4,412.7 | 351.8 |
| 1969 | 2,156.8 | 117.2 | 5,903.9 | 296.2 | 633.2 | 53.6 | 503.5 | 53.7 | 5,139.8 | 378.5 |
| 1970 | 2,230.4 | 117.4 | 6,392.0 | 396.7 | 622.3 | 64.3 | 580.1 | 90.4 | 5,662.5 | 391.4 |
| 1971 | 2,011.4 | 122.7 | 5,847.2 | 368.1 | 534.4 | 57.0 | 450.7 | 55.2 | 5,143.3 | 333.8 |
| 1972 | 2,466.5 | 182.8 | 6,979.0 | 364.5 | 550.9 | 49.4 | 425.9 | 46.0 | 7,997.0 | 718.0 |
| 1973 | 1,619.0 | 112.2 | 4,356.2 | 267.0 | 500.8 | 57.7 | 620.5 | 89.1 | 6,257.4 | 523.1 |
| 1974 | 2,011.3 | 129.9 | 6,598.2 | 345.8 | 626.3 | 70.8 | 512.8 | 56.8 | 5,780.5 | 409.8 |
| 1975 | 1,980.8 | 106.7 | 5,900.4 | 267.3 | 831.9 | 93.5 | 595.1 | 56.1 | 6,460.0 | 486.0 |
| 1976 | 1,748.1 | 106.9 | 5,475.6 | 299.2 | 665.9 | 66.3 | 614.4 | 70.1 | 5,818.7 | 348.7 |
| 1977 | 1,451.8 | 82.1 | 3,926.1 | 246.8 | 634.0 | 79.9 | 664.0 | 74.9 | 6,260.2 | 362.8 |
| 1978 | 1,975.3 | 115.6 | 5,108.2 | 267.8 | 724.6 | 62.2 | 373.2 | 41.5 | 5,984.4 | 403.0 |
| 1979 | 2,406.5 | 135.6 | 5,376.1 | 274.4 | 697.5 | 63.8 | 582.0 | 59.8 | 7,657.9 | 548.6 |
| 1980 | 1,908.2 | 119.9 | 4,508.1 | 228.6 | 728.4 | 116.7 | 734.6 | 83.8 | 6,381.7 | 421.2 |
| 1981 | 2,333.6 | 177.4 | 3,479.5 | 260.5 | 594.9 | 62.0 | 620.8 | 59.1 | 5,990.9 | 414.2 |
| 1982 | 2,147.6 | 121.7 | 3,708.8 | 226.6 | 616.9 | 74.2 | 513.3 | 50.9 | 5,532.0 | 380.9 |
| 1983 | 1,875.7 | 105.3 | 3,510.6 | 178.1 | 711.9 | 83.3 | 526.6 | 58.9 | 7,173.8 | 494.9 |
| 1984 | 1,618.2 | 91.9 | 2,964.8 | 166.8 | 671.3 | 72.0 | 530.1 | 60.1 | 7,024.3 | 484.7 |
| 1985 | 1,702.1 | 125.7 | 2,515.5 | 143.0 | 578.2 | 67.1 | 375.9 | 42.9 | 5,098.0 | 333.1 |
| 1986 | 2,128.2 | 112.0 | 2,739.7 | 152.1 | 559.6 | 60.5 | 438.3 | 41.5 | 5,235.3 | 355.5 |
| 1987 | 1,950.2 | 118.4 | 2,628.3 | 159.4 | 502.4 | 54.9 | 450.1 | 77.9 | 4,862.7 | 303.8 |
| 1988 | 1,680.9 | 210.4 | 2,005.5 | 164.0 | 441.9 | 66.2 | 435.0 | 40.2 | 4,671.4 | 309.5 |
| 1989 | 1,538.3 | 95.9 | 2,111.9 | 181.3 | 510.7 | 58.5 | 477.4 | 48.4 | 4,342.1 | 291.3 |
| 1990 | 1,759.3 | 118.6 | 2,256.6 | 183.3 | 480.9 | 48.2 | 539.3 | 60.3 | 4,293.1 | 264.9 |
| 1991 | 1,716.2 | 104.6 | 1,803.4 | 131.3 | 445.6 | 42.1 | 491.2 | 66.4 | 5,254.9 | 364.9 |
| 1992 | 1,954.4 | 132.1 | 2,098.1 | 161.0 | 595.6 | 69.7 | 481.5 | 97.3 | 4,639.2 | 291.9 |
| 1993 | 2,046.5 | 114.3 | 2,053.4 | 124.2 | 485.4 | 53.1 | 472.1 | 67.6 | 4,080.1 | 249.4 |
| 1994 | 2,912.0 | 141.4 | 2,972.3 | 188.0 | 653.5 | 66.7 | 525.6 | 71.1 | 4,529.0 | 253.6 |
| 1995 | 2,854.9 | 150.3 | 2,757.9 | 177.6 | 888.5 | 90.6 | 770.6 | 92.2 | 4,446.4 | 277.6 |
| 1996 | 3,449.0 | 165.7 | 2,735.9 | 147.5 | 834.2 | 83.1 | 848.5 | 118.3 | 4,217.4 | 234.5 |

Table C.3. Continued.

| | Northern shoveler | | Northern pintail | | Redhead | | Canvasback | | Scaup | |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | $\widehat{N}$ | $\widehat{SE}$ | $\widehat{N}$ | $\widehat{SE}$ | $\widehat{N}$ | $\widehat{SE}$ | $\widehat{N}$ | $\widehat{SE}$ | $\widehat{N}$ | $\widehat{SE}$ |
| 1997 | 4,120.4 | 194.0 | 3,558.0 | 194.2 | 918.3 | 77.2 | 688.8 | 57.2 | 4,112.3 | 224.2 |
| 1998 | 3,183.2 | 156.5 | 2,520.6 | 136.8 | 1,005.1 | 122.9 | 685.9 | 63.8 | 3,471.9 | 191.2 |
| 1999 | 3,889.5 | 202.1 | 3,057.9 | 230.5 | 973.4 | 69.5 | 716.0 | 79.1 | 4,411.7 | 227.9 |
| 2000 | 3,520.7 | 197.9 | 2,907.6 | 170.5 | 926.3 | 78.1 | 706.8 | 81.0 | 4,026.3 | 205.3 |
| 2001 | 3,313.5 | 166.8 | 3,296.0 | 266.6 | 712.0 | 70.2 | 579.8 | 52.7 | 3,694.0 | 214.9 |
| 2002 | 2,318.2 | 125.6 | 1,789.7 | 125.2 | 564.8 | 69.0 | 486.6 | 43.8 | 3,524.1 | 210.3 |
| 2003 | 3,619.6 | 221.4 | 2,558.2 | 174.8 | 636.8 | 56.6 | 557.6 | 48.0 | 3,734.4 | 225.5 |
| 2004 | 2,810.4 | 163.9 | 2,184.6 | 155.2 | 605.3 | 51.5 | 617.2 | 64.6 | 3,807.2 | 202.3 |
| 2005 | 3,591.5 | 178.6 | 2,560.5 | 146.8 | 592.3 | 51.7 | 520.6 | 52.9 | 3,386.9 | 196.4 |
| 2006 | 3,680.2 | 236.5 | 3,386.4 | 198.7 | 916.3 | 86.1 | 691.0 | 69.6 | 3,246.7 | 166.9 |
| 2007 | 4,552.8 | 247.5 | 3,335.3 | 160.4 | 1,009.0 | 84.7 | 864.9 | 86.2 | 3,452.2 | 195.3 |
| 2008 | 3,507.8 | 168.4 | 2,612.8 | 143.0 | 1,056.0 | 120.4 | 488.7 | 45.4 | 3,738.3 | 220.1 |
| 2009 | 4,376.3 | 224.1 | 3,225.0 | 166.9 | 1,044.1 | 106.3 | 662.1 | 57.4 | 4,172.1 | 232.3 |
| 2010 | 4,057.4 | 198.4 | 3,508.6 | 216.4 | 1,064.2 | 99.5 | 585.2 | 50.8 | 4,244.4 | 247.9 |
| 2011 | 4,641.0 | 232.8 | 4,428.6 | 267.9 | 1,356.1 | 128.3 | 691.6 | 46.0 | 4,319.3 | 261.1 |
| 2012 | 5,017.6 | 254.2 | 3,473.1 | 192.4 | 1,269.9 | 99.2 | 759.9 | 68.5 | 5,238.6 | 296.8 |
| 2013 | 4,751.0 | 202.3 | 3,335.0 | 188.4 | 1,202.2 | 90.5 | 787.0 | 57.6 | 4,165.7 | 250.8 |
| 2014 | 5,278.9 | 265.3 | 3,220.3 | 179.7 | 1,278.7 | 102.5 | 685.3 | 50.7 | 4,611.1 | 253.3 |
| 2015 | 4,391.4 | 219.0 | 3,043.0 | 182.5 | 1,195.9 | 92.9 | 757.3 | 63.3 | 4,395.3 | 252.5 |
| 2016 | 3,966.9 | 189.0 | 2,618.5 | 204.2 | 1,288.8 | 115.4 | 736.5 | 68.8 | 4,991.7 | 297.6 |

Table C.4. Total breeding duck[a] estimates for the traditional survey area, in thousands.

| | Traditional Survey Area | |
|---|---|---|
| Year | $\widehat{N}$ | $\widehat{SE}$ |
| 1955 | 39,603.6 | 1,264.0 |
| 1956 | 42,035.2 | 1,177.3 |
| 1957 | 34,197.1 | 1,016.6 |
| 1958 | 36,528.1 | 1,013.6 |
| 1959 | 40,089.9 | 1,103.6 |
| 1960 | 32,080.5 | 876.8 |
| 1961 | 29,829.0 | 1,009.0 |
| 1962 | 25,038.9 | 740.6 |
| 1963 | 27,609.5 | 736.6 |
| 1964 | 27,768.8 | 827.5 |
| 1965 | 25,903.1 | 694.4 |
| 1966 | 30,574.2 | 689.5 |
| 1967 | 32,688.6 | 796.1 |
| 1968 | 28,971.2 | 789.4 |
| 1969 | 33,760.9 | 674.6 |
| 1970 | 39,676.3 | 1,008.1 |
| 1971 | 36,905.1 | 821.8 |
| 1972 | 40,748.0 | 987.1 |
| 1973 | 32,573.9 | 805.3 |
| 1974 | 35,422.5 | 819.5 |
| 1975 | 37,792.8 | 836.2 |
| 1976 | 34,342.3 | 707.8 |
| 1977 | 32,049.0 | 743.8 |
| 1978 | 35,505.6 | 745.4 |
| 1979 | 38,622.0 | 843.4 |
| 1980 | 36,224.4 | 737.9 |
| 1981 | 32,267.3 | 734.9 |
| 1982 | 30,784.0 | 678.8 |
| 1983 | 32,635.2 | 725.8 |
| 1984 | 31,004.9 | 716.5 |
| 1985 | 25,638.3 | 574.9 |
| 1986 | 29,092.8 | 609.3 |
| 1987 | 27,412.1 | 562.1 |
| 1988 | 27,361.7 | 660.8 |
| 1989 | 25,112.8 | 555.4 |
| 1990 | 25,079.2 | 539.9 |
| 1991 | 26,605.6 | 588.7 |
| 1992 | 29,417.9 | 605.6 |
| 1993 | 26,312.4 | 493.9 |
| 1994 | 32,523.5 | 598.2 |
| 1995 | 35,869.6 | 629.4 |
| 1996 | 37,753.0 | 779.6 |

Table C.4. Continued.

| Year | Traditional Survey Area[a] $\widehat{N}$ | $\widehat{SE}$ |
|---|---|---|
| 1997 | 42,556.3 | 718.9 |
| 1998 | 39,081.9 | 652.0 |
| 1999 | 43,435.8 | 733.9 |
| 2000 | 41,838.3 | 740.2 |
| 2001 | 36,177.5 | 633.1 |
| 2002 | 31,181.1 | 547.8 |
| 2003 | 36,225.1 | 664.7 |
| 2004 | 32,164.0 | 579.8 |
| 2005 | 31,734.9 | 555.2 |
| 2006 | 36,160.3 | 614.4 |
| 2007 | 41,172.2 | 724.8 |
| 2008 | 37,276.5 | 638.3 |
| 2009 | 42,004.8 | 701.9 |
| 2010 | 40,893.8 | 718.4 |
| 2011 | 45,554.3 | 766.5 |
| 2012 | 48,575.3 | 796.8 |
| 2013 | 45,607.3 | 749.8 |
| 2014 | 49,152.2 | 831.1 |
| 2015 | 49,521.7 | 812.1 |
| 2016 | 48,362.8 | 827.6 |

[a] Total ducks in the traditional survey area include species in Appendix C.3 plus American black ducks, ring-necked duck, goldeneyes, bufflehead, and ruddy duck.

Table C.5. Breeding population estimates and 90% credibility intervals (in thousands) for the six most abundant species of ducks in the eastern survey area, 1990–2016[a].

| | Mallard | | American black duck | | Green-winged teal | | Ring-necked duck | | Goldeneyes[b] | | Mergansers[c] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year | $\hat{N}$ | 90% CI | $\hat{N}$ | 90% CI | $\hat{N}$ | 90% CI | $\hat{N}$ | 90% CI | $\hat{N}$ | 90% CI | $\hat{N}$ | 90% CI |
| 1990.0 | 308.0 | (199.7, 535.7) | 594.8 | (529.8, 673.6) | 248.1 | (195.0, 326.3) | 519.7 | (411.7, 666.8) | 373.1 | (295.1, 487.0) | 382.3 | (325.8, 454.4) |
| 1991.0 | 355.7 | (232.0, 595.9) | 601.9 | (531.6, 691.7) | 239.5 | (186.8, 317.3) | 459.3 | (368.5, 597.6) | 394.3 | (308.3, 520.9) | 451.8 | (379.3, 538.1) |
| 1992.0 | 349.0 | (220.3, 596.6) | 573.2 | (506.9, 654.7) | 228.4 | (178.8, 307.1) | 472.0 | (374.1, 617.7) | 403.3 | (318.3, 528.2) | 448.6 | (373.6, 548.7) |
| 1993.0 | 355.4 | (230.1, 611.8) | 554.0 | (481.7, 629.4) | 209.6 | (160.1, 279.8) | 440.9 | (344.6, 572.0) | 389.3 | (303.7, 509.6) | 432.1 | (361.1, 522.2) |
| 1994.0 | 368.2 | (234.5, 626.6) | 512.1 | (451.9, 585.4) | 217.1 | (168.6, 291.8) | 435.0 | (339.3, 568.1) | 401.9 | (316.9, 535.4) | 428.9 | (353.8, 533.6) |
| 1995.0 | 305.8 | (196.0, 536.5) | 598.4 | (526.0, 683.1) | 224.5 | (170.7, 304.1) | 450.9 | (355.8, 585.9) | 350.3 | (272.9, 460.8) | 463.2 | (387.0, 563.9) |
| 1996.0 | 336.8 | (221.4, 583.7) | 714.2 | (637.7, 807.3) | 300.7 | (237.6, 398.4) | 573.0 | (452.8, 733.2) | 435.0 | (341.4, 584.2) | 424.9 | (364.0, 504.0) |
| 1997.0 | 359.1 | (233.6, 609.2) | 597.7 | (534.5, 670.4) | 232.0 | (180.2, 307.7) | 511.3 | (407.1, 658.9) | 434.5 | (340.2, 577.2) | 430.7 | (366.8, 516.3) |
| 1998.0 | 397.9 | (261.3, 669.3) | 630.0 | (565.0, 705.6) | 217.9 | (172.1, 287.9) | 446.1 | (356.6, 577.7) | 377.4 | (299.8, 497.1) | 353.3 | (301.2, 417.6) |
| 1999.0 | 408.7 | (268.3, 680.5) | 717.2 | (641.7, 803.0) | 269.0 | (210.8, 360.1) | 524.6 | (422.5, 672.7) | 474.9 | (366.2, 643.5) | 416.9 | (353.1, 493.2) |
| 2000.0 | 372.8 | (245.7, 624.3) | 654.9 | (587.5, 729.3) | 274.4 | (218.7, 350.1) | 559.0 | (445.2, 715.5) | 449.2 | (350.5, 600.7) | 427.0 | (364.9, 506.0) |
| 2001.0 | 397.9 | (260.2, 659.2) | 612.8 | (548.1, 686.4) | 225.1 | (177.8, 296.3) | 501.1 | (401.0, 651.2) | 521.1 | (401.3, 715.4) | 407.2 | (347.3, 478.0) |
| 2002.0 | 390.9 | (258.3, 652.3) | 705.2 | (630.7, 792.7) | 269.1 | (211.4, 363.2) | 505.3 | (399.0, 659.8) | 594.2 | (443.6, 848.0) | 558.0 | (474.2, 666.9) |
| 2003.0 | 407.3 | (266.2, 677.9) | 646.1 | (580.1, 728.6) | 268.8 | (210.5, 355.7) | 519.0 | (415.3, 669.0) | 435.3 | (341.9, 585.7) | 477.0 | (405.7, 569.5) |
| 2004.0 | 428.0 | (285.0, 697.7) | 646.0 | (576.1, 724.0) | 310.8 | (243.8, 414.3) | 561.1 | (450.4, 717.0) | 431.0 | (340.6, 565.9) | 510.1 | (435.7, 602.3) |
| 2005.0 | 415.3 | (271.3, 698.6) | 617.9 | (551.6, 696.5) | 244.7 | (190.8, 323.3) | 528.1 | (428.3, 673.4) | 387.7 | (307.8, 507.0) | 473.7 | (405.5, 562.4) |
| 2006.0 | 387.1 | (259.3, 643.3) | 633.1 | (567.8, 711.9) | 248.3 | (196.3, 328.5) | 543.6 | (435.0, 698.2) | 384.2 | (306.1, 500.4) | 430.7 | (367.7, 506.6) |
| 2007.0 | 435.9 | (285.1, 712.1) | 739.0 | (656.7, 832.5) | 278.8 | (220.5, 361.4) | 672.1 | (532.1, 853.6) | 469.8 | (363.8, 634.3) | 457.7 | (390.2, 543.1) |
| 2008.0 | 431.0 | (287.4, 715.4) | 638.7 | (571.9, 714.1) | 302.3 | (227.7, 426.0) | 545.8 | (436.1, 697.2) | 446.3 | (349.6, 597.6) | 435.2 | (372.8, 517.3) |
| 2009.0 | 449.2 | (295.6, 736.0) | 597.1 | (533.4, 671.7) | 297.9 | (232.1, 405.3) | 535.5 | (429.0, 682.7) | 405.9 | (318.0, 535.2) | 461.5 | (390.9, 549.1) |
| 2010.0 | 365.6 | (240.2, 608.6) | 562.3 | (506.4, 632.3) | 276.5 | (218.1, 370.1) | 545.9 | (439.8, 688.1) | 400.1 | (309.9, 533.7) | 381.0 | (325.7, 451.2) |
| 2011.0 | 418.4 | (271.9, 681.4) | 542.8 | (487.6, 608.1) | 247.2 | (194.5, 327.9) | 520.0 | (414.3, 668.7) | 405.6 | (320.1, 536.7) | 400.8 | (341.6, 477.6) |
| 2012.0 | 397.5 | (263.1, 663.3) | 602.8 | (537.5, 676.1) | 254.3 | (200.6, 331.4) | 519.9 | (414.2, 663.8) | 397.8 | (314.7, 518.5) | 420.1 | (356.3, 496.4) |
| 2013.0 | 489.6 | (318.8, 812.7) | 625.8 | (562.6, 699.8) | 286.8 | (224.5, 371.3) | 633.3 | (495.6, 831.1) | 460.0 | (363.5, 614.5) | 461.7 | (394.1, 544.8) |
| 2014.0 | 430.2 | (282.5, 704.9) | 613.3 | (548.4, 688.5) | 226.4 | (177.6, 298.3) | 497.5 | (396.7, 638.5) | 384.8 | (299.5, 538.7) | 414.4 | (351.1, 486.4) |
| 2015.0 | 398.7 | (266.4, 664.8) | 542.1 | (484.0, 612.9) | 219.1 | (170.1, 290.8) | 511.5 | (403.2, 663.9) | 354.3 | (278.3, 468.1) | 406.9 | (346.4, 483.0) |
| 2016.0 | 408.8 | (268.6, 674.0) | 612.2 | (543.9, 698.3) | 222.2 | (173.3, 299.2) | 577.9 | (460.7, 736.6) | 362.8 | (284.7, 476.5) | 439.0 | (373.8, 520.8) |

[a] Estimates for mallards, American black ducks, green-winged teal, ring-necked ducks, goldeneyes, and mergansers from Bayesian hierarchical analysis using FWS and CWS data from strata 51, 52, 63, 64, 66–68, 70–72.

[b] Common and Barrow's.

[c] Common, red-breasted, and hooded.

## D. Historical estimates of goose and swan populations

Table D.1. Abundance indices (in thousands) for North American Canada goose populations, 1969–2016.

| Year | North Atlantic[a,b] | Atlantic[a,b] | Atlantic Flyway Resident[a] | Pacific[a] | Lesser[a] | Miss. Flyway Giant[a] | Taverner's[a] |
|---|---|---|---|---|---|---|---|
| 1969/70 | | | | | 12.7 | | |
| 1970/71 | | | | | 8.2 | | |
| 1971/72 | | | | | 3.4 | | |
| 1972/73 | | | | | 6.4 | | |
| 1973/74 | | | | | 21.2 | | |
| 1974/75 | | | | | 6.9 | | |
| 1975/76 | | | | | 3.0 | | |
| 1976/77 | | | | | 4.7 | | |
| 1977/78 | | | | | 6.9 | | |
| 1978/79 | | | | | 6.5 | | |
| 1979/80 | | | | | 12.9 | | |
| 1980/81 | | | | | 18.4 | | |
| 1981/82 | | | | | 16.0 | | |
| 1982/83 | | | | | 3.4 | | |
| 1983/84 | | | | | 13.8 | | |
| 1984/85 | | | | | 9.6 | | |
| 1985/86 | | | | | 6.7 | | 66.2 |
| 1986/87 | | | | | 4.6 | | 47.8 |
| 1987/88 | | 118.2 | | | 6.8 | | 50.2 |
| 1988/89 | | | | | 7.1 | | 48.3 |
| 1989/90 | 45.9 | | | | 11.7 | | 53.4 |
| 1990/91 | 46.5 | | | | 4.3 | | 76.9 |
| 1991/92 | 44.2 | | | | 9.1 | | 76.4 |
| 1992/93 | 49.9 | 93.0 | | | 5.9 | 779.4 | 49.3 |
| 1993/94 | 48.3 | 43.2 | | | 16.7 | 909.4 | 56.7 |
| 1994/95 | 46.6 | 34.0 | | | 9.6 | 941.6 | 49.5 |
| 1995/96 | 59.7 | 51.5 | | | 7.7 | 1,037.3 | 66.6 |
| 1996/97 | 54.7 | 72.1 | | 104.3 | 5.0 | 957.0 | 61.3 |
| 1997/98 | 50.0 | 48.6 | | 109.2 | 5.7 | 1,140.5 | 57.2 |
| 1998/99 | 61.5 | 83.7 | | 181.9 | 5.7 | 1,163.3 | 65.7 |
| 1999/00 | 51.2 | 95.8 | | 174.1 | 9.3 | 1,436.7 | 53.8 |
| 2000/01 | 50.7 | 135.2 | | 129.2 | 6.1 | 1,296.3 | 56.7 |
| 2001/02 | 51.6 | 182.4 | | 137.2 | 4.9 | 1,415.2 | 39.8 |
| 2002/03 | 49.1 | 174.9 | 1,126.7 | 146.1 | 6.3 | 1,416.3 | 54.2 |
| 2003/04 | 53.9 | 191.8 | 1,073.1 | 119.3 | 6.3 | 1,430.4 | 44.5 |
| 2004/05 | 47.1 | 175.7 | 1,167.1 | 94.3 | 4.8 | 1,367.0 | 45.5 |
| 2005/06 | 47.3 | 186.1 | 1,144.0 | 155.6 | 4.2 | 1,575.2 | 45.8 |
| 2006/07 | 54.1 | 207.3 | 1,128.0 | 180.5 | 9.5 | 1,454.7 | 58.0 |
| 2007/08 | 48.2 | 174.0 | 1,024.9 | 283.8 | 10.3 | 1,461.7 | 53.1 |
| 2008/09 | 50.5 | 186.8 | 1,006.1 | 164.1 | 6.4 | 1,448.3 | 50.5 |

**Table D.1.** Continued.

| Year | North Atlantic[a,b] | Atlantic[a,b] | Atlantic Flyway Resident[a] | Pacific[a] | Lesser[a] | Miss. Flyway Giant[a] | Taverner's[a] |
|---|---|---|---|---|---|---|---|
| 2009/10 | 49.3 | 165.1 | 977.1 | 180.4 | 6.8 | 1,638.0 | 58.2 |
| 2010/11 | 52.2 | 216.0 | 1,015.1 | 200.8 | 3.6 | 1,670.3 | 37.1 |
| 2011/12 | 52.3 | 190.3 | 879.8 | 218.8 | 3.8 | 1,766.2 | 47.4 |
| 2012/13 | 53.3 | | 951.9 | 221.3 | 4.1 | 1,600.7 | 27.7 |
| 2013/14 | 56.6 | 191.2 | 1,084.9 | 163.0 | 2.3 | 1,461.0 | 43.8 |
| 2014/15 | 51.9 | 161.3 | 963.8 | 255.3 | 4.0 | 1,620.4 | 35.4 |
| 2015/16 | 50.3 | 191.5 | 950.0 | 246.9 | 6.6 | 1,528.8 | 48.4 |

[a] Surveys conducted in spring.
[b] Number of breeding pairs.
[c] Surveys conducted in January.
[d] Fall-winter indices.

Table D.1. Continued.

| Year | W. Prairie & Great Plains[c] | Central Flyway Arctic Nesting[c] | Hi-line[a] | Rocky Mountain[a] | Dusky | Cackling[d] | Aleutian[d] |
|---|---|---|---|---|---|---|---|
| 1969/70 | 92.1 | 139.6 | 58.8 | | | | |
| 1970/71 | 132.4 | 281.9 | 99.6 | 43.8 | | | |
| 1971/72 | 101.0 | 321.9 | 53.0 | 30.4 | | | |
| 1972/73 | 86.6 | 407.8 | 30.1 | 34.4 | | | |
| 1973/74 | 81.1 | 310.1 | 33.9 | 38.3 | | | |
| 1974/75 | 82.2 | 257.2 | 29.1 | 38.2 | | | 0.8 |
| 1975/76 | 115.5 | 446.2 | 40.5 | 25.4 | | | 0.9 |
| 1976/77 | 106.1 | 446.4 | 40.9 | 25.2 | | | 1.3 |
| 1977/78 | 239.1 | 335.9 | 39.8 | 37.2 | | | 1.5 |
| 1978/79 | 191.9 | 342.2 | 50.5 | 52.8 | | | 1.6 |
| 1979/80 | 170.9 | 362.8 | 51.2 | 31.0 | | | 1.7 |
| 1980/81 | 208.8 | 398.8 | 51.0 | 54.0 | | | 2.0 |
| 1981/82 | 193.1 | 438.3 | 54.5 | 58.8 | | | 2.7 |
| 1982/83 | 249.2 | 317.6 | 74.1 | 42.1 | | | 3.5 |
| 1983/84 | 229.1 | 408.3 | 105.8 | 41.7 | | | 3.8 |
| 1984/85 | 255.1 | 386.1 | 92.3 | 43.9 | | 47.8 | 4.2 |
| 1985/86 | 282.9 | 379.2 | 101.8 | 62.1 | 16.8 | 46.2 | 4.3 |
| 1986/87 | 298.8 | 356.5 | 95.4 | 62.2 | 15.5 | 68.2 | 5.0 |
| 1987/88 | 392.4 | 463.7 | 131.3 | 98.2 | 15.7 | 83.7 | 5.4 |
| 1988/89 | 474.6 | 511.2 | 124.8 | 88.1 | 17.1 | 87.2 | 5.8 |
| 1989/90 | 437.4 | 523.9 | 185.8 | 83.9 | 16.0 | 108.7 | 6.3 |
| 1990/91 | 414.0 | 827.7 | 148.3 | 78.5 | 10.7 | 98.7 | 7.0 |
| 1991/92 | 398.8 | 839.2 | 168.0 | 94.4 | 17.6 | 151.8 | 7.7 |
| 1992/93 | 430.2 | 509.2 | 158.0 | 107.7 | 16.4 | 156.6 | 11.7 |
| 1993/94 | 463.7 | 549.6 | 160.9 | 131.1 | 16.2 | 222.6 | 15.7 |
| 1994/95 | 529.7 | 729.8 | 234.6 | 141.7 | 12.0 | 239.2 | 19.2 |
| 1995/96 | 538.9 | 685.1 | 200.5 | 139.4 | 11.8 | 255.3 | 15.4 |
| 1996/97 | 634.7 | 679.1 | 208.0 | 96.6 | 13.3 | 301.3 | 20.4 |
| 1997/98 | 753.2 | 674.8 | 257.7 | 139.2 | 14.3 | 221.1 | 32.4 |
| 1998/99 | 792.2 | 951.4 | 204.5 | 157.3 | 10.3 | 247.0 | 35.5 |
| 1999/00 | 847.1 | 495.0 | 287.7 | 173.4 | 10.1 | 256.7 | 34.2 |
| 2000/01 | 862.9 | 313.2 | 261.9 | 170.1 | 11.0 | 258.8 | |
| 2001/02 | 806.9 | 665.6 | 239.0 | 143.3 | 12.2 | 171.8 | |
| 2002/03 | 953.3 | 768.5 | 239.1 | 141.7 | 9.7 | 239.1 | 72.8 |
| 2003/04 | 915.0 | 662.3 | 208.4 | 159.2 | 11.0 | 175.9 | 108.5 |
| 2004/05 | 931.2 | 578.0 | 245.4 | 160.1 | 15.9 | 224.1 | 87.1 |
| 2005/06 | 948.6 | 734.5 | 217.6 | 139.3 | 11.9 | 246.4 | 100.0 |
| 2006/07 | 1,175.8 | 870.8 | 309.5 | 145.1 | 10.1 | 253.8 | 107.4 |
| 2007/08 | 1,160.6 | 615.1 | 348.2 | 212.8 | 9.0 | 289.8 | 111.0 |
| 2008/09 | 1,280.5 | 531.5 | 306.7 | 124.7 | 6.6 | 230.8 | 83.6 |

Table D.1. Continued.

| Year | W. Prairie & Great Plains[c] | Central Flyway Arctic Nesting[c] | Hi-line[a] | Rocky Mountain[a] | Dusky | Cackling[d] | Aleutian[d] |
|---|---|---|---|---|---|---|---|
| 2009/10 | 1,289.0 | 707.8 | 277.6 | 144.1 | 9.4 | 281.3 | 107.4 |
| 2010/11 | 1,596.3 | 737.7 | 274.0 | 104.9 | 11.6 | 184.1 | 101.4 |
| 2011/12 | 1,800.5 | 743.6 | 494.4 | 143.4 | 13.5 | 206.7 | 132.5 |
| 2012/13 | 1,551.5 | 519.5 | 338.9 | 159.1 | | 319.0 | 161.1 |
| 2013/14 | 1,381.2 | 567.3 | 288.2 | 116.7 | 15.4 | 287.4 | 147.6 |
| 2014/15 | 1,483.7 | 828.1 | 378.5 | 169.8 | 17.7 | 347.1 | 189.0 |
| 2015/16 | 1,851.6 | 625.2 | 463.9 | | 13.2 | 327.5 | 156.0 |

[a] Surveys conducted in spring.
[b] Number of breeding pairs
[c] Surveys conducted in January.
[d] Fall-winter indices.

Table D.2. Abundance indices for snow, Ross's, white-fronted, and emperor goose populations, 1969–2016.

| | Snow and Ross's geese | | | | White-fronted geese | | |
|---|---|---|---|---|---|---|---|
| Year | Greater snow geese[a] | Mid-continent[b] | Western Central Flyway[b] | Western Arctic & Wrangel Isl.[b] | Mid-continent[b] | Pacific[b] | Emperor geese[b] |
| 1969/70 | 89.6 | 777.0 | 6.9 | | | | |
| 1970/71 | 123.3 | 1,070.2 | 11.1 | | | | |
| 1971/72 | 134.8 | 1,313.4 | 13.0 | | | | |
| 1972/73 | 143.0 | 1,025.3 | 11.6 | | | | |
| 1973/74 | 165.0 | 1,189.8 | 16.2 | | | | |
| 1974/75 | 153.8 | 1,096.6 | 26.4 | | | | |
| 1975/76 | 165.6 | 1,562.4 | 23.2 | | | | |
| 1976/77 | 160.0 | 1,150.3 | 33.6 | | | | |
| 1977/78 | 192.6 | 1,966.4 | 31.1 | | | | |
| 1978/79 | 170.1 | 1,285.7 | 28.2 | | | | |
| 1979/80 | 180.0 | 1,398.1 | 30.4 | 528.1 | | | |
| 1980/81 | 170.8 | 1,406.7 | 37.6 | 204.2 | | | 93.3 |
| 1981/82 | 163.0 | 1,794.1 | 50.0 | 759.9 | | | 100.6 |
| 1982/83 | 185.0 | 1,755.5 | 76.1 | 354.1 | | | 79.2 |
| 1983/84 | 225.4 | 1,494.5 | 43.0 | 547.6 | | | 71.2 |
| 1984/85 | 260.0 | 1,973.0 | 62.9 | 466.3 | | 163.2 | 58.8 |
| 1985/86 | 303.5 | 1,449.4 | 96.6 | 549.8 | | 141.9 | 42.0 |
| 1986/87 | 255.0 | 1,913.8 | 63.5 | 521.7 | | 140.0 | 51.7 |
| 1987/88 | 363.8 | 1,750.7 | 46.2 | 525.3 | | 186.7 | 53.8 |
| 1988/89 | 363.2 | 1,956.2 | 67.6 | 441.0 | | 198.1 | 45.8 |
| 1989/90 | 368.3 | 1,724.3 | 38.7 | 463.9 | | 220.0 | 67.6 |
| 1990/91 | 352.6 | 2,135.8 | 104.6 | 708.5 | | 196.5 | 71.0 |
| 1991/92 | 448.1 | 2,021.9 | 87.9 | 690.1 | | 218.8 | 71.3 |
| 1992/93 | 498.4 | 1,744.1 | 45.1 | 639.3 | 622.9 | 234.1 | 52.5 |
| 1993/94 | 591.4 | 2,200.8 | 84.9 | 569.2 | 676.3 | 258.9 | 57.3 |
| 1994/95 | 616.6 | 2,725.1 | 80.1 | 478.2 | 727.3 | 302.2 | 51.2 |
| 1995/96 | 669.1 | 2,398.1 | 93.1 | 501.9 | 1,129.4 | 374.6 | 80.3 |
| 1996/97 | 657.5 | 2,957.7 | 127.2 | 366.3 | 742.5 | 370.5 | 57.1 |
| 1997/98 | 836.6 | 3,022.2 | 103.5 | 416.4 | 622.2 | 388.0 | 39.7 |
| 1998/99 | 1,008.0 | 2,575.7 | 236.4 | 354.3 | 1,058.3 | 393.4 | 56.4 |
| 1999/00 | 816.5 | 2,397.3 | 137.5 | 579.0 | 963.1 | 352.7 | 62.6 |
| 2000/01 | 837.4 | 2,341.3 | 105.8 | 656.8 | 1,067.6 | 438.9 | 84.4 |
| 2001/02 | 725.0 | 2,696.1 | 99.9 | 448.1 | 712.3 | 359.7 | 58.7 |
| 2002/03 | 721.0 | 2,435.0 | 105.9 | 596.9 | 680.2 | 422.0 | 71.2 |
| 2003/04 | 890.0 | 2,214.3 | 135.4 | 587.8 | 528.2 | 374.9 | 47.4 |
| 2004/05 | 880.0 | 2,344.2 | 143.0 | 750.3 | 644.3 | 443.9 | 54.0 |
| 2005/06 | 938.0 | 2,221.7 | 140.6 | 710.7 | 522.8 | 509.3 | 76.0 |
| 2006/07 | 838.0 | 2,917.1 | 170.6 | 799.7 | 751.3 | 604.7 | 77.5 |
| 2007/08 | 718.0 | 2,455.1 | 188.5 | 1,073.5 | 764.3 | 627.0 | 64.9 |
| 2008/09 | 1,009.0 | 2,753.4 | 284.4 | 957.4 | 751.7 | 536.7 | 91.9 |
| 2009/10 | 824.0 | 2,657.5 | 238.1 | 901.0 | 583.2 | 649.8 | 64.6 |
| 2010/11 | 917.0 | 3,175.2 | 196.0 | 863.8 | 709.8 | 604.3 | 74.2 |
| 2011/12 | 1,005.0 | 4,021.2 | 205.3 | 1,097.9 | 681.7 | 664.2 | 67.6 |
| 2012/13 | 921.0 | 4,614.0 | 225.9 | 881.4 | 777.9 | 579.9 | |
| 2013/14 | 796.0 | 3,814.7 | 264.8 | 1,351.2 | | 637.2 | 79.9 |
| 2014/15 | 818.0 | 3,284.1 | 243.3 | 1,180.7 | 1,005.6 | 479.1 | 98.2 |
| 2015/16 | 915.0 | 3,452.6 | 236.3 | | 977.1 | 685.5 | 79.3 |

[a] Surveys conducted in spring.
[b] Fall-winter indices

Table D.3. Abundance indices of North American brant and swan populations from January surveys, 1969–2016.

| Year | Brant | | Tundra swans | |
|---|---|---|---|---|
| | Atlantic | Pacific[a] | Western | Eastern |
| 1969/70 | 106.5 | 141.7 | 31.0 | |
| 1970/71 | 151.0 | 149.2 | 98.8 | |
| 1971/72 | 73.3 | 124.8 | 82.8 | |
| 1972/73 | 40.8 | 125.0 | 33.9 | |
| 1973/74 | 88.1 | 130.7 | 69.7 | |
| 1974/75 | 88.4 | 123.4 | 54.3 | |
| 1975/76 | 127.0 | 122.0 | 51.4 | |
| 1976/77 | 73.8 | 147.0 | 47.3 | |
| 1977/78 | 46.7 | 162.9 | 45.6 | |
| 1978/79 | 42.0 | 129.4 | 53.5 | |
| 1979/80 | 59.2 | 146.4 | 65.2 | |
| 1980/81 | 97.0 | 197.5 | 83.6 | |
| 1981/82 | 104.5 | 121.0 | 91.3 | 73.2 |
| 1982/83 | 123.5 | 109.3 | 67.3 | 87.5 |
| 1983/84 | 127.3 | 135.0 | 61.9 | 81.4 |
| 1984/85 | 146.3 | 145.1 | 48.8 | 96.9 |
| 1985/86 | 110.4 | 134.2 | 66.2 | 90.9 |
| 1986/87 | 109.4 | 110.9 | 52.8 | 95.8 |
| 1987/88 | 131.2 | 145.0 | 59.2 | 78.7 |
| 1988/89 | 137.9 | 135.6 | 78.7 | 91.3 |
| 1989/90 | 135.4 | 151.7 | 40.1 | 90.6 |
| 1990/91 | 147.7 | 132.7 | 47.6 | 98.2 |
| 1991/92 | 184.8 | 117.8 | 63.7 | 113.0 |
| 1992/93 | 100.6 | 125.0 | 62.2 | 78.2 |
| 1993/94 | 157.2 | 129.3 | 79.4 | 84.8 |
| 1994/95 | 148.2 | 133.5 | 52.9 | 85.1 |
| 1995/96 | 105.9 | 128.0 | 98.1 | 79.5 |
| 1996/97 | 129.1 | 155.3 | 122.5 | 92.4 |
| 1997/98 | 138.0 | 138.8 | 70.5 | 100.6 |
| 1998/99 | 171.6 | 132.3 | 119.8 | 111.0 |
| 1999/00 | 157.2 | 135.6 | 89.6 | 115.3 |
| 2000/01 | 145.3 | 126.0 | 87.3 | 98.4 |
| 2001/02 | 181.6 | 138.2 | 58.7 | 114.7 |
| 2002/03 | 164.5 | 106.1 | 102.7 | 111.7 |
| 2003/04 | 129.6 | 121.3 | 83.0 | 110.8 |
| 2004/05 | 123.2 | 107.2 | 92.1 | 72.5 |
| 2005/06 | 146.6 | 141.0 | 106.9 | 81.3 |
| 2006/07 | 150.6 | 130.6 | 109.4 | 114.4 |
| 2007/08 | 161.6 | 157.0 | 89.7 | 96.2 |
| 2008/09 | 151.3 | | 105.2 | 100.2 |
| 2009/10 | 138.4 | 163.5 | 76.7 | 97.3 |
| 2010/11 | 158.9 | 165.0 | 49.3 | 97.7 |
| 2011/12 | 149.2 | 177.3 | 117.2 | 111.7 |
| 2012/13 | 111.8 | 163.3 | 75.3 | 107.1 |
| 2013/14 | 132.9 | 173.3 | 68.2 | 105.0 |
| 2014/15 | 111.4 | 136.5 | 56.3 | 117.1 |
| 2015/16 | 157.9 | 140.0 | 68.2 | 113.6 |

[a] Beginning in 1986, counts of Pacific brant in Alaska were included with the Pacific flyway.

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