7-23-2009

Waterfowl Population Status, 2009

Kathy Fleming
U.S. Fish and Wildlife Service, Kathy_Fleming@fws.gov

Timothy J. Moser
U.S. Fish and Wildlife Service, tim_moser@fws.gov

Pamela R. Garrettson
U.S. Fish and Wildlife Service, Pam_Garrettson@fws.gov

Walt Rhodes
U.S. Fish and Wildlife Service, Walt_Rhodes@fws.gov

Nathan Zimpfer
U.S. Fish and Wildlife Service, Nathan_Zimpfer@fws.gov

U.S. Fish and Wildlife Service

Waterfowl

Population Status, 2009

Waterfowl Population Status, 2009

July 23, 2009

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 (FWS), 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 2009-2010 hunting season.

Cover: 2009-2010 Duck stamp. Long-tailed duck by Joshua Spies, winner of the 2008 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.

Authors: This report was prepared by the U.S. Fish and Wildlife Service, Division of Migratory Bird Management, Population and Habitat Assessment Branch. The principal authors were Kathy Fleming, Timothy Moser, Pamela Garrettson, Walt Rhodes, and Nathan Zimpfer. The authors compiled information from the numerous sources to provide an assessment of the status of waterfowl populations.

Report Preparation: 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. Ray Bentley, John Bidwell, Dale Caswell, Carl Ferguson, Elizabeth Huggins, Mark Koneff, Ed Mallek, Dan Nieman, Fred Roetker, John Solberg, Phil Thorpe, Jim Bredy, John Rayfield, Walt Rhodes, Terry Liddick, and James Wortham provided habitat narratives, reviewed portions of the report that addressed major breeding areas, and provided helpful comments. Rebecca Rau, Tom Cooper, and Phil Thorpe provided helpful comments on earlier drafts. Kathy Fleming provided the survey area map, and the colorized revisions to the goose and swan range maps.

This report should be cited as: U.S. Fish and Wildlife Service. 2009. Waterfowl population status, 2009. U.S. Department of the Interior, Washington, D.C. USA.

All Division of Migratory Bird Management reports are available from our Web site (http://www.fws.gov/migratorybirds/).

Table of Contents

List of Tables

List of Figures

1 Status of Ducks

Abstract: In the traditional survey area, which includes strata 1–18, 20–50, and 75–77, the total duck population estimate was 42.0 ± 0.7 [SE] million birds. This estimate represents a 13% increase over last year's estimate of 37.3 ± 0.6 million birds and was 25% above the long-term average (1955–2008). Estimated mallard (*Anas platyrhynchos*) abundance was 8.5 ± 0.2 million birds, which was a 10% increase over last year's estimate of 7.7 ± 0.3 million birds and 13% above the long-term average. Estimated abundance of gadwall (*A. strepera*; 3.1 ± 0.2 million) was similar to the 2008 estimate and 73% above the long-term average. Estimated American wigeon abundance (*A. americana*; 2.5 ± 0.1 million) was similar to 2008 and the long-term average. Estimated abundances of green-winged teal (*A. crecca*; 3.4 ± 0.2 million) and blue-winged teal (*A. discors*; 7.4 ± 0.4 million) were similar to last year's estimates and well above their long-term averages (+79% and +60%, respectively). Northern shovelers (*A. clypeata*; 4.4 ± 0.2 million) were 25% above the 2008 estimate and remain well above their long-term average (+92%). The estimate for northern pintails (*A. acuta*) was 3.2 ± 0.2 million, which was 23% above the 2008 estimate of 2.6 ± 0.1 million, and 20% below the long-term average. Estimated abundance of redheads (*Aythya americana*; 1.0 ± 0.1 million) was similar to last year and 62% above the long-term average. The canvasback estimate (*A. valisineria*; 0.7 ± 0.06 million) was 35% above the 2008 estimate (0.5 ± 0.05 million) and similar to the long-term average. The scaup estimate (*A. affinis* and *A. marila* combined; 4.2 ± 0.2 million) was similar to that of 2008 and 18% below the long-term average of 5.1 ± 0.05 million. Habitat conditions during the 2009 Waterfowl Breeding Population and Habitat Survey were characterized by above-average moisture across the southern portions of the traditional survey area, good habitat in the eastern survey area, and late spring conditions across northern survey areas. The total pond estimate (prairie Canada and U.S. combined) was 6.4 ± 0.2 million. This was 45% above last year's estimate of 4.4 ± 0.2 million ponds and 31% above the long-term average of 4.9 ± 0.03 million ponds. The 2009 estimate of ponds in prairie Canada was 3.6 ± 0.1 million. This was a 17% increase from last year's estimate (3.1 ± 0.1 million) and was similar to the long-term average (3.4 ± 0.03 million). The 2009 pond estimate for the northcentral U.S. of 2.9 ± 0.1 million was 108% above last year's estimate (1.4 ± 0.07 million) and 87% above the long-term average (1.5 ± 0.02 million). The projected mallard fall-flight index was 10.3 ± 0.9 million. The eastern survey area was restratified in 2005 and is now composed of strata 51–72. Estimates of mallards, scaup, scoters (black [*Melanitta nigra*], white-winged [*M. fusca*], and surf [*M. perspicillata*]), green-winged teal, American wigeon, bufflehead (*Bucephala albeola*), American black duck (*Anas rubripes*), ring-necked duck (*Aythya collaris*), mergansers (red-breasted [*Mergus serrator*], common [*M. merganser*], and hooded [*Lophodytes cucullatus*]), and goldeneye (common [*B. clangula*] and Barrow's [*B. islandica*]) were all similar to their 2008 estimates and long-term averages.

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 the databases resulting from surveys which include estimates of the size of breeding populations, production, 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 breed-

ing 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.1). The eastern survey area (strata 51–72) 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.1).

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 portion 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, portions of the eastern survey area have been surveyed since 1990. In the traditional survey area, 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 level 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 eastern Canada and the northeast U.S., similar to those in the midcontinent, in order 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 population sizes for eastern North America (strata 51–72) are estimated using a hierarchical-modeling approach that combines USFWS and CWS data. For strata containing both CWS and USFWS surveys (51, 52, 63, 64, 66–68, and 70), USFWS estimates were adjusted for visibility by CWS plot estimates, and then averaged to derive stratum-level estimates. In strata with only USFWS survey estimates (53, 54, 56–59, 62, 65, and 69), traditional visibility-correction factors were used. No visibility adjustments were made for strata with only CWS plots (71 and 72). In cases where the USFWS has traditionally not recorded observations to the species level (i.e., scoters, mergansers, scaup, and goldeneyes), estimates were produced for multi-species groupings from 2007 forward. While estimates were generated for all strata in the eastern survey area, survey-wide composite estimates 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 fixed-wing 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 population size were constructed using a hierarchical model (Link and Sauer 2002). The model 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 to the area of each stratum to produce a stratum/year/method-specific population estimate. Estimates for the airplane surveys were adjusted for visibility bias by multiplying them

by the total CWS helicopter survey population estimates for all years divided by the total USFWS fixed-wing survey population estimates for all years. The composite estimate was calculated as the average of the CWS estimate and adjusted USFWS estimate to provide estimated total indicated birds for each stratum and year. 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. Even this modified modeling approach was not adequate for species that occur at lower densities and are more patchily distributed in the eastern survey area (scaup, scoters, bufflehead, and American wigeon). Estimates for these species were the means of CWS and visibility-adjusted USFWS survey averages weighted by their precision, such that more precise estimates were given higher weights. We will continue to investigate methods that will allow us to estimate populations of these rarer species within the 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 drakes. For this index, observed black duck pairs are scaled by 1.5 rather than the 1.0 scaling traditionally applied by the USFWS. However, in this report, estimates for American black ducks and other species are based on total indicated birds, an index estimated using the conventional scaling factor applied by the USFWS.

This model-based approach and changes in analytical procedures for some species may preclude comparisons of results from 2008-forward to those in previous reports. We anticipate additional refinements to the survey design and analysis for eastern North America during the coming years, and composite estimates are subject to change in the future.

Waterfowl Production and Habitat Survey

Since 2004, we have had no traditional Waterfowl Production and Habitat Survey (conducted in July) to verify the early predictions of our biologists in the field. The production survey was discontinued due to budget constraints within the migratory bird program and because modern analytical procedures reduced the utility of brood indices produced by the survey. In this report we present habitat conditions as recorded during the months of May and June at the time of the Waterfowl Breeding Population and Habitat Survey.

Total Duck Species Composition

In the traditional survey area, our estimate of total ducks excludes scoters, eiders (*Somateria* and *Polysticta* spp.), long-tailed ducks (*Clangula hyemalis*), mergansers, and wood ducks (*Aix sponsa*), because the traditional survey area does not include a large portion of their breeding ranges.

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, as of 2008, the status of western mallards will be 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. Otherwise, the fall-flight index remains unchanged; it 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 2009).

Review of Estimation Procedures

Since the inception of the Waterfowl Breeding Population and Habitat Survey in 1955, there have been continual modifications to the conduct of the survey and analysis of the data, but the last comprehensive review was completed over 10 years ago (Smith 1995). During this time new analytical approaches, personnel, and equipment were put in place. In addition, environmental conditions and management needs have changed. Therefore, the USFWS has initiated a review of operational and analytical procedures. As a first step, we plan to address several estimation procedures. First, we are in the process of updating spatial coverages and recalculating stratum areas. Second, we are responding to a recent publication by Fieberg and Giudice (2008), which identified an error in the computer programs historically used to calculate standard errors for aggregate estimates. These improvements, along with results from related investigations into our methods of variance estimation, visibility correction, and population change detection, will entail some modification to the existing time series, so that new methods do not affect evaluation of long-term trends. We intend to implement improvements to our estimation procedures, and estimates presented in future reports will reflect updates made as a result of this review. In an effort to streamline and facilitate the regulations cycle and to expedite data requests from cooperators, we are also in the process of updating current data collection, storage, and access procedures.

Results and Discussion

2008 in Review

Habitat conditions during the 2008 Waterfowl Breeding Population and Habitat Survey were characterized in many areas by a delayed spring in comparison with several preceding years. Drought in parts of the traditional survey area contrasted sharply with record amounts of snow and rainfall in the eastern survey area. The total pond estimate (prairie Canada and U.S. combined) was 4.4 ± 0.2 million. This was 37% below the 2007 estimate of 7.0 ± 0.3 million ponds and 10% below the long-term average of 4.9 ± 0.03 million ponds. The 2008 estimate of ponds in prairie Canada was 3.1 ± 0.1 million. This was a 39% decrease from the 2007 estimate (5.0 ± 0.3 million), and 11% below the 1961–2007 average (3.4 ± 0.03 million). The parklands were drier in 2008 than in 2007, when excess water created much additional waterfowl habitat; still this area was classified as fair to good overall with most seasonal and semi-permanent wetlands full. A late April snowstorm recharged wetlands in some areas of the northern parklands; these were classified as excellent.

The U.S. prairies experienced drought conditions in the spring of 2008 and many semi-permanent wetlands and livestock dugouts were dry. At the time of the survey, habitat in this area was considered fair to poor; exceptions were regions with temporary and seasonal water in southeastern South Dakota, and areas of western South Dakota that received abundant rain and snowfall in early May. Habitat conditions in these locations were considered good. The 2008 pond estimate for the northcentral U.S. (1.4 ± 0.07 million) was 30% below the 2007 estimate (2.0 ± 0.1 million) and 11% below the long-term average (1974–2007; 1.5 ± 0.02 million). Following the completion of the survey the Dakotas and neighboring areas experienced several heavy rainfall events. This eased drought conditions somewhat and may have improved habitat conditions for late-nesting waterfowl and increased the success rate of renesting attempts.

In the bush regions of the traditional survey area (Alaska, Yukon, Northwest Territories, northern Manitoba, northern Saskatchewan, and western Ontario) spring breakup was later in 2008 than in previous years. Locally variable snowfall and, consequently, variable runoff, resulted in habitat conditions that ranged from fair in the east to good in the west. Most large lakes were still frozen on May 20 in the Northwest Territories; however, warmer temperatures in late

May led to habitat conditions suitable for nesting during the survey period. Good conditions were present throughout Alaska, with slightly late spring conditions in some coastal areas.

The boreal forest of the eastern survey area was generally in good condition in the spring of 2008, although in most areas spring was delayed by 1–2 weeks relative to the early springs of preceding years. Most of the eastern survey area experienced record or near-record winter snowfall and spring precipitation accompanied by average to below-average temperatures. These conditions caused extensive flooding in some parts of Maine and the Maritimes and likely disrupted normal waterfowl nesting chronology. Newfoundland and Labrador also received above-average winter precipitation, but snow melt and breakup was gradual with minimal flooding. The frost seal throughout much of southern Ontario was poor; however, winter snowfall and spring rains led to good-to-excellent habitat conditions across most of the area with the exception of extreme southwestern Ontario which was characterized as fair. Conditions in western Ontario initially pointed toward a late spring, but higher temperatures and winds provided good melting conditions so habitats were ready for the arrival of breeding pairs. In more northern sections of Ontario, ice persisted on lakes late into May and early June. Conditions in northern Quebec were slightly drier than average, and spring-like conditions came early.

In the traditional survey area, the 2008 total duck (excluding scoters, eiders, long-tailed ducks, mergansers, and wood ducks) population estimate was 37.3 ± 0.6 million birds. This was 9% lower than the 2007 estimate of 41.2 ± 0.7 million birds, but 11% above the 1955–2007 long-term average.

In the eastern Dakotas, 2008 total duck numbers were 17% lower than the 2007 estimate but 53% above the long-term average. The total duck estimate in southern Alberta was similar to 2007, and to the long-term average. The total duck estimate was 19% lower than that of 2007 in southern Saskatchewan, but remained 20% above the long-term average. The total duck count in southern Manitoba was similar to the 2007 estimate, and 21% below its long-term average. The total duck estimate in central and northern Alberta, northeastern British Columbia and the Northwest Territories was 13% higher than the 2007 estimate and similar to the long-term average. The estimate in the northern Saskatchewan–northern Manitoba–western Ontario area was similar to 2007, but 11% below the long-term average. The 2008 total duck estimate in the western Dakotas–eastern Montana area was 30% below both their 2007 estimate and long-term average. In the Alaska–Yukon Territory–Old Crow Flats region the total duck estimate was 10% below 2007, but remained 42% above its long-term average.

Several states and provinces conduct breeding waterfowl surveys in areas outside the geographic extent of the Waterfowl Breeding Population and Habitat Survey of the USFWS and CWS. In California, the northeastern U.S., Oregon, and Wisconsin, measures of precision for survey estimates are available. In Oregon, the 2008 total duck estimate was 29% lower than in 2007, and 19% below the long-term average. The 2008 total duck estimate in California was similar to the 2007 estimate and the long-term average. Wisconsin's 2008 total duck estimate was 33% higher than in 2007, and 45% above its long-term average. The 2008 total breeding duck estimate in the northeastern U.S. fell by 20% relative to 2007, and was 16% below the long-term average. Of the states without measures of precision for total duck numbers, the 2008 estimates in Michigan and Minnesota fell by more than 40% compared to those in 2007. Estimates in 2008 fell slightly in Washington and increased slightly in Nevada relative to 2007.

In the traditional survey area in 2008, estimated mallard abundance was 7.7 ± 0.3 million birds, which was similar to the 2007 estimate of 8.3 ± 0.3 million birds and the long-term average. Blue-winged teal abundance was 6.6 ± 0.3 million birds. This value was similar to the 2007 estimate of 6.7 ± 0.4 million birds and 45% above the long-term average. Estimated abundances of gadwall (2.7 ± 0.2 million) and northern shoveler (3.5 ± 0.2 million) were below 2007 estimates (−19% and −23%, respectively) but both remained 56% above their respective long-term averages. Estimated abundance of American

Table 1: Estimated number (in thousands) of May ponds in portions of prairie and parkland Canada and the northcentral U.S.

			Change from 2008			Change from LTA	
Region	2009	2008	%	*P*	LTA[a]	%	*P*
Prairie Canada							
S. Alberta	687	849	−19	0.067	741	−7	0.343
S. Saskatchewan	2,210	1,608	+37	0.001	1,993	+11	0.109
S. Manitoba	671	598	+12	0.154	676	−1	0.874
Subtotal	3,568	3,055	+17	0.014	3,410	+5	0.292
Northcentral U.S.							
Montana & Western Dakotas	1,034	531	+95	<0.001	537	+93	<0.001
Eastern Dakotas	1,832	845	+117	<0.001	997	+84	<0.001
Subtotal	2,866	1,376	+108	<0.001	1,534	+87	<0.001
Total	6,434	4,431	+45	<0.001	4,917	+31	<0.001

[a] Long-term average. Prairie and parkland Canada, 1961–2008; northcentral U.S. and Grand Total, 1974–2008.

wigeon (2.5 ± 0.2 million) was similar to the 2007 estimate and the long-term average. Estimated abundances of green-winged teal (3.0 ± 0.2 million) and redheads (1.1 ± 0.1 million) were similar to 2007 and were >50% above their long-term averages. The redhead and green-winged teal estimates were the highest and the second highest ever for this region. Estimated abundance of canvasbacks (0.5 ± 0.05 million) was 44% below the record high 2007 estimate (0.9 ± 0.09 million) and 14% below the long-term average. The estimate for northern pintails was 2.6 ± 0.1 million, which was 22% below the 2007 estimate of 3.3 ± 0.2 million, and 36% below the long-term average. The scaup estimate (3.7 ± 0.2 million) was similar to 2007, and remained 27% below the long-term average of 5.1 ± 0.2 million.

In the eastern survey area, 2008 population estimates for the 10 most abundant species surveyed were similar to 2007 and to their 1990–2007 averages. The estimate for American black ducks was 496,000, and the estimate for mallards was 450,000.

2009 Breeding Populations and Habitat Conditions

Overall Habitat and Population Status

Habitat conditions during the 2009 Waterfowl Breeding Population and Habitat Survey were characterized by above-average moisture across the southern portions of the traditional survey area, good habitat in the eastern survey area, and late spring conditions across northern survey areas. The total pond estimate (prairie Canada and U.S. combined) was 6.4 ± 0.2 million (Table 1, Figure 1). This was 45% above last year's estimate of 4.4 ± 0.2 million ponds and 31% above the long-term average of 4.9 ± 0.03 million ponds.

Conditions across the Canadian prairies improved in 2009, with the exception of southern Alberta. The 2009 estimate of ponds in prairie Canada was 3.6 ± 0.1 million. This was a 17% increase from last year's estimate (3.1 ± 0.1 million) and was similar to the 1961–2008 average (3.4 ± 0.03 million). The prairie parklands received below-normal precipitation but waterfowl habitat in this area continued to benefit from above-normal precipitation received in 2007 and was classified as fair to good.

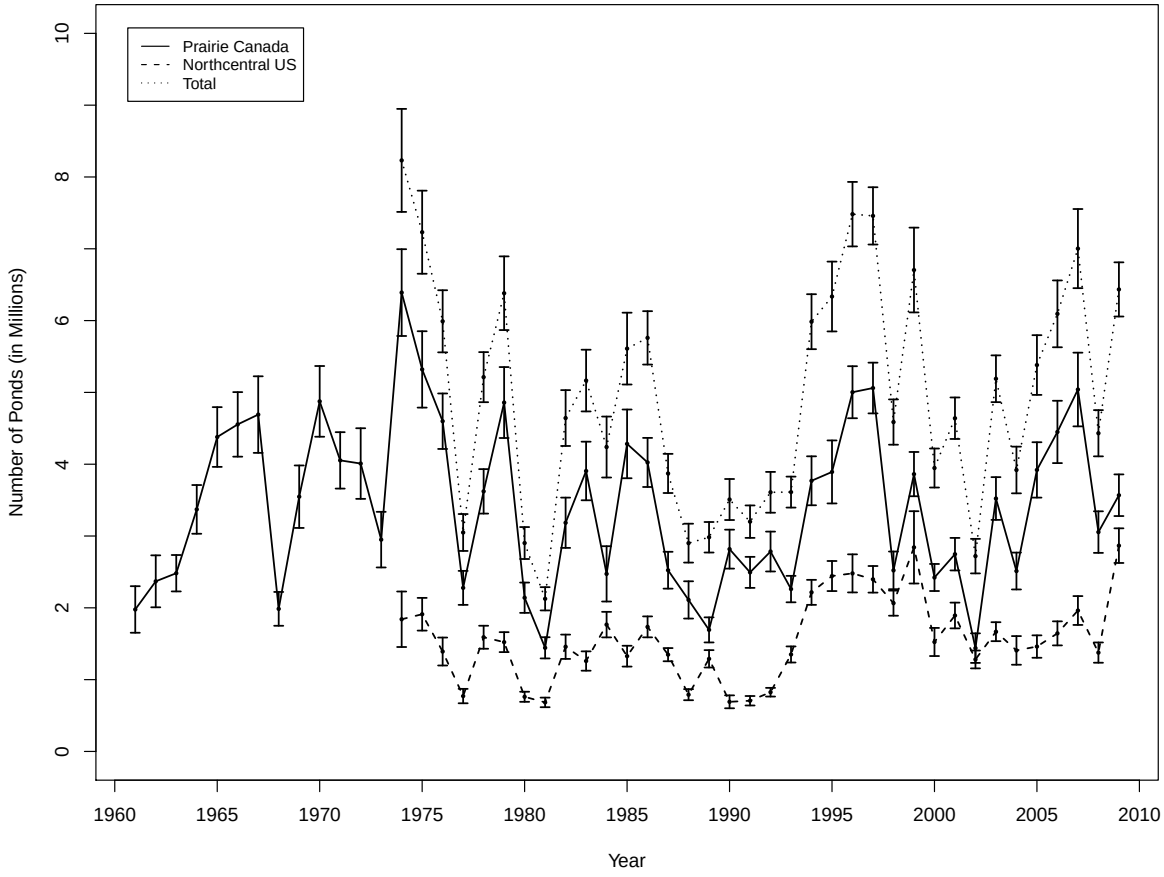


Figure 1: Number of ponds in May and 90% confidence intervals in prairie Canada and the north-central U.S.

Significant improvements in wetland numbers occurred in the U.S. prairies during 2009. The 2009 pond estimate for the northcentral U.S. of 2.9 ± 0.1 million was 108% above last year's estimate (1.4 ± 0.07 million) and 87% above the long-term average (1974–2008; 1.5 ± 0.02 million). Considerable precipitation in late spring 2008 and above-normal precipitation over the fall and winter recharged wetlands across the Dakotas and eastern Montana. Drier conditions were noted in western Montana and southeastern South Dakota.

In the bush regions of the traditional survey area (Alaska, Yukon, Northwest Territories, northern Manitoba, northern Saskatchewan, and western Ontario), spring breakup was delayed as much as three weeks relative to normal in 2009. Most of the large lakes across the region remained frozen in early June, whereas smaller habitats, such as beaver ponds, were open. Overall habitat conditions in northern Alberta and the Northwest Territories, and most of Alaska, were rated as good. Below-average precipitation through northern Saskatchewan and portions of northern Manitoba negatively affected smaller ponds.

The boreal forest of the eastern survey area was generally in good condition this spring, although northern survey areas in Ontario, Quebec, and Labrador experienced a very late spring. Above-average snowfall was recorded from Maine to the Maritimes, but average spring temperatures prevented the flooding that occurred in 2008, resulting in good-to-excellent waterfowl habitat in 2009. Good-to-excellent waterfowl habitat existed throughout New York and much of Quebec and Ontario. Although overall habitat conditions were good in the east-

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

			Change from 2008			Change from LTA	
Region	2009	2008	%	*P*	LTA[b]	%	*P*
Alaska–Yukon Territory–Old Crow Flats	4,345	5,123	−15	0.003	3,641	+19	<0.001
C. & N. Alberta–N.E. British Columbia–NWT	6,934	6,934	+0	0.999	7,093	−2	0.610
N. Saskatchewan –N. Manitoba–W. Ontario	3,813	3,162	+21	0.014	3,528	+8	0.154
S. Alberta	3,288	4,199	−22	<0.001	4,287	−23	<0.001
S. Saskatchewan	8,053	8,949	−10	0.083	7,497	+7	0.102
S. Manitoba	1,371	1,223	+12	0.118	1,539	−11	0.022
Montana & Western Dakotas	2,468	1,139	+117	<0.001	1,610	+53	<0.001
Eastern Dakotas	11,733	6,546	+79	<0.001	4,330	+171	<0.001
Total	42,005	37,276	+13	<0.001	33,526	+25	<0.001
Other regions							
California	511	554	−8	0.639	596	−14	0.244
Northeastern U.S.[c]	1,271	1,197	+6	0.532	1,416	−10	0.136
Oregon	198	240	−17	0.067	292	−32	<0.001
Wisconsin	502	627	−20	0.165	438	+15	0.164

[a] Includes the 10 species in Appendix C.3 plus American black duck, ring-necked duck, goldeneyes, bufflehead, and ruddy duck; excludes eiders, long-tailed duck, scoters, mergansers, and wood ducks.

[b] Long-term average, 1955–2008; 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.

ern survey area, flooding from a series of major storms in southwestern Ontario during mid-May and persistent winter conditions in the James and Hudson Bay Lowlands may have reduced habitat quality in those areas.

In the traditional survey area, which includes strata 1–18, 20–50, and 75–77, the total duck population estimate (excluding scoters, eiders, long-tailed ducks, mergansers, and wood ducks) was 42.0 ± 0.7 million birds. This estimate represents a 13% increase over last year's estimate of 37.3 ± 0.6 million birds and was 25% above the long-term average (1955–2008; Table 2, Appendix C.4). In the eastern Dakotas, total duck numbers were 79% above the 2008 estimate and 171% above the long-term average. The total duck estimate in southern Alberta was 22% below last year's estimate, and 23% below the long-term average. The total duck estimate was 10% below 2008 in southern Saskatchewan, but was similar to the long-term average. In southern Manitoba, the total duck population estimate was similar to last year's, but was 11% below the long-term average. The total duck estimate in central and northern Alberta, northeastern British Columbia, and the Northwest Territories was unchanged from last year and the long-term average. The estimate in the northern Saskatchewan–northern Manitoba–western Ontario survey area was 21% higher than the 2008 estimate but similar to the long-term average.

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

			Change from 2008			Change from LTA	
Region	2009	2008	%	*P*	LTA[a]	%	*P*
Alaska–Yukon Territory–Old Crow Flats	503	532	−6	0.650	368	+37	0.003
C. & N. Alberta–N.E. British Columbia–NWT	1,080	1,079	+0	0.997	1,072	+1	0.939
N. Saskatchewan –N. Manitoba–W. Ontario	930	1,046	−11	0.437	1,142	−19	0.032
S. Alberta	754	875	−14	0.099	1,086	−31	<0.001
S. Saskatchewan	1,867	1,907	−2	0.838	2,066	−10	0.088
S. Manitoba	417	381	+10	0.397	381	+10	0.227
Montana & Western Dakotas	444	354	+26	0.071	501	−11	0.166
Eastern Dakotas	2,517	1,549	+62	<0.001	895	+181	<0.001
Total	8,512	7,724	+10	0.027	7,511	+13	<0.001
Eastern survey area	463	451	+3	[b]	407	+14	[b]
Other regions							
California	302	297	+2	0.951	366	−18	0.322
Michigan	259	189	+37	0.123	382	−32	0.005
Minnesota	236	298	−21	0.182	224	+6	0.737
Northeastern U.S.[c]	667	619	+8	0.436	777	−14	0.021
Oregon	80	84	−6	0.593	106	−25	<0.001
Wisconsin	200	188	+6	0.739	181	+10	0.491

[a] Long-term average. Traditional survey area 1955–2008; eastern survey area 1990–2008; years for other regions vary (see Appendix C.2).

[b] *P*-values not appropriate because these data were analyzed with Bayesian methods.

[c] Includes all or portions of CT, DE, MD, MA, NH, NJ, NY, PA, RI, VT, and VA.

The total duck estimate in the western Dakotas–eastern Montana area was 117% above the 2008 estimate and 53% above the long-term average. In the Alaska–Yukon Territory–Old Crow Flats region the total duck estimate was 15% lower than last year, but 19% above the long-term average.

Several states and provinces conduct breeding waterfowl surveys in areas outside the geographic extent of the Waterfowl Breeding Population and Habitat Survey of the USFWS and CWS. In California, the northeastern U.S., Oregon, and Wisconsin, measures of precision for survey estimates are available. In Oregon, the total duck estimate was 17% lower than in 2008, and 32% below the long-term average. The total duck estimate in California was similar to the 2008 estimate and the long-term average. Wisconsin's total duck estimate was 20% lower than in 2008, but 15% above its long-term average. The total breeding duck estimate in the northeastern U.S. was similar to 2008, and was 9% below the long-term average. Of the states without measures of precision for total duck numbers, the estimate in Michigan increased by 16%, and in Minnesota, fell by more than 31% compared to those in 2008. Estimates fell slightly in Washington relative to 2008.

Trends and annual breeding population estimates for 10 principal duck species from the traditional survey area are provided in this report (Tables 3–12, Figure 2, 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. Mallard abundance was 8.5 ± 0.2 million birds, 10% higher than last year's estimate of 7.7 ± 0.3 million birds and 13% higher than the long-term average (Table 3). The mallard estimate in southern Alberta was 14% below last year's and was 31% below the long-term average. In the eastern Montana–western Dakotas survey area, mallard counts were 26% above the 2008 estimate but similar to the long-term mean. In the central and northern Alberta–northeastern British Columbia–Northwest Territories region the mallard estimate was similar to 2008 and the long-term average. In the northern Saskatchewan–northern Manitoba–western Ontario survey area, the mallard estimate was similar to that of 2008, but 19% below the long-term average. Mallard numbers were similar to the 2008 estimate and 37% above their long-term average in the Alaska–Yukon Territory–Old Crow Flats region. In the southern Manitoba survey area, the mallard estimate was similar to last year's and to the long-term average. In southern Saskatchewan, mallards were similar to last year but 10% below the long-term average. In the eastern Dakotas, mallards were 62% above last year's count, and 181% above the long-term average. Mallard abundance with estimates of precision are also available for other areas where surveys are conducted (California, Oregon, Wisconsin, the northeast U.S., as well as Michigan and Minnesota). Mallard numbers were similar in California to last year and the long-term average. In Wisconsin, mallards were similar to last year but 10% above the long-term average. Mallards were 6% lower in Oregon than last year, and 25% lower than the long-term average. The mallard estimate was similar to the 2008 estimate in the northeast U.S., but was 14% below the long-term average. In Michigan, mallard estimates were similar to 2008 estimates, and were 32% below the long-term average. In Minnesota, the mallard estimate was 21% lower than last year. In the states without estimates of precision (Washington and Nevada), mallards decreased relative to 2008. However, due to changes in survey design Nevada's mallard estimate is not comparable to previous years.

In the traditional survey area the estimated abundance of blue-winged teal (7.4 ± 0.4 million) was similar to last year's estimate and above the long-term average (+60%). Gadwall abundance (3.1 ± 0.2 million) was similar to the 2008 estimate and 73% above the long-term average. Estimated American wigeon abundance (2.5 ± 0.1 million) was similar to 2008 and the long-term average. Estimated abundance of green-winged teal (3.4 ± 0.2 million) was similar to last year's estimate and well above the long-term average (+79%). Northern shovelers (4.4 ± 0.2 million) were 25% above the 2008 estimate of 3.5 ± 0.2 million and remain well above their long-term average (+92%). The estimate for northern pintails was 3.2 ± 0.2 million, which

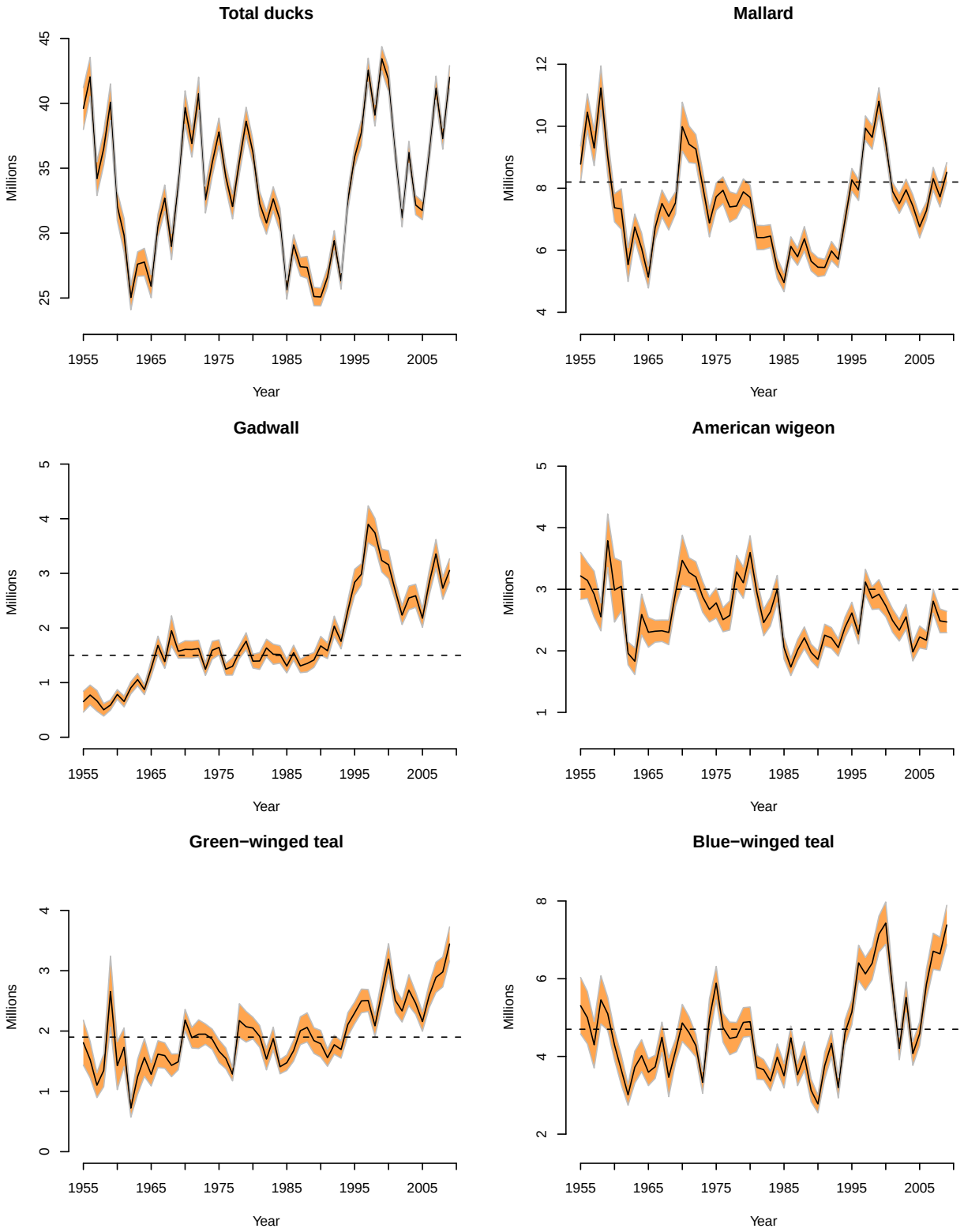


Figure 2: Breeding population estimates, 95% confidence intervals, and North American Waterfowl Management Plan population goal (dashed line) for selected species in the traditional survey area (strata 1–18, 20–50, 75–77).

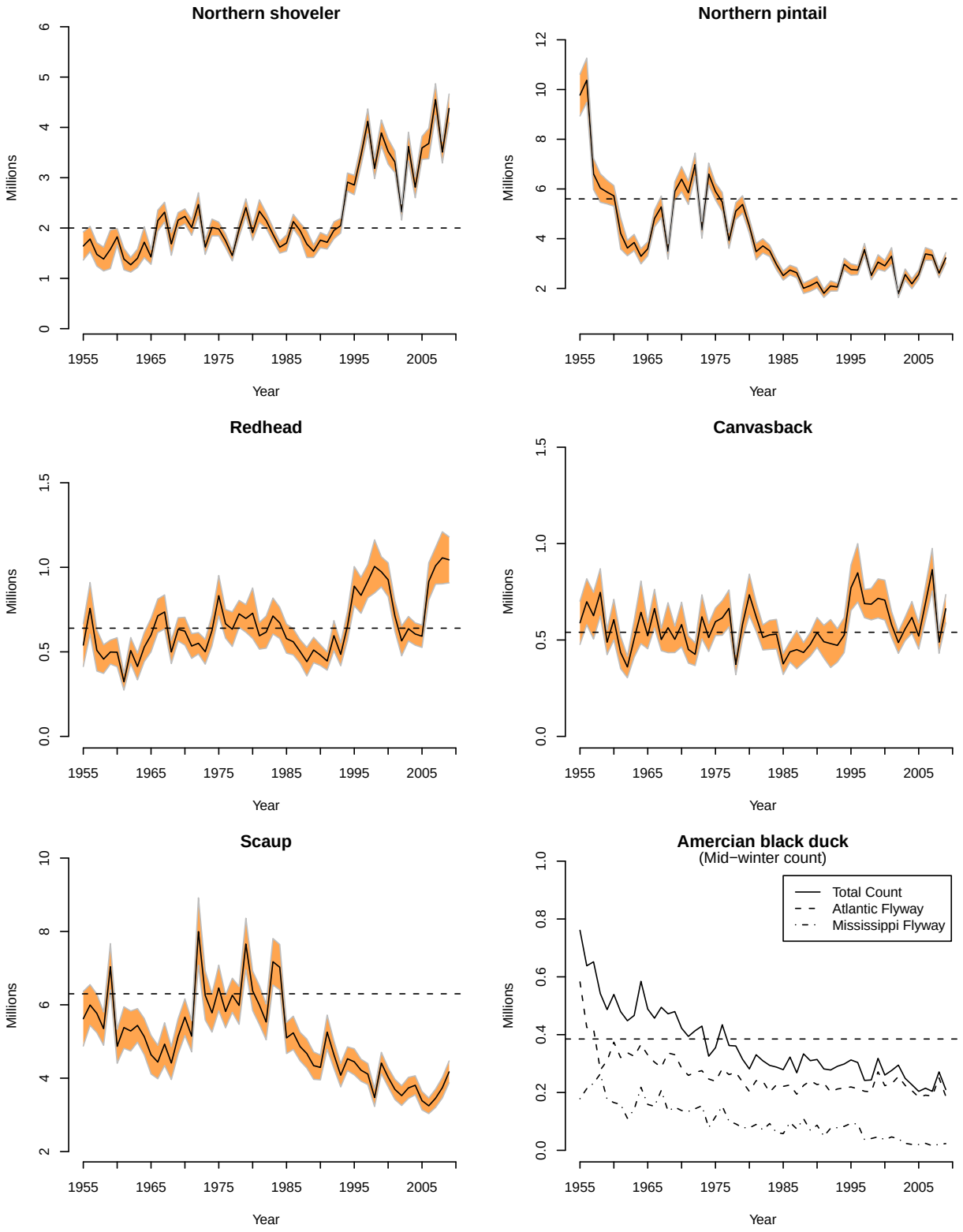


Figure 2: Continued.

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

			Change from 2008			Change from LTA	
Region	2009	2008	%	*P*	LTA[a]	%	*P*
Alaska–Yukon Territory–Old Crow Flats	2	4	−50	0.517	2	+3	0.967
C. & N. Alberta–N.E. British Columbia–NWT	67	109	−39	0.057	51	+31	0.341
N. Saskatchewan –N. Manitoba–W. Ontario	9	10	−8	0.871	27	−67	<0.001
S. Alberta	401	420	−5	0.822	314	+28	0.210
S. Saskatchewan	1,044	1,011	+3	0.840	590	+77	<0.001
S. Manitoba	118	112	+5	0.847	69	+70	0.014
Montana & Western Dakotas	319	200	+59	0.017	196	+63	0.005
Eastern Dakotas	1,094	861	+27	0.060	514	+113	<0.001
Total	3,054	2,728	+12	0.157	1,763	+73	<0.001

[a] Long-term average, 1955–2008.

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

			Change from 2008			Change from LTA	
Region	2009	2008	%	*P*	LTA[a]	%	*P*
Alaska–Yukon Territory–Old Crow Flats	805	921	−13	0.221	535	+50	<0.001
C. & N. Alberta–N.E. British Columbia–NWT	793	819	−3	0.861	903	−12	0.272
N. Saskatchewan –N. Manitoba–W. Ontario	147	90	+64	0.102	245	−40	0.003
S. Alberta	133	180	−26	0.108	290	−54	<0.001
S. Saskatchewan	237	372	−36	0.068	420	−43	<0.001
S. Manitoba	9	12	−26	0.410	59	−85	<0.001
Montana & Western Dakotas	216	58	+270	<0.001	108	+99	0.001
Eastern Dakotas	128	34	+278	<0.001	49	+162	<0.001
Total	2,469	2,487	−1	0.929	2,609	−5	0.307

[a] Long-term average, 1955–2008.

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

			Change from 2008			Change from LTA	
Region	2009	2008	%	*P*	LTA[a]	%	*P*
Alaska–Yukon Territory–Old Crow Flats	658	655	+1	0.968	380	+73	<0.001
C. & N. Alberta–N.E. British Columbia–NWT	1,225	1,068	+15	0.474	760	+61	0.006
N. Saskatchewan –N. Manitoba–W. Ontario	399	282	+41	0.009	203	+96	<0.001
S. Alberta	175	297	−41	0.052	197	−11	0.445
S. Saskatchewan	648	561	+16	0.553	244	+166	<0.001
S. Manitoba	48	48	+0	0.999	51	−7	0.763
Montana & Western Dakotas	175	56	+210	<0.001	40	+336	<0.001
Eastern Dakotas	115	13	+766	<0.001	45	+154	0.007
Total	3,444	2,980	+16	0.114	1,920	+79	<0.001

[a] Long-term average, 1955–2008.

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

			Change from 2008			Change from LTA	
Region	2009	2008	%	*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	248	393	−37	0.125	275	−10	0.697
N. Saskatchewan –N. Manitoba–W. Ontario	116	87	+34	0.486	256	−55	<0.001
S. Alberta	480	818	−41	0.004	618	−22	0.026
S. Saskatchewan	1,740	2,318	−25	0.098	1,278	+36	0.036
S. Manitoba	303	265	+14	0.523	379	−20	0.120
Montana & Western Dakotas	345	235	+47	0.116	265	+30	0.214
Eastern Dakotas	4,152	2,525	+64	<0.001	1,534	+171	<0.001
Total	7,384	6,640	+11	0.153	4,607	+60	<0.001

[a] Long-term average, 1955–2008.

Table 8: Northern shoveler breeding population estimates (in thousands) for regions in the traditional survey area.

			Change from 2008			Change from LTA	
Region	2009	2008	%	*P*	LTA[a]	%	*P*
Alaska–Yukon Territory–Old Crow Flats	464	466	+0	0.984	279	+66	0.015
C. & N. Alberta–N.E. British Columbia–NWT	293	322	−9	0.625	218	+34	0.110
N. Saskatchewan –N. Manitoba–W. Ontario	16	37	−57	0.065	42	−62	<0.001
S. Alberta	527	618	−15	0.355	383	+38	0.034
S. Saskatchewan	894	1,184	−25	0.056	694	+29	0.038
S. Manitoba	137	90	+53	0.061	109	+26	0.129
Montana & Western Dakotas	408	134	+203	<0.001	150	+173	<0.001
Eastern Dakotas	1,639	657	+149	<0.001	400	+309	<0.001
Total	4,376	3,508	+25	0.002	2,273	+92	<0.001

[a] Long-term average, 1955–2008.

Table 9: Northern pintail breeding population estimates (in thousands) for regions in the traditional survey area.

			Change from 2008			Change from LTA	
Region	2009	2008	%	*P*	LTA[a]	%	*P*
Alaska–Yukon Territory–Old Crow Flats	930	1,250	−26	0.030	925	+0	0.966
C. & N. Alberta–N.E. British Columbia–NWT	243	331	−27	0.169	370	−34	0.001
N. Saskatchewan –N. Manitoba–W. Ontario	21	4	+425	0.006	39	−45	0.008
S. Alberta	172	240	−28	0.159	703	−76	<0.001
S. Saskatchewan	444	423	+5	0.782	1,195	−63	<0.001
S. Manitoba	48	29	+63	0.121	108	−56	<0.001
Montana & Western Dakotas	383	50	+662	<0.001	262	+46	0.090
Eastern Dakotas	984	285	+245	<0.001	453	+117	<0.001
Total	3,225	2,613	+23	0.005	4,056	−20	<0.001

[a] Long-term average, 1955–2008.

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

			Change from 2008			Change from LTA	
Region	2009	2008	%	*P*	LTA[a]	%	*P*
Alaska–Yukon Territory–Old Crow Flats	1	2	−60	0.450	2	−46	0.384
C. & N. Alberta-N.E. British Columbia–NWT	29	94	−70	0.077	40	−29	0.137
N. Saskatchewan –N. Manitoba–W. Ontario	6	12	−48	0.252	27	−77	<0.001
S. Alberta	135	333	−59	0.014	122	+10	0.726
S. Saskatchewan	285	383	−26	0.297	202	+41	0.056
S. Manitoba	69	56	+23	0.610	72	−5	0.883
Montana & Western Dakotas	33	3	+934	0.032	9	+251	0.087
Eastern Dakotas	487	173	+181	0.001	170	+187	<0.001
Total	1,044	1,056	−1	0.941	645	+62	<0.001

[a] Long-term average, 1955–2008.

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

			Change from 2008			Change from LTA	
Region	2009	2008	%	*P*	LTA[a]	%	*P*
Alaska–Yukon Territory–Old Crow Flats	41	72	−43	0.185	91	−54	<0.001
C. & N. Alberta–N.E. British Columbia–NWT	88	84	+5	0.874	75	+18	0.501
N. Saskatchewan –N. Manitoba–W. Ontario	49	23	+109	0.215	54	−9	0.758
S. Alberta	52	79	−34	0.262	65	−21	0.337
S. Saskatchewan	280	166	+69	0.027	187	+50	0.036
S. Manitoba	48	31	+59	0.052	56	−14	0.347
Montana & Western Dakotas	26	9	+198	0.003	8	+223	0.002
Eastern Dakotas	77	25	+210	0.005	33	+134	0.013
Total	662	489	+35	0.018	569	+16	0.109

[a] Long-term average, 1955–2008.

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

			Change from 2008			Change from LTA	
Region	2009	2008	%	*P*	LTA[a]	%	*P*
Alaska–Yukon Territory–Old Crow Flats	821	1,071	−23	0.034	922	−11	0.158
C. & N. Alberta–N.E. British Columbia–NWT	1,685	1,627	+4	0.812	2,556	−34	<0.001
N. Saskatchewan –N. Manitoba–W. Ontario	684	406	+69	0.012	573	+19	0.211
S. Alberta	287	176	+63	0.110	344	−17	0.363
S. Saskatchewan	324	256	+26	0.436	411	−21	0.238
S. Manitoba	70	60	+17	0.604	132	−47	<0.001
Montana & Western Dakotas	34	16	+111	0.031	51	−33	0.036
Eastern Dakotas	266	127	+110	0.006	100	+166	<0.001
Total	4,172	3,738	+12	0.175	5,090	−18	<0.001

[a] Long-term average, 1955–2008.

was 23% above the 2008 estimate of 2.6 ± 0.1 million, and 20% below the long-term average. Estimated abundance of redheads (1.0 ± 0.1 million) was similar to last year and 62% above the long-term average. The canvasback estimate (0.7 ± 0.06 million) was 35% above the 2008 estimate (0.5 ± 0.05 million) and similar to the long-term average. The combined scaup estimate (4.2 ± 0.2 million) was similar to that of 2008, and 18% below the long-term average. Population estimates for the 10 most abundant species in the eastern survey area were all similar to last year's estimates and to long-term averages (Table 13, Figures 3 and 4, Appendix C.5).

The longest time series of data available to assess the status of the American black duck is provided by the midwinter surveys conducted in January in states of the Atlantic and Mississippi Flyways. Measures of precision are not available for the midwinter surveys. In 2009, the total midwinter count of American black ducks in both flyways combined was 210,100, which was 15% below the most recent 10-year average (1999–2008) of 248,100. In the Atlantic Flyway, the black duck midwinter index was 186,900, which was 16% below the flyway's 10-year average of 222,400. In the Mississippi Flyway, the black duck midwinter index in 2009 was 23,200, which was 21% below the 10-year flyway average of 29,400. A shorter 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 3). In the eastern survey area, the 2009 estimate for breeding American black ducks (464,000) was statistically similar to the 2008 estimate (499,000) and to the 1990–2008 average (478,000). Black duck population estimates for northeast states from New Hampshire south to Virginia are available from the Atlantic Flyway Breeding Waterfowl Survey. The estimate from the 2009 survey (39,500) was not significantly different from the 2008 estimate (65,000) but was 42% below the 1993–2008 average (68,400).

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

Table 13: Duck breeding population estimates[a] (in thousands) for the 10 most abundant species in the eastern survey area.

Species	2009	2008	% Change from 2008[c]	Average[b]	% Change from average[c]
Mergansers (common, red-breasted, and hooded)	460	460	+0[d]	453	+2
Mallard	463	451	+3	407	+14
American black duck	464	499	−7	478	−3
American wigeon	12	8	+43	19	−37
Green-winged teal	273	270	+1	242	+13
Scaup (greater and lesser)	38	32	+18	38	+1
Ring-necked duck	551	546	+1	526	+5
Goldeneyes (common and Barrow's)	396	422	−6	407	−3
Bufflehead	27	30	−11	25	+9
Scoters (black, white-winged, and surf)	101	86	+18	82	+23

[a] Estimates for mallard, American black duck, green-winged teal, ring-necked duck, goldeneyes, and mergansers from Bayesian hierarchical analysis using FWS and CWS data from strata 51, 52, 63, 64, 66–68, 70–72. All others were computed as the variance-weighted means of FWS and CWS estimates for strata 51, 52, 63, 64, 66–68, 70–72.

[b] Average for 1990–2008.

[c] No changes were significant at ($P < 0.10$) as determined by overlap of Bayesian credibility intervals or confidence intervals.

[d] Rounded values mask change in estimates.

population indices 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 (95% credible intervals), in addition to the trend estimates and 95% credible intervals presented here. In the Atlantic and Mississippi Flyways combined, the BBS wood duck index increased by an average of 2.3% (UCL 3.0%, LCL 1.7%) per year over the entire survey period (1966–2008), 3.0% (UCL 4.0%, LCL 2.2%) over the past 20 years (1989–2008), and 3.5% (UCL 4.9%, LCL 2.3%) over the most recent (1999-2008) 10-year period. The Atlantic Flyway wood duck index increased by an average of 1.7% (UCL 2.5%, LCL 0.9%) annually over the entire time series (1966–2008), by 2.7% (UCL 3.9%, LCL 1.6%) over the past 20 years (1989–2008), and by 3.3% (UCL 5.4%, LCL 1.4%) from 1999–2008. In the Mississippi Flyway, the corresponding BBS wood duck index trends averaged +2.6% (UCL 3.4%, LCL 1.8%, 1966–2008), 3.2% (UCL 4.4%, LCL 2.2%, 1989–2008), and 3.6% (UCL 5.4%, LCL 2.0%, 1999–2008; 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 estimate from the 2009 survey (368,000) was similar to the 2008 estimate (386,100) and to the 1993–2008 average (376,600).

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 available under *Waterfowl Breeding Population Surveys, Field Crew Reports* located on the Division of Migratory Bird Management's Web site on the Publications page (http://www.fws.gov/migratorybirds/NewReportsPublications/WPS.html). Although these reports will no longer be produced, habitat and population status for each region will continue to be summarized here. 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)

The habitat conditions in this survey area have deteriorated from last year, with a portion of the Alberta prairie potholes experiencing record dry conditions due to drought. However, some western areas were still classified as good habitat, with wetter conditions than in the east. While the aspen parkland conditions were in better condition than areas to the south, they appeared drier than last year. Wetland habitats appeared more stable in the boreal forest transition; the larger and deeper wetland systems in this region are typically less affected by drought than the shallow prairie potholes.

Overall, May ponds were 19% lower than the 2008 estimate, and similar to the long-term average. The total duck estimate was 22% lower than that of 2008 and 23% lower than the long-term average. The mallard estimate was 14% below last year and 31% below the long-term average. Blue-winged teal and green-winged teal estimates were both 41% below their 2008 estimates, while blue-winged teal were 22% below, and green-winged teal similar to their long-term averages. Northern pintail numbers were similar to 2008, but remained 76% below their long-term average for this survey area. Gadwall numbers were similar to those of 2008 and the long-term average. The northern shoveler estimate was similar to 2008 but was 38% higher than its long-term average. American wigeon were also similar to their 2008 estimate, but 54% below their long-term average. The redhead estimate was 59% lower than in 2008 and similar to its

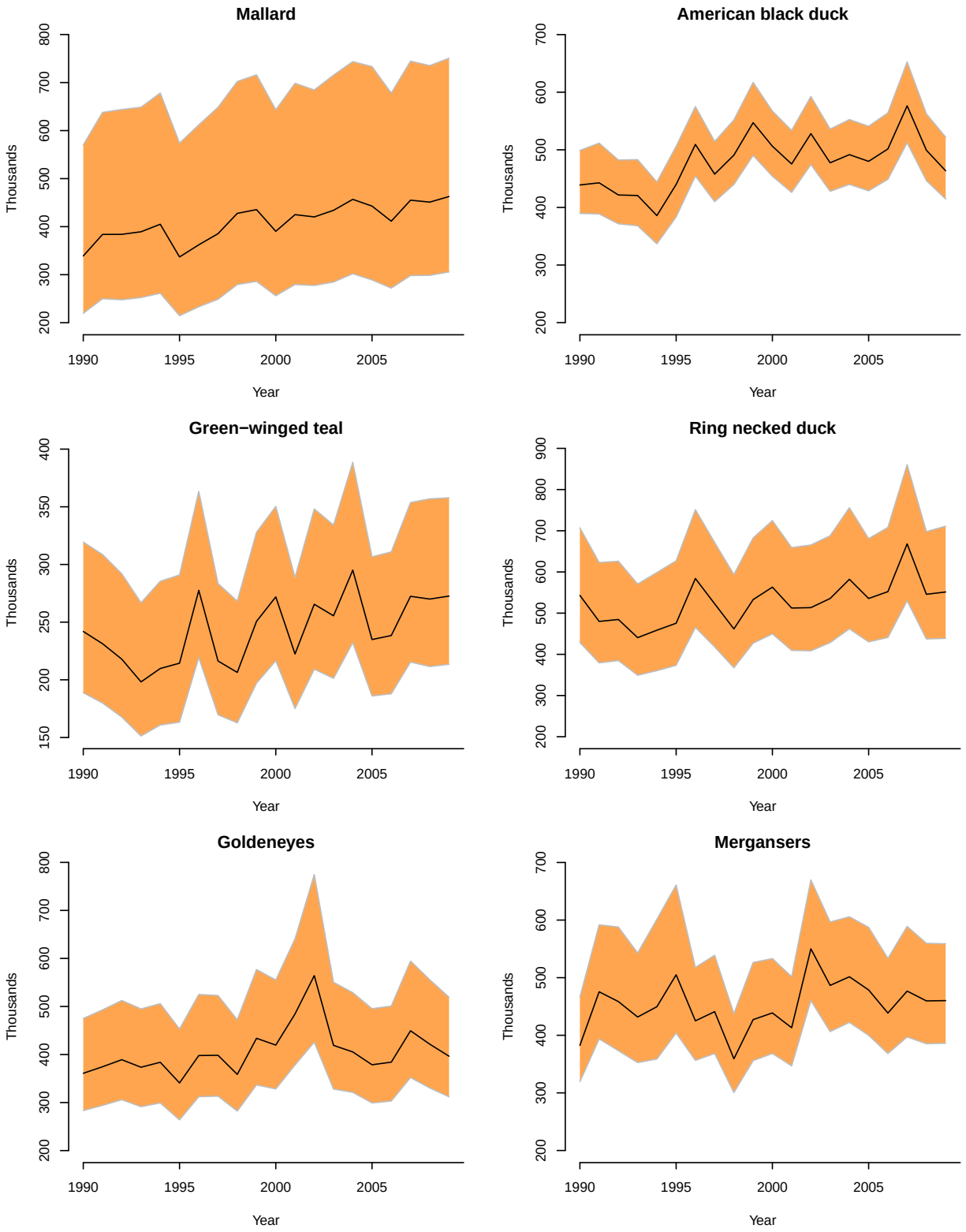


Figure 3: Breeding population estimates and 90% credibility intervals from Bayesian hierarchical models, for selected species in the eastern survey area (strata 51, 52, 63, 64, 66–68, 70–72).

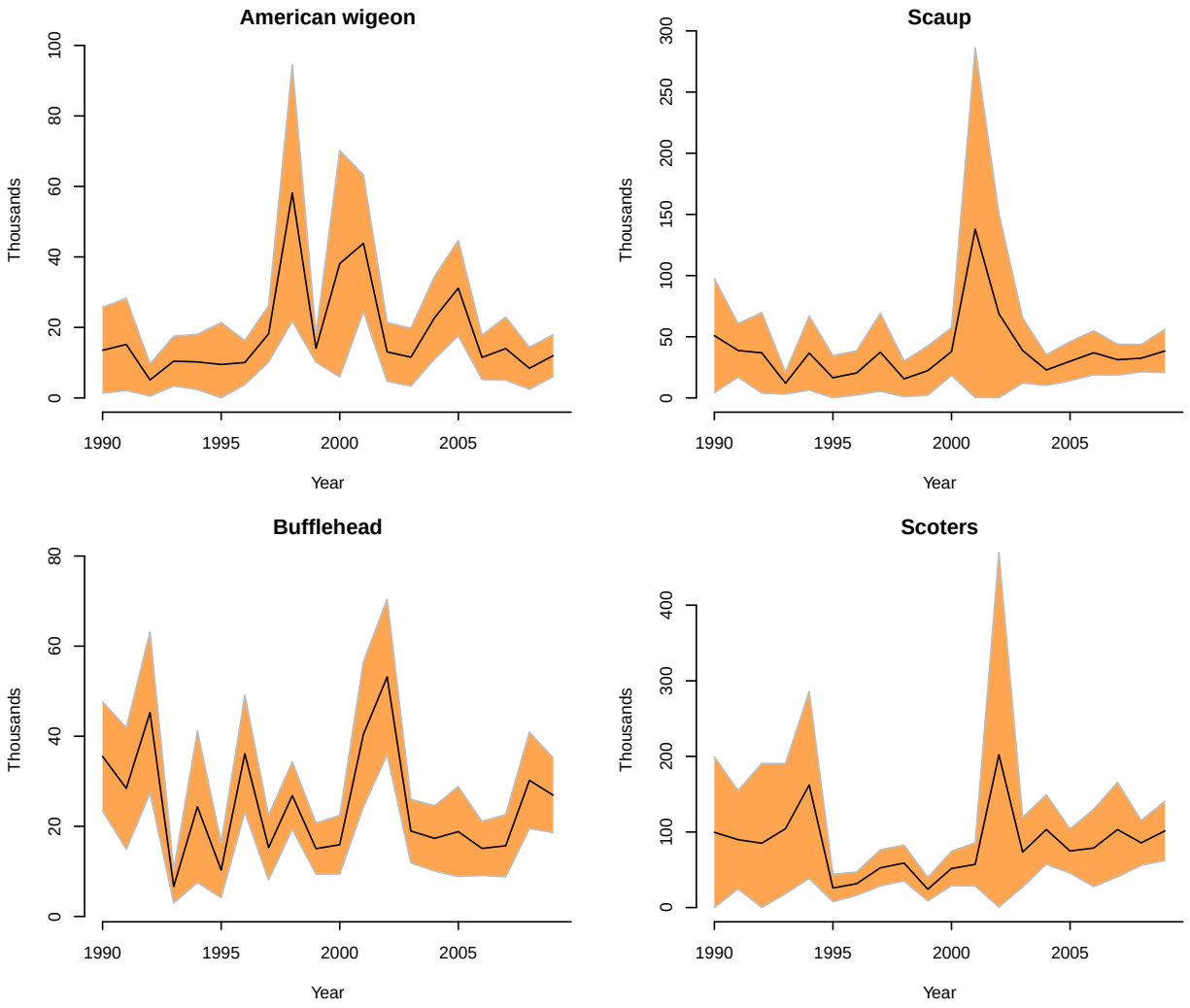


Figure 4: Breeding population estimates (precision-weighted means) and 90% confidence intervals for selected species in the eastern survey area (strata 51, 52, 63, 64, 66–68, 70–72).

long-term average for the survey area. Both canvasback and scaup were similar to 2008 and to their long-term average.

Southern Saskatchewan (strata 30–33)

Habitat conditions for nesting waterfowl improved considerably in the southern grasslands of southern Saskatchewan since last year, but deteriorated in the northern grasslands and portions of the parklands. Good-to-excellent wetland conditions were observed in the southern grasslands this year as a result of above-average precipitation that fell during the fall of 2008. The colder-than-average winter provided a good frost seal and preserved the water for spring waterfowl use. The remainder of the survey area received average to below-average precipitation over the preceding year. Fall and winter precipitation was below average across the majority of the survey area with the exception of the southeast grasslands, which had average to above-average precipitation. Spring precipitation was less than 40% of normal for the western third of the survey area. The remainder of the survey area received 60–85% of normal precipitation. Monthly average temperatures were below normal through much of the winter and all of the spring. May temperatures were 2–4°C below average for the survey area. The southwest grasslands remained dry but had fair wetland conditions for waterfowl. Wetland conditions deteriorated from the southeast to the northwest in the grasslands of this region. The northern grasslands continued to dry out and at the time of the survey were considered poor for waterfowl production. The wetlands in the eastern grasslands southeast of Saskatoon remain in good condition. The parklands continued to dry out and much of the area was considered only fair. A band of good wetland conditions stretched from Saskatoon towards the Manitoba border. These conditions remained good only because of residual water from the last two years of above-average precipitation.

The May pond estimate was 37% above last year's, but similar to the long-term average. Total ducks were 10% below the 2008 estimate, but similar to their long-term average. The mallard estimate was similar to 2008 estimate and 10% lower than the long-term average. American wigeon numbers were 36% lower than last year and 43% lower than the long-term average. Gadwall, green-winged teal, and redhead estimates were also similar to last year's, and were 77%, 166%, and 41% higher than their respective long-term averages. Blue-winged teal and northern shoveler numbers were both 25% lower than last year's estimates, but were 36% and 29% above their respective long-term averages. Canvasbacks were 69% above the 2008 estimate and 50% above their long-term average for the survey area. Scaup estimated abundance was similar to last year's estimate and the long-term average. Northern pintail estimated abundance was similar to the 2008 estimate but remained 63% below the long-term average for the survey area.

Southern Manitoba (strata 25, 34–40)

Habitat conditions in this survey area have significantly improved over 2008 conditions. The 2008–2009 winter and spring was cooler than average with increased precipitation, both as snow in winter and rain in early spring. Drought indicators showed substantial improvements over last year. At the beginning of the survey, spring phenology appeared to be slightly delayed. Significant snowfall in early May improved conditions in the northern parts of strata 34 and 37. Conditions in southwest Manitoba (strata 39 and 40) were good to excellent, while the adjacent areas to the west in Saskatchewan (strata 34 and 35) were fair. All of these areas were much improved over 2008. Prior to beginning the survey there was still significant flooding in the Red River valley; however, this area dried out substantially as flood waters receded by the time the survey was flown. In the boreal forest habitat of central Manitoba conditions were rated fair to excellent. While much of the muskeg habitat seemed drier than normal, most of the ponds and wetland basins were full. A fair amount of ice remained on the larger lakes in this area. With the wet conditions this past spring, there was little evidence of tilling or burning wetland basins for agriculture. Agricultural activities were apparently delayed, and not much activity was observed until the final days of the survey. Over-

all, the combination of above-average winter and spring precipitation and cool spring temperatures should provide favorable nesting and brood habitat in this survey area, and production is predicted to be good.

The May pond count was similar to the 2008 estimate and the long-term average. Estimates for most species in this survey area were similar to those of 2008. The total duck count was similar to 2008 but 11% below the long-term average. Northern shovelers and canvasbacks were the only species in this survey area with estimates higher than in 2008—the shoveler estimate was 53% higher, and the canvasback estimate was 59% higher—but both were similar to their long-term averages. Mallards, blue-winged teal, green-winged teal, and redheads were all similar to their 2008 estimates and long-term averages. The gadwall estimate was similar to last year's, but was 70% above the long-term average. American wigeon and northern pintail numbers were similar to last year, but were 85% and 56% below their respective long-term averages. The scaup estimate was similar to 2008 but 47% below its long-term average.

Montana and Western Dakotas (strata 41–44)

In May of 2008 a weather event produced significant precipitation near the Montana/South Dakota border, which initiated a recovery from the otherwise dry conditions prevalent across the entire survey area last year. While occurring late in the nesting season of 2008, the additional moisture stimulated vegetation growth which provided good residual cover in early 2009. By April of 2009 drought indicators showed marked improvement in soil moisture and precipitation. As a result of the relatively cold winter and adequate frost seal, habitat conditions in all of eastern Montana and western Dakotas were significantly improved over the previous five years. Nearly all primary and secondary river systems showed evidence of high flows in early spring. Responding to increases in precipitation, upland vegetation was advanced and robust over most of the region, particularly in the area east of Billings which is typically dry. In southwest South Dakota and western North Dakota habitat was ranked as good to excellent, with 75–100% of basins containing water, many at full capacity. In the higher elevation terrain of eastern Montana, where there are fewer ponds and stream drainages compared to the Dakotas, habitat conditions were still ranked fair to excellent. The combination of good residual vegetation, a large increase in spring precipitation, and subsequent vegetation growth in 2009 produced very favorable waterfowl nesting conditions in the western Dakotas and Eastern Montana. Brood habitat and overall waterfowl production should be good in this survey area.

Overall in Montana and the western Dakotas, May pond counts were 95% above the 2008 estimate and 93% above the long-term average. Most species were well above their 2008 estimates. Total ducks were 117% higher than their 2008 estimate, and 53% higher than their long-term average (LTA). The mallard estimate was 26% higher than 2008 but similar to its long-term average. American wigeon (+270%, +99% LTA), green-winged teal (+210%, +336% LTA), and northern shoveler (+203%, +173% LTA) estimates were higher than both their 2008 estimates and their long-term averages. Northern pintail (+662%, +46% LTA) and redhead (+934%, +251% LTA) estimates were well above their 2008 estimates and the long-term average in this survey area. The blue-winged teal estimate was similar to last year's and its long-term average. Gadwall were 59% above the 2008 estimate, and 63% higher than the long-term average. Canvasbacks were 198% above the 2008 estimate and 223% above their long-term average. The scaup estimate was 111% above last year's, but 33% below the long-term average.

Eastern Dakotas (strata 45–49)

Significant improvements in wetland numbers and condition have occurred over most of the region since 2008. South Dakota experienced above-normal precipitation and normal fall temperatures in 2008. Overall, the winter was wetter and colder than normal. In the southern third of South Dakota, wetland conditions were similar to or only slightly improved from last year. The evidence of intense agriculture and wetland drainage was most evident in the extreme southeast part of the state, where a small area

was rated in poor condition. The remainder of the southern third was considered in fair condition. The northern two-thirds of east river South Dakota exhibited the most pronounced improvement in wetland conditions in the state since last year. Precipitation in much of the Leola Hills and glacial drift plain improved wetland conditions from fair to poor in 2008 to mostly good to excellent in 2009. Overall, wetland conditions in North Dakota showed more overall improvement since last year than South Dakota. North Dakota experienced a wetter and colder winter than normal, with cooler temperatures and higher to normal precipitation in the spring. Improvements in wetland condition occurred over most of north and eastern North Dakota, and this region was classified as good to excellent. Only the central Red River Valley and small parts of the coteau slope were rated fair. Dry conditions last year allowed many shallow basins to be tilled, removing wetland cover. Additionally, as much as 800,000 acres formerly enrolled in the Conservation Reserve Program has been lost in the Dakotas since 2007, and an additional 400,000 acres are due to expire in 2009, which may further reduce or fragment available nesting cover. Overall, with the strong and positive response by waterfowl to the improved habitat conditions, we expect above-average production in this survey area this year.

Overall in the eastern Dakotas, May pond counts were 117% above the 2008 estimate, and 84% above the long-term average. Total ducks were 79% higher than their 2008 estimate, and 171% above their long-term average. All the major species estimates in this survey area showed increases over their 2008 estimates and long-term averages. Mallard and gadwall counts increased 62% and 27% relative to 2008 estimates, and 181% and 113% above their long-term averages. American wigeon (+278%, +162% LTA), green-winged teal (+766%, +154% LTA), and northern pintail (+245%, +117% LTA) were well above their 2008 estimates and their long-term averages. The blue-winged teal estimate was 64% above the 2008 estimate, and 171% above its long-term average. Northern shovelers were 149% above last year's estimate, and 309% above their long-term average. Canvasbacks (+210%, +134% LTA), redheads (+181%, +187% LTA), and scaup estimates (+110%, +166% LTA) were all higher than their 2008 estimates and their long-term averages.

Northern Saskatchewan, Northern Manitoba, and Western Ontario (strata 21–24, 50)

This region generally received average to below-average precipitation. Temperatures ranged from significantly below average to slightly above average since May 2008. Precipitation trends were fairly consistent across the survey area. Precipitation ranged from 60% to 115% of average from May 2008 (Agriculture and Agri-Food Canada 2009, Saskatchewan Watershed Authority 2009). Total annual precipitation was near average over the northern portions of both Saskatchewan and Manitoba; however, near Buffalo Narrows in westcentral Saskatchewan, total annual precipitation was below average. Beginning in the fall of 2008, precipitation was only 60% to 85% of normal in the survey area, with slightly wetter pockets near Prince Albert and La Ronge, Saskatchewan, and Lynn Lake and Gillam, Manitoba. The dry trend continued into the spring, especially during May 2009 across the northern portion of Saskatchewan and Manitoba.

Spring and summer temperatures during 2008 were average over the region. Temperatures during October and November 2008 averaged 2–5°C above average but were more than 5°C below normal during December 2008. January and February 2009 were near normal. Spring in the survey area was delayed 1–3 weeks beginning in March 2009, when temperatures averaged 3–5°C below normal, and continued through May. The coldest temperatures, more than 4°C below normal, were from Key Lake, Saskatchewan, and Lynn Lake, Manitoba eastward towards Gillam and Churchill, Manitoba.

Wetland conditions were fair to good in the southern portion of the survey area west and slightly north of Prince Albert, Saskatchewan and around Thompson and Gillam, Manitoba. These smaller wetlands (e.g., beaver flowages, potholes) were thawed during the survey despite the very late spring. Through northern Saskatchewan and the remainder of north-

ern Manitoba, those wetlands that were thawed showed reduced water levels. The waterline in some of these wetlands was as much as 30–60 m from the shore. All of the big lakes, such as Cree, Wollaston, Reindeer, Black, Athabasca, Split and Stephens, had very little, if any, open water around the margins, indicating the late spring and resulting in poor waterfowl nesting habitat. Despite the slightly dry conditions over the last year, river flow in major drainages like the Churchill and major lake levels were average.

The total duck estimate in this survey area was 21% above the 2008 estimate, but similar to the long-term average. Mallard, gadwall, and American wigeon estimates were all similar to last year's estimates, but were 19%, 67%, and 40% below their long-term averages, respectively. Blue-winged teal were similar to the 2008 estimate, but 55% lower than the long-term average. Green-winged teal were 41% above the 2008 estimate, and 96% above the long-term average. The northern shoveler estimate was 57% below last year's, and 62% below the long-term average. Northern pintails were well above the 2008 estimate (425%), but were 45% below their long-term average for this survey area. Redheads and canvasbacks were similar to their 2008 estimates, but the redhead estimate was 77% lower than their long-term average, while canvasbacks were similar to their long-term average. The scaup estimate was 69% above the 2008 estimate, but similar to the long-term average.

Central and Northern Alberta, Northeastern British Columbia, and Northwest Territories (strata 13–18, 20, 77)

Habitat conditions were generally good across the survey area. Wetland conditions differed according to variation in winter precipitation. A fairly dry spring limited the widespread flooding that often impacts early nesting waterfowl in this region, such as in the Peace–Athabasca river delta, where spring flooding was minimal. However, the Mackenzie River delta was an exception, with persisting high water. Aside from the major deltas, the important small wetlands often created by beaver dams appeared to be in ideal condition. Although 2009 was characterized by a late spring, an early warm up occurred in some regions. This allowed some early nesting waterfowl to make use of the smaller beaver flowages, ponds, and the many miles of small streams. We saw flocked mallard drakes in these habitats, suggesting that some birds initiated nests early in the survey period. However, the long-lasting, severely cold winter caused a delayed ice breakup on the larger lakes, with areas east of Yellowknife especially slow to open. Although areas further west experienced a delayed breakup as well, they were being well utilized by waterfowl during the survey.

Total duck numbers were similar to both the 2008 estimate and the long-term average for the survey area. Counts of mallards, American wigeon, blue-winged teal, northern shoveler, and canvasbacks were all similar to last year and their long-term averages. Northern pintail and scaup estimates were both similar to last year's estimates but both were 34% below their respective long-term averages. The gadwall estimate was 39% below the 2008 estimate but similar to its long-term average. Green-winged teal were similar to the 2008 estimate but 61% higher than the long-term average. Redheads were 70% below the 2008 estimate but similar to their long-term average.

Alaska, Yukon Territory, and Old Crow Flats (strata 1–12)

In this survey area, breeding conditions depend largely on the timing of spring phenology, because wetland conditions are less variable than on the prairies. Good conditions were present throughout Alaska in 2009, though spring was slightly late in some coastal areas. Spring arrived later than average on the Copper River Delta (stratum 7) and in some areas of the outer coast of the Yukon–Kuskokwim (YK) Delta (stratum 9). The southwest portion of the YK Delta had slightly more ice than normal at the time of the survey. Spring breakup in interior Alaska and southcentral Alaska (strata 1–6) started slowly but was normal during the survey. There was extensive flooding within the Innoko River drainage (stratum 5) and in parts of the Koyukuk River drainage (stratum 6). The flooding in these areas may have resulted in reduced production this year. Bris-

tol Bay (stratum 8), Seward Peninsula (stratum 10), and Kotzebue Sound (stratum 11) seemed to have normal breakup timing and wetland conditions. Despite the late spring, lakes on the Seward Peninsula had less ice than in recent years. The Old Crow Flats (stratum 12) was average and slightly more advanced in breakup compared to more recent years. Overall, production is expected to be fair to good, with possible lower production in the flooded areas and in areas where breakup occurred later than normal.

The total duck estimate for the survey area was 15% lower than that of 2008, but 19% above the long-term average. The mallard estimate was similar to last year but 37% above its long-term average. Estimates for gadwall and redheads were similar to both 2008 estimates and their long-term averages. American wigeon, green-winged teal, and northern shoveler were all similar to their 2008 estimates but they were 50%, 73%, and 66% above their respective long-term averages. The canvasback estimate was similar to last year but 54% below the long-term average. Northern pintail and scaup estimates were 26% and 23% below their 2008 estimates, respectively, but were both similar to their long-term averages.

Eastern Survey Area (strata 51–72)

The boreal forest of the eastern survey area was generally in good condition this spring, although northern survey areas in Ontario, Quebec, and Labrador experienced a very late spring. Late winter/spring precipitation in southwest Ontario filled wetland basins to capacity by the beginning of the survey, resulting in excellent nesting conditions. The James and Hudson Bay Lowlands of far northern Ontario were in good-to-poor condition for breeding waterfowl at the time of the survey. Deep snow blanketed parts of this area, while others received below-normal accumulation. Cold spring temperatures kept wetlands and lakes in this area frozen until early June, especially in the Lowlands of Hudson Bay. These conditions, along with several late-May storms, will likely depress production in this region. Habitat conditions in southern and central Quebec were classified as good, due to the wet winter and normal spring timing; however, some lakes northeast of Chibougamau were still frozen at the time of the survey. Above-average snowfall was recorded from Maine to the Maritimes, but average spring temperatures prevented the flooding that occurred in 2008, resulting in waterfowl habitat that was rated good to excellent in 2009. An exception was the below-average snowpack in Newfoundland, even at high elevations; still, habitat in this region was classified as excellent. Spring phenology in the Atlantic region (strata 62–67) appeared to be normal, except for slightly delayed timing in Nova Scotia. Overall, although habitat conditions were good in the eastern survey area, flooding from a series of major storms in southwestern Ontario during mid-May and persistent winter conditions in the James and Hudson Bay Lowlands may have reduced habitat quality in those areas.

In the eastern survey area, estimates of mallards, scaup, scoters, green-winged teal, American wigeon, buffleheads, American black ducks, ring-necked ducks, mergansers, and goldeneyes were all similar to their 2008 estimates and long-term averages (Table 13).

Other areas

Over much of the Pacific Flyway, the outlook for waterfowl production improved relative to last year. In California, the total duck estimate in 2009 was 510,800, which was similar to last year's estimate and their long-term average of 596,400. The mallard estimate in 2009 was 302,000, also similar to the 2008 estimate and their long-term average (366,500). Late spring precipitation in the Central Valley improved nesting habitat, but also delayed rice cultivation in the Sacramento Valley. Rice fields that have been planted and then flooded provide important brood habitat for mallards. Therefore, later hatching broods tend to have higher survival, which is opposite to what is observed in prairie-nesting ducks. Overall, increased recruitment is expected in many parts of California compared to the dry spring conditions experienced in 2008.

In Nevada, the outlook for waterfowl production also improved over much of the state. In the western portion of the state, the Carson, Walker,

and Truckee River flows are the highest in two years, which should improve wetland conditions along their banks and at their terminal lakes. Moreover, June rains were the third highest on record, and were accompanied by cool temperatures which likely benefited plant growth. One of the state's largest playa lakes, the Humboldt Sink, had been dry for the past two years, but snowmelt was expected to fill it this year. In addition, a series of dikes will be constructed to segment the Toulon portion of the Humboldt WMA to establish working marshes. Over the rest of the state, conditions were variable; in northeastern Nevada, spring snowmelt and flow on the east side of the Ruby Mountains were insufficient to fill the Franklin Lake WMA. Ponds on Ruby Lake NWR will be filled according to their management plan. In southern Nevada, habitats on Kirch, Key Pittman, and Overton WMAs were in adequate condition at the start of the breeding season. Several large lakes remain dry in Pahranagat NWR, with other segments there in good condition. In Nevada the total duck estimate was 105,500, and the mallard estimate was 12,700 (due to changes in Nevada's survey design the 2009 totals are not comparable to previous years).

In western Oregon, a good snow pack produced average water conditions. Southeast Oregon was generally dry during the survey period but habitat conditions improved substantially due to above-average precipitation during late May and throughout June. Wetland areas in other areas of eastern Oregon also benefited from late-spring precipitation, and were generally in above-average condition. In Oregon, the total duck estimate in 2009 was 198,300, which was 17% lower than 2008, and 32% below the long-term average. The 2009 mallard count was 79,500, which was 6% lower than last year, and 25% lower than the long-term average. In eastern Washington, the total pond count in 2009 was 6,000, up 9% from 2008, due to increased water on the landscape in Lincoln County, Douglas County, and the Far East. However, pond counts on the Okanogan and Omak transects declined, so that the overall count was 9% below the long-term average. Overall, biologists expect a fall flight similar to that of 2008, but below the long-term average for eastern Washington wetlands. The 2009 total duck estimate from Washington was 116,500, which was slightly lower than the 2008 estimate of 120,900. The 2009 mallard estimate was 47,500, which was lower than the 2008 estimate of 50,600. In British Columbia, temperatures were atypically cold throughout the winter of 2008–2009, which resulted in heavier-than-normal snow accumulation at low elevations. Precipitation was above normal in the north and below normal in the south from November 2008 to February 2009. However, in March 2009 a series of Pacific frontal storms moved across the province, which brought heavier-than-normal snowfall to most areas. Thus, snowpack conditions were quite variable across the interior of the province in late April and early May 2009: below normal in the southern interior, near-normal in the central interior, and above normal in the northern interior. Despite this precipitation, overall in May 2009 water levels were low and habitat conditions remained poor, similar to those of 2007 and 2008.

Wetland habitat conditions in the Sandhills region of Nebraska were good to excellent. Continued precipitation through May and June was conducive to renesting attempts and good brood-rearing conditions; thus, good production was anticipated in this region in 2009. In Michigan, pond numbers were up 5% compared to last year, but pond numbers were 19% below the 1992–2008 average. The total duck estimate in Michigan for 2009 was 530,500 (excluding mergansers), which was 16% higher than 2008, and 31% below the long-term average. The 2009 mallard estimate was 258,000, which was similar to 2008 estimate of 189,000, and 32% below the long-term average.

In Wisconsin, the total state breeding duck population estimate of 502,400 was down 20% relative to 2008 and 15% above the long-term mean. The 2009 total mallard population estimate of 200,500 was higher than 2008 and 10% above the long-term mean (36 years). In 2009, the population estimate for wood ducks was 113,500, which was below the 2008 estimate, and 51% above the long-term mean. Some late snows and early spring rains improved conditions in the

central and northeast regions of the state but important waterfowl breeding areas in northwest Wisconsin remained dry (down 37% relative to normal). Precipitation in southcentral (48% above normal) and southeast (31% above normal) Wisconsin was up during this important spring period. Despite high precipitation in the southern areas of the state, wetland conditions were only average. Breeding and brood-rearing habitat in southern Wisconsin was considered good in 2009, but in northern Wisconsin it was considered poor. Across Minnesota, wetland habitat conditions were above average, but highly variable. Southern and eastcentral Minnesota were extremely dry, while westcentral to northwest Minnesota was extremely wet. Wetland numbers decreased 2% compared to 2008 but remained 26% above the 10-year average and 28% above the long-term average. The estimated numbers of temporary (Type 1) wetlands decreased 44% from 2008 and were 43% below the long-term average. The mallard breeding population index (236,000) in Minnesota was statistically similar to that of 2008 (298,000). Mallard numbers were 19% below the 10-year average but 6% above the long-term average of 224,000 breeding mallards. The estimate of total duck abundance (507,000, excluding scaup), decreased 31% compared to 2008 and was 32% below the 10-year average and 19% below the long-term average (626,100), and was the third lowest estimate since 1983.

In the northeast United States, good habitat conditions were generally reported for nesting waterfowl across the area covered by the northeastern plot survey, which encompasses New Hampshire to Virginia. Much of the survey area experienced a cool spring, but a few localized areas had higher-than-normal temperatures. The first three months of the year in many areas were some of the driest on record, but rainfall over much of the area during the months just before and during the survey period was well above normal. Some areas reported double their normal monthly precipitation in May and June. This record spring precipitation recharged most of the previously dry areas, which created a substantial amount of nesting and brood habitat across much of the survey area. Thus, the forecast for nesting waterfowl was average to above average. Total duck numbers from the Atlantic Flyway Breeding Waterfowl survey (1.3 million) were similar to the 2008 estimate of 1.2 million, but 9% below their 1993–2008 average (1.4 million). Mallard numbers (666,800) were similar to the 2008 estimate of 619,100 and 14% below their long-term average of 777,000.

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 was estimated to be 10.3 ± 0.9 million in 2009 (Figure 5). This was similar to the 2008 estimate of 9.2 ± 0.8 million.

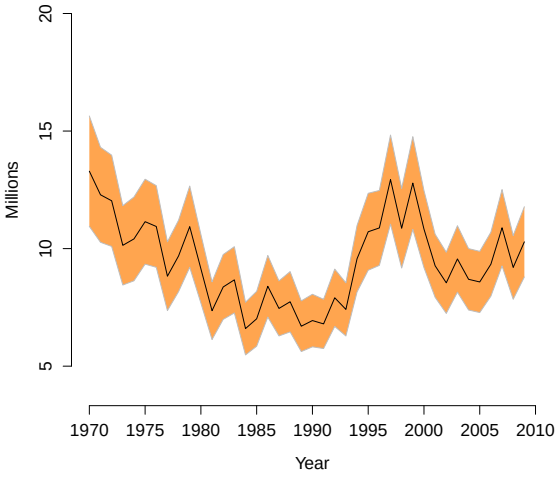


Figure 5: Estimates and 90% confidence intervals for the size of the mallard population in the fall.

References

Agriculture and Agri-Food Canada. 2009. Drought Watch: Prairies. Technical report. URL http://agr.gc.ca/pfra/drought/mapscc_e.htm.

Fieberg, J., and J. Giudice. 2008. Variance of stratified survey estimators with probability of detection adjustments. Journal of Wildlife Management 3:837–844.

Link, W. A., and J. R. Sauer. 2002. A hierarchical analysis of population change with application to Cerulean warblers. Ecology 83:2832–2840.

Martin, T. G., B. A. Wintle, J. R. Rhodes, P. M. Kuhnert, S. A. Field, S. J. Low-Choy, A. J. Tyre, H. P. Possingham, and M. Anderson. 2005. Zero tolerance ecology: improving ecological inference by modeling the source of zero observations. Ecology Letters 8:1235–1246.

Saskatchewan Watershed Authority. 2009. Streamflow Forecast and Water Supply Outlook for Saskatchewan, May 1, 2009. River Forecast Centre, Operations, Saskatchewan Watershed Authority Technical report, Moose Jaw, Saskatchewan. URL http://www.swa.ca/WaterManagement/ClimateConditions.asp.

Sauer, J. R., and S. Droege. 1990. Wood duck population trends from the North American Breeding Bird Survey. Pages 159–165 *in* L. H. Fredrickson, G. V. Burger, S. P. Havera, D. A. Graber, R. E. Kirby, and T. S. Taylor, editors. Proceedings of the 1988 North American Wood Duck Symposium, 20–22 February 1988. St. Louis, MO.

Smith, G. W. 1995. A critical review of the aerial and ground surveys of breeding waterfowl in North America. U.S. Department of Interior Biological Science Report 5, Washington, D.C.

U.S. Fish and Wildlife Service. 2009. Adaptive Harvest Management: 2009 Hunting Season. U.S. Department of Interior Technical report, Washington, D.C.

Zimpfer, N. L., W. E. Rhodes, E. D. Silverman, G. S. Zimmerman, and M. D. Koneff. 2009. Trends in duck breeding populations, 1955-2009. U.S. Department of Interior Technical report, Washington, D.C. URL http://www.fws.gov/migratorybirds/NewsPublicationsReports.html.

2 Status of Geese and Swans

Abstract: We provide information on the population status and productivity of North American Canada geese (*Branta canadensis*), brant (*B. bernicla*), snow geese (*Chen caerulescens*), Ross' geese (*C. rossii*), emperor geese (*C. canagica*), white-fronted geese (*Anser albifrons*), and tundra swans (*Cygnus columbianus*). In May of 2009, temperatures were 1–5°C colder than average throughout the central region of subarctic and Arctic Canada. In some locales harsh spring conditions persisted into June. In areas near Hudson Bay and the Queen Maud Gulf, goose and swan nesting activities were delayed by 1 to 3 weeks. In contrast, nesting conditions were favorable near Wrangel Island, Alaska's North Slope and eastern interior regions, parts of the Canadian high Arctic, and Newfoundland. Improved wetland abundance in the Canadian and U.S. prairies, and other temperate regions will likely improve the production of Canada geese that nest at southern latitudes. Primary abundance indices decreased for 15 goose populations and increased for ten goose populations in 2009 compared to 2008. Primary abundance indices for both populations of tundra swans increased in 2009 from 2008 levels. The following populations displayed significant positive trends during the most recent 10-year period ($P < 0.05$); Mississippi Flyway Giant, Aleutian, Atlantic, and Eastern Prairie Canada geese; Greater, Western Arctic/Wrangel Island, and Western Central Flyway light geese; and Pacific white-fronted geese. No populations showed a significant negative 10-year trend. The forecast for the production of geese and swans in North America for 2009 is regionally variable, but production for many populations will be reduced this year due to harsh spring conditions in much of central Canada.

This section summarizes information regarding the status, annual production of young, and expected fall flights 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). The annual production of young by northern-nesting geese is influenced greatly by weather conditions on the breeding grounds, especially the timing of spring snowmelt and its impact on the initiation of nesting activity (i.e., phenology). 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, recruitment rates are less variable, but productivity is influenced by localized drought and flood 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. Some of the goose populations described herein are comprised of more than one subspecies and some light goose populations contain two species (i.e., snow and Ross' 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

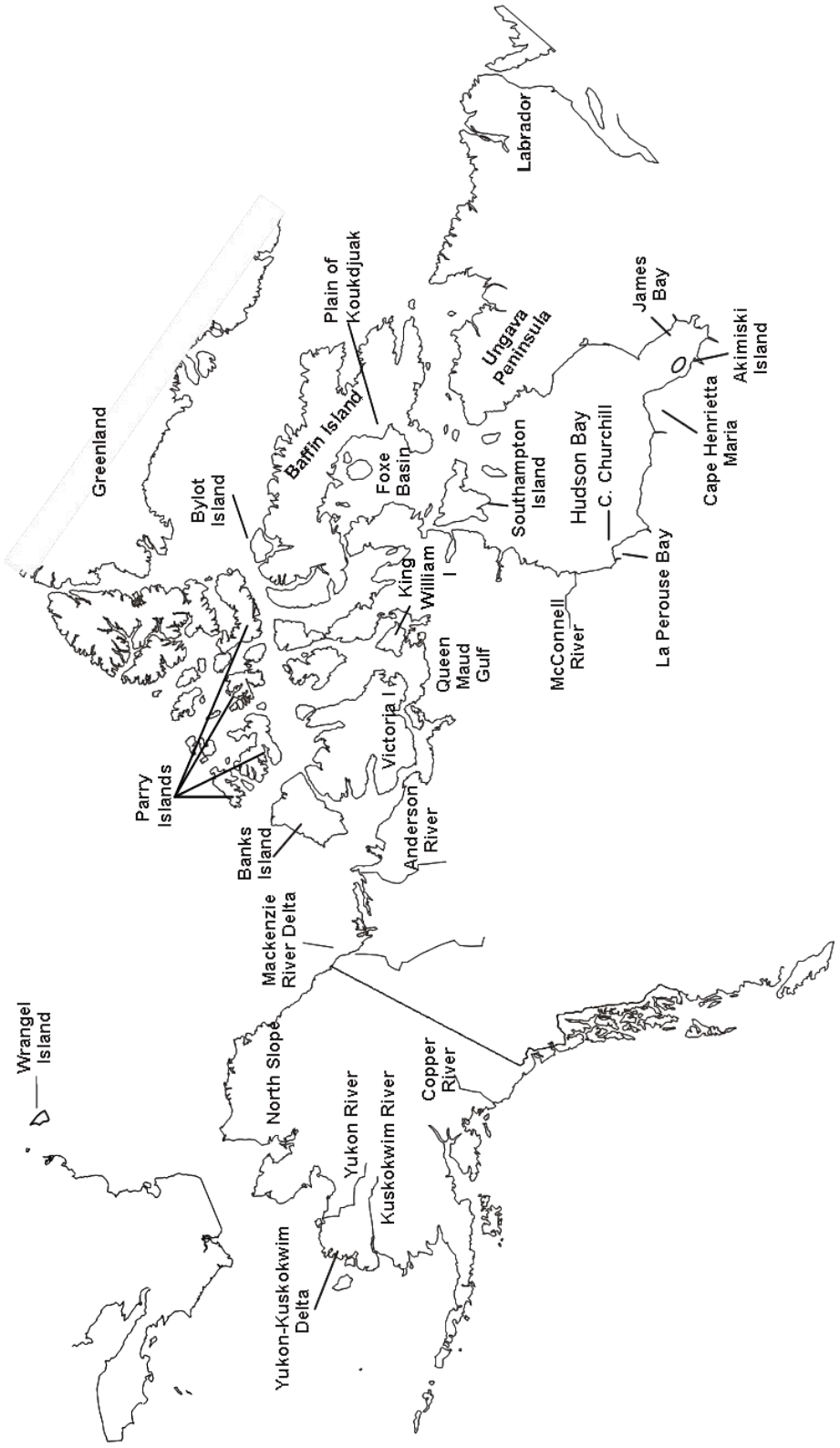


Figure 6: Important goose and swan nesting areas in Arctic and subarctic North America.

Figure 7: The extent of snow and ice cover in North America on 2 June 2009 and 2 June 2008 (data from National Oceanic and Atmospheric Administration).

goose populations. When survey methodology allowed, 95% confidence intervals were presented with population estimates. The 10-year 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 years were calculated and, where possible, assessed with a z-test using the sum of sampling variances for the two estimates. Primary abundance indices, those related to management plan population objectives, are described first in population-specific sections and graphed when data are available.

Because this report was completed prior to the final annual assessment of goose and swan reproduction, the annual productivity of most populations is only predicted qualitatively. Information on habitat conditions and forecasts of productivity were primarily based on observations made during various waterfowl surveys and interviews with field biologists. These reports provide reliable information for specific locations, but may not provide accurate assessment for the vast geographic range of waterfowl populations.

Results and Discussion

Conditions in the Arctic and Subarctic

May 2009 was 1–5°C colder than average throughout a broad area of subarctic and Arctic central Canada. In areas near Hudson Bay and the Queen Maud Gulf, harsher than average spring conditions persisted into June. Despite near average or below average overwinter snowfall, snow cover persisted in many of these areas and delayed goose nesting activities by 1 to 3 weeks beyond average. Several Waterfowl Breeding Population and Habitat Survey crews throughout North America reported unusually high numbers of migrant geese in southerly crew areas, suggesting a delayed migration of northern-nesting geese in spring 2009. In contrast, climate records and field reports from Wrangel Island, much of Alaska, the western Canadian Arctic, and the high Arctic indicate near average or earlier than average spring breakup. Gosling production of many migrant Canada goose populations that migrate to the Atlantic, Mississippi, and Central Flyways will likely be reduced substantially in 2009. It is expected that production of snow, Ross', and white-fronted geese of the Central and Mississippi Flyways will also be below average. The snow and ice cover graphics (Figure 7, National Oceanic and Atmospheric Administration, http://www.natice.noaa.gov/ims/) illustrates the persistent snow cover in the eastern subarctic and advanced snowmelt along the north coast of western Canada on 2 June 2009 compared to the same date in 2008.

Conditions in Southern Canada and the United States

Conditions that influence the productivity of Canada geese vary less from year to year in these temperate regions than in the Arctic and subarc-

tic. Given adequate wetland numbers and the absence of flooding, temperate-nesting Canada geese are reliably productive. Indices of wetland abundance in the Canadian and U.S. prairies in 2009 were greatly improved from 2008 and contributed to increased nesting and brood rearing success this year. Generally favorable nesting conditions were reported in most areas inhabited by temperate-nesting geese in southern Canada and the United States. In a few regions (e.g., WY, eastern AB, and western SK) drought or inclement weather during laying or hatching reduced production potential. Production of temperate-nesting Canada geese from most of their North American range is expected to be average or above average in 2009.

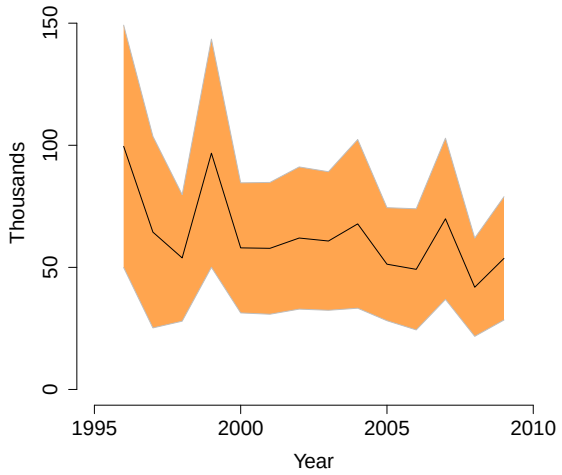


Figure 8: Estimated numbers (and 95% confidence intervals) of North Atlantic Population Canada geese (breeding pairs).

Status of Canada Geese

North Atlantic Population (NAP)

NAP Canada geese principally nest in Newfoundland and Labrador. They generally commingle during winter with other Atlantic Flyway Canada geese, although NAP geese have a more coastal distribution than other populations (Figure 9). Biologists are considering revising the index used to monitor this population to one that combines the WBPHS transect and the Canadian helicopter plot survey data. We continue to present interim indices until that new index has been adopted. Based on data from the 2009 WBPHS, biologists estimated 53,700 (±25,200) indicated pairs (singles plus pairs) within the NAP range (strata 66 and 67), 28% more than in 2008 ($P = 0.473$; Figure 8). Indicated pair estimates declined an average of 2% per year during 2000–2009 ($P = 0.269$). The 2009 estimate of 179,700 (±89,300) total NAP Canada geese was 66% above last year's estimate ($P = 0.174$). Preliminary information from the CWS helicopter plot surveys in Newfoundland and Labrador indicated a strong nesting effort that remained above the long-term average. Below-average winter snowfall and mild spring temperatures contributed to an early snowmelt in Newfoundland in 2009 and likely benefited NAP Canada geese. In Labrador, average winter snowfall and a colder spring contributed to less favorable nesting conditions. Preliminary data indicated that clutch sizes of NAP geese in 2009 appeared to be larger than average. A fall flight similar to that of 2008 is expected.

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. The AP winters from New England to South Carolina, but the largest concentrations occur on the Delmarva Peninsula (Figure 9). Spring surveys in 2009 yielded an estimate of 176,100 (±28,300) breeding pairs, 4% more than in 2008 ($P = 0.752$; Figure 10.1). Breeding pair estimates increased an average of 5% per year during 2000–2009 ($P = 0.025$). In 2009, 38% of indicated pairs were observed as singles. This proportion is well below the 17-year average (51%), near the lowest on record (34%), and indicates a poor nesting effort in 2009. The estimated total spring population of 1,097,700 (±171,600) in 2009 was 11% lower than in 2008 ($P = 0.362$). May temperatures in AP range in 2009 were 3–4°C colder than average and snowmelt was delayed. Nesting studies along Ungava Bay estimated a mean nest initiation date seven days later than average, and a below-average clutch size of 3.62. Production is

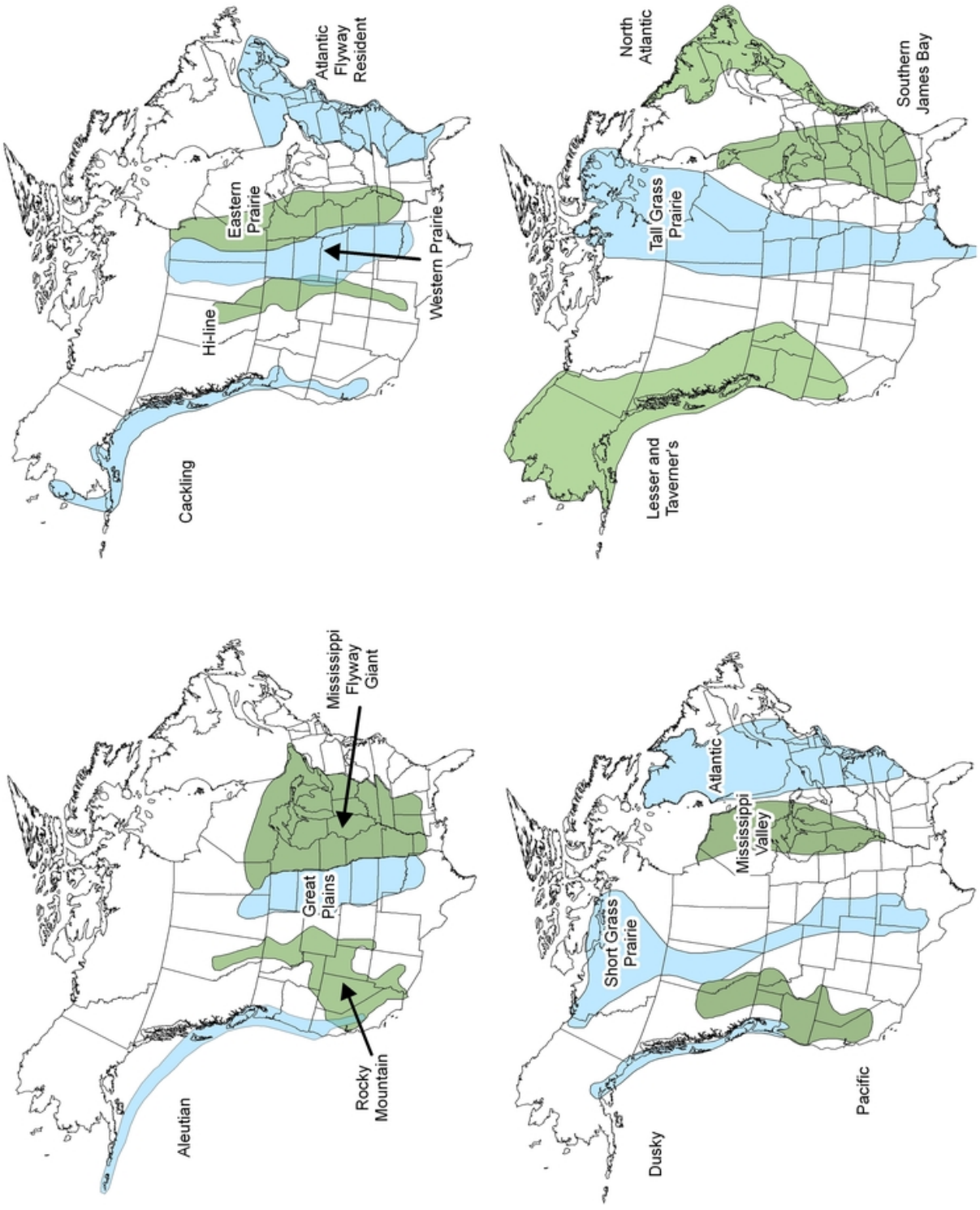
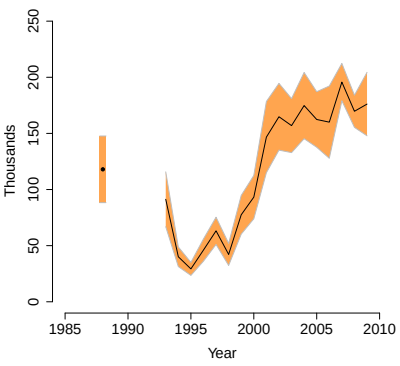
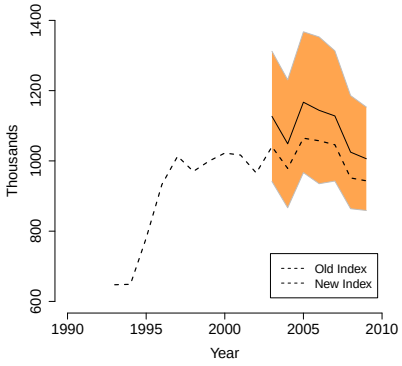


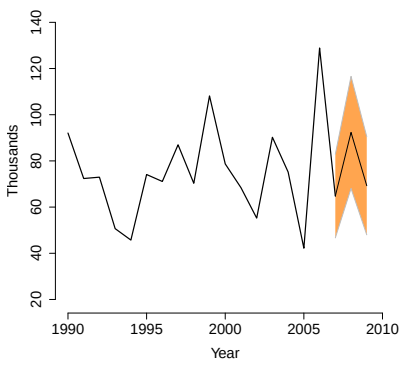
Figure 9: Approximate ranges of Canada goose populations in North America.



10.1: Atlantic Population



10.2: Atlantic Flyway Resident Population



10.3: Southern James Bay Population

Figure 10: Estimated numbers (and 95% confidence intervals) of Atlantic Population (breeding pairs), Atlantic Flyway Resident Population (breeding adults), and Southern James Bay Population (breeding adults) Canada geese.

expected to be poor to moderate in 2009 with a fall flight reduced from 2008.

Atlantic Flyway Resident Population

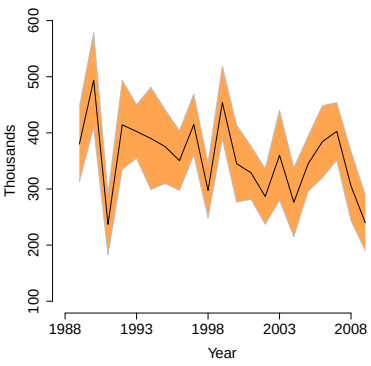
This population of large Canada geese inhabits its southern Ontario and Quebec, the southern Maritime provinces, and all states of the Atlantic Flyway (Figure 9). Surveys during spring 2009 estimated 1,006,100 (±147,200) Canada geese in this population, 2% fewer than in 2008 ($P = 0.866$; Figure 10.2). The new indices decreased an average of 1% per year during the last seven years ($P = 0.203$). Nesting conditions in the northern portion of the AFRP range were reportedly good to excellent, with cool and dry weather during nesting activities. Although the southern portion of the range experienced cool and wet weather, biologists expect excellent AFRP production. The 2009 fall flight was expected to be similar to the recent average.

Southern James Bay Population (SJBP)

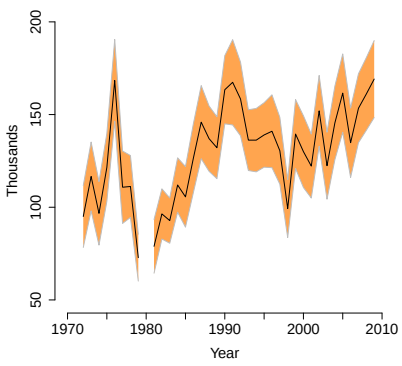
This population nests on Akimiski Island and in the Hudson Bay Lowlands to the west and south of James Bay. The SJBP winters from southern Ontario and Michigan to Mississippi, Alabama, Georgia, and South Carolina (Figure 9). The estimated number of breeding SJBP geese in spring 2009 was 69,200 (±21,200), 25% lower than last year's index ($P = 0.161$; Figure 10.3). These indices of SJBP geese have increased an average of 1% per year since 2000 ($P = 0.710$). Transect-level analyses of this year's breeding pair estimates appeared similar to the previous five years on Akimiski Island and the mainland. The 2009 survey indicated a total spring population of 77,500 (±23,900) Canada geese, 30% fewer than in 2008 ($P = 0.074$). Surveys in 2009 were conducted with the traditionally used aircraft and within the target survey period. Above-average snow pack and a colder than average May contributed to nesting phenology near the long-term average, but much later than the previous five-year average. Nesting studies on Akimiski Island indicated relatively low nest densities, below-average clutch sizes, and poorer nest success compared to recent years. Biologists expect gosling production and the 2009 fall flight to be below average.

Mississippi Valley Population (MVP)

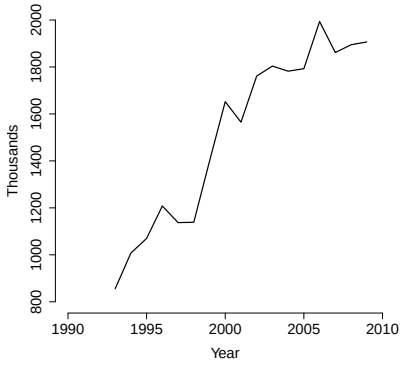
The nesting range of this population is in northern Ontario, principally in the Hudson Bay Lowlands, west of Hudson and James Bays. MVP Canada geese primarily concentrate during fall and winter in Wisconsin, Illinois, and Michigan (Figure 9). Breeding ground surveys conducted in 2009 indicated the presence of 239,600 (±49,500) MVP breeding adults, 21% fewer than



11.1: Mississippi Valley Population



11.2: Eastern Prairie Population



11.3: Mississippi Flyway Giant Population

Figure 11: Estimated numbers (and 95% confidence intervals) of Mississippi Valley Population (breeding adults), Eastern Prairie Population (single and paired breeding adults), and Mississippi Flyway Giant Population (breeding adults) Canada geese.

in 2008 ($P = 0.104$; Figure 11.1). Estimates of breeding adults decreased an average of 1% per year during 2000–2009 ($P = 0.592$). Transect-level analyses of MVP breeding pairs indicated the 2009 estimates were lower ($P = 0.044$) than the previous five-year mean. Surveys indicated a total population of 518,200 (±191,800) Canada geese, a 17% decrease from the revised 2008 estimate ($P = 0.392$). Spring phenology in the MVP range in 2009 was among the latest recorded since 1989. May was characterized by near-record snow cover, mean daily temperatures more than 3°C below average, and several snow storms. Nesting studies near Peawanuck, Ontario yielded nest density estimates even lower than last year's poor nesting effort, and very low nest success. Nesting conditions inland from the coast appeared to be less harsh. Biologists expect poor production again in 2009 and a fall flight lower than that of last year.

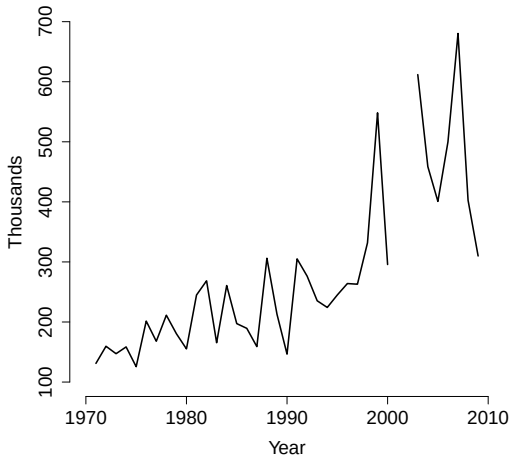
Eastern Prairie Population (EPP)

These geese nest in the Hudson Bay Lowlands of Manitoba and concentrate primarily in Manitoba, Minnesota, and Missouri during winter (Figure 9). The 2009 survey estimate of single and paired EPP geese was 169,200 (±20,800), 5% higher than last year ($P = 0.581$; Figure 11.2). Estimates of these population components have increased an average of 3% per year during 2000–2009 ($P = 0.016$). The 2009 spring estimate of total geese was 279,900 (±31,200), 9% higher than the 2008 estimate ($P = 0.317$). The estimated number of productive geese (nesting pairs and singles) was 54,100 in 2009, 20% lower than in 2008. Biologists at the Nestor One field station near Cape Churchill observed the latest median hatch date (12 July), the second lowest nest density (2.7 nests/100 ha), and the second lowest clutch size recorded during studies there during 1976–2009. Very poor production and a fall flight lower than 2008 is expected in 2009.

Mississippi Flyway Giant Population (MFGP)

Giant Canada geese have been reestablished or introduced in all Mississippi Flyway states. This subspecies now represents a large proportion of all Canada geese in the Mississippi Flyway (Figure 9). Biologists estimated the presence of 1,906,600 MFGP geese during the spring of 2009, 1% more than the revised 2008 estimate, and the second highest estimate on record (Figure 11.3). These estimates have increased an average of 2% per year since 2000 ($P = 0.003$). Iowa and Minnesota reported above-average nesting conditions in 2009, while production in other MFGP states was expected

12.1: Western Prairie/Great Plains Population



12.2: Tall Grass Prairie Population

Figure 12: Numbers of Western Prairie/Great Plains Population and Tall Grass Prairie Population Canada geese estimated during winter surveys.

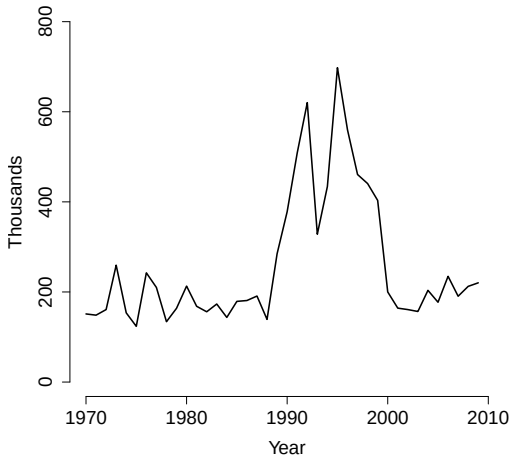
to be near average. Biologists expect a fall flight this year similar to that of 2008.

Western Prairie and Great Plains Populations (WPP/GPP)

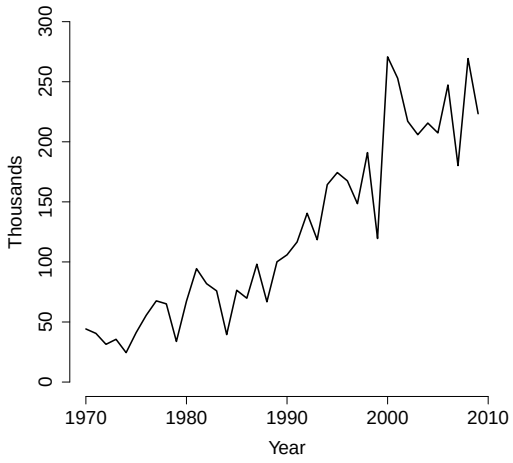
The WPP is composed of mid-sized and large Canada geese that nest in eastern Saskatchewan and western Manitoba. The GPP is composed of large Canada geese resulting from restoration efforts in Saskatchewan, North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, and Texas. Geese from these breeding populations commingle during migration with other Canada geese along the Missouri River in the Dakotas and on reservoirs from southwestern Kansas to Texas (Figure 9). These two populations are managed jointly and surveyed during winter. During the 2009 MWS, 628,000 WPP/GPP geese were counted, 6% fewer than in 2008 (Figure 12.1). These indices decreased 2% per year since 2000 ($P = 0.422$). In 2009, the estimated spring population in the portion of WPP/GPP range included in the WBPHS was 922,900 (±128,100) geese, 11% more than last year ($P = 0.330$). The WBPHS estimates have increased an average of 5% per year since 2000 ($P = 0.004$). The northern WPP range experienced a colder-than-average May and nesting activities were likely delayed. However, wetland abundance in the southern WPP and most of GPP range was greatly improved in 2009 from that of 2008. Goose production in 2009 was reported as above average in South and North Dakota, average to above average in Nebraska, and near average in Oklahoma. A fall flight improved from that of 2008 is expected.

Tall Grass Prairie Population (TGPP)

These small Canada geese 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. TGPP Canada geese winter mainly in Oklahoma, Texas, and northeastern Mexico (Figure 9). These geese mix with other Canada geese on wintering areas, making it difficult to estimate the size of the winter population. During the 2009 MWS in the Central Flyway, 309,900 TGPP geese were counted, 23% fewer than in 2008 (Figure 12.2). These estimates increased an average of 5% per year during 2000–2009 ($P = 0.334$). Most of TGP range, with the exception of Baffin Island, experienced May temperatures 1–4°C below average which likely delayed nesting activities. Nesting phenology of



13.1: Short Grass Prairie Population



13.2: Hi-line Population

Figure 13: Numbers of Short Grass Prairie and Hi-line Canada geese estimated during winter surveys.

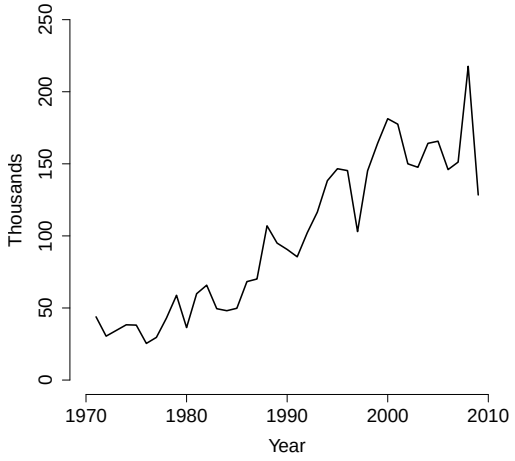
several species on Southampton Island were delayed 2–3 weeks, and production is likely to be low. Biologists working in the Queen Maud Gulf Sanctuary reported goose nesting phenology was one week later than average, and near the latest recorded since 1993. Aerial survey crews working in central Arctic TGP range observed 5–10% snow cover, similar to the last two years and reported phenology as 1–2 weeks later than average. Available information suggests that the production of TGPP Canada geese will be below average in 2009.

Short Grass Prairie Population (SGPP)

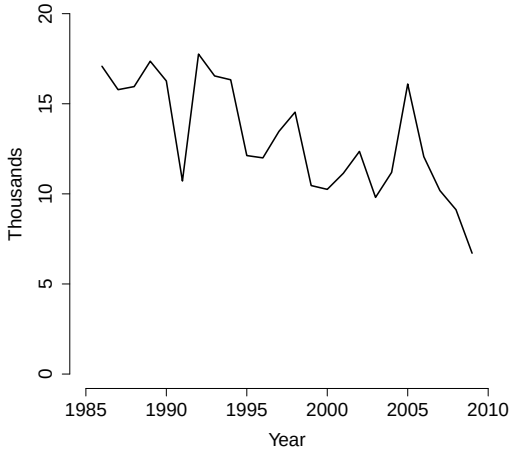
These small Canada geese nest on Victoria and Jenny Lind Islands and on the mainland from the Queen Maud Gulf west and south to the Mackenzie River and northern Alberta. These geese winter in southeastern Colorado, northeastern New Mexico, and the Oklahoma and Texas panhandles (Figure 9). The MWS index of SGPP Canada geese in 2009 was 220,300, 4% higher than in 2008 (Figure 13.1). These indices have increased an average of 3% per year since 2000 ($P = 0.067$). In 2009, the estimated spring population of SGPP geese in the Northwest Territories (WBPHS strata 13–18) was 134,100 (±47,300), a 15% increase from 2008 ($P = 0.621$). WBPHS estimates have increased an average of 6% per year since 2000 ($P = 0.108$). In the eastern half of SGP range, May and June temperatures were 1–3°C colder than average. Spring precipitation was average or below average throughout SGP range. Nesting phenology in the Queen Maud Gulf Sanctuary was one week later than average, and near the latest on record (since 1991). Aerial surveys conducted in eastern SGPP range encountered 5–10% snow cover, similar to the last 2 years, and reported phenology as 1–2 weeks later than average. In western SGPP range (i.e., West Victoria Island and near Inuvik), spring temperatures were average or warmer than average. Wetland conditions in boreal forest SGPP nesting areas were assessed as good. Production of SGPP geese in 2009 is expected to be below average.

Hi-line Population (HLP)

These large Canada geese nest in southeastern Alberta, southwestern Saskatchewan, eastern Montana and Wyoming, and in Colorado. They winter in these states and central New Mexico (Figure 9). The 2009 MWS indicated a total of 223,400 HLP Canada geese, 17% fewer than last year's estimate (Figure 13.2). The MWS estimates have decreased an average of



14.1: Rocky Mountain Population



14.2: Dusky Canada Geese

Figure 14: Estimated numbers of Rocky Mountain Population and dusky Canada geese (breeding adults).

1% per year since the record high count in 2000 ($P = 0.506$). The 2009 WBPHS estimate for Saskatchewan, Alberta, and Montana was 298,400 (±63,600), 12% lower than the 2008 estimate ($P = 0.439$). The WBPHS population estimates have decreased an average of 2% per year during 2000–2009 ($P = 0.247$). Wetland abundance and condition in 2009 were generally improved from last year throughout HLP range. Cool and wet weather during early nesting may have reduced production in Wyoming but weather was not a major negative factor in other states. The fall flight of HLP geese is expected to be similar to that of 2008.

Rocky Mountain Population (RMP)

These large Canada geese nest in southern Alberta and western Montana, and the inter-mountain regions of Utah, Idaho, Nevada, Wyoming, and Colorado. They winter mainly in central and southern California, Arizona, Nevada, Utah, Idaho, and Montana (Figure 9). Spring population estimates from RMP states and provinces in 2009 totaled 128,400 geese, 41% fewer than the revised estimate from 2008 (Figure 14.1). These estimates have decreased an average of 1% per year since 2000 ($P = 0.563$). Population indices in 2009 decreased in Alberta, Montana, Wyoming, Colorado, and Nevada, while increasing only in Utah. Slightly improved wetland conditions and gosling production was reported from most states. The fall flight of RMP geese is expected to be near average.

Pacific Population (PP)

These large Canada geese nest and winter west of the Rocky Mountains from northern Alberta and British Columbia south through the Pacific Northwest to California (Figure 9). The total of PP goose indices in 2009 was 127,000, 47% lower than last year. Most PP geese are surveyed in Alberta (WBPHS strata 76–77) where 68,100 (±28,500) were estimated in 2009, 63% fewer than the unusually high estimate in 2008 ($P = 0.039$), and similar to other recent surveys. Indices of statewide nesting effort in Washington, California, and Nevada increased from 2008 levels, and decreased slightly in Oregon. Habitat conditions varied throughout PP range in 2009 but generally wetland conditions were improved from 2008 with the exception of southwest Idaho and western Washington. In general, gosling production and the 2009 fall flight are expected to be near average.

Dusky Canada Geese (DCG)

These mid-sized Canada geese predominantly nest on the Copper River Delta of southeastern Alaska, and winter principally in the Willamette and Lower Columbia River Valleys of Oregon and Washington (Figure 9). The official population index of DCG was changed from a wintering mark-resight method to a direct count of geese on DCG breeding areas in 2007. The 2009 spring population estimate was 6,700 DCG, 26% below 2008, and the lowest on record for this population since 1986, when comparable surveys were initiated (Figure 14.2). These estimates have decreased an average of 3% during 2000–2009 ($P = 0.222$). Spring snowmelt on the Copper River Delta breeding area was slightly delayed in 2009 due to heavy winter snowfall, and nesting phenology was a few days later than average. A moderately strong run of spawning eulachon (a common prey fish of eagles) contributed to high nest success and low eagle predation on dusky geese this year. Despite the low population level in 2009, gosling production is expected to be near average.

Cackling Canada Geese

Cackling Canada geese nest on the Yukon-Kuskokwim Delta (YKD) of western Alaska. They primarily winter in the Willamette and Lower Columbia River Valleys of Oregon and Washington (Figure 9). Since 1999, the primary index of this population has been an estimate of the fall population derived from the previous spring counts of adults on the YKD. The fall estimate for 2009 is 160,600 geese, 17% lower than that of 2008. These estimates have increased an average of 1% per year since 2000 ($P = 0.521$; Figure 15). Indices of total cackling geese in the YKD coastal zone in 2009 decreased about 20% from last year but indicated pair numbers remained near the record high level of 2008. The timing of spring snowmelt on the YKD was near average and the median hatch date of cackling geese was one day earlier than the long-term average. Yukon Delta nesting surveys conducted during 2009 indicated clutch sizes were slightly below average, fox predation was reduced from the levels of recent years, and nest success was high. Overall, good production and a fall flight similar to that of last year are expected.

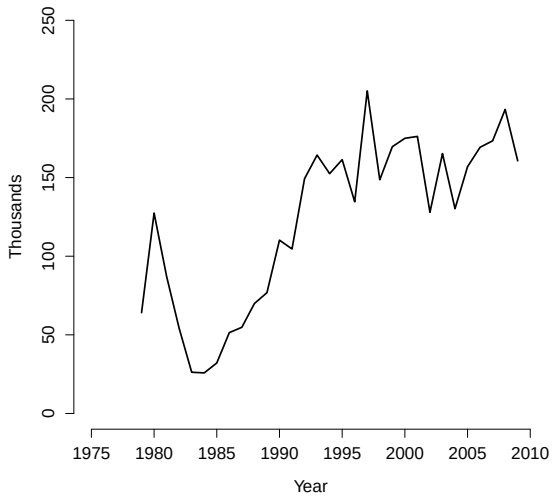


Figure 15: Estimated numbers of cackling Canada geese (fall geese).

Lesser and Taverner's Canada Geese

These populations nest throughout Alaska and winter in Washington, Oregon, and California (Figure 9). Taverner's geese are more strongly associated with tundra areas of the North Slope and western Alaska, while lesser Canada geese tend to nest in Alaska's interior. However, these geese mix with other Canada geese throughout the year and reliable estimates of separate populations are not presently available. The 2009 estimate of Canada geese within WBPHS strata predominantly occupied by these subspecies (strata 1–6, 8, 10–12) was 68,000, 26% lower than the 2008 estimate ($P = 0.339$). These estimates have declined an average of 3% per year since 2000 ($P = 0.239$). Timing of spring break-up and flooding extent in Alaska's interior was variable in 2009. In general, above-average goose production was reported in eastern interior areas, but flooding was reported to have reduced nest success and gosling production in western areas. Overall, production of lesser Canada geese in the interior is expected to be near average. Spring phenology was nearly a week early on the North Slope, and near average on the Yukon Delta. Production of Taverner's

geese is expected to be better than average on the Yukon Delta and the North Slope.

Aleutian Canada Geese (ACG)

The Aleutian Canada goose was listed as endangered in 1967 (the population numbered approximately 800 birds in 1974) and was de-listed in 2001. These geese now nest primarily on the Aleutian Islands, although historically they nested from near Kodiak Island, Alaska to the Kuril Islands in Asia. They now winter along the Pacific Coast to central California (Figure 9). Aleutian population estimates since 1996 are based on analysis of observations of neck-banded geese in California. The preliminary population estimate during the winter of 2008–2009 was 79,500 (±26,100), 29% lower than the revised 2008 estimate ($P = 0.034$; Figure 16). These estimates have increased by an average of 10% per year during the last 10 winters ($P = 0.050$). Biologists working on Buldir Island reported that nesting phenology in 2009 was approximately three days earlier than average, the mean clutch size of 3.4 eggs was lower than the previous average (4.1), and that a strong nesting effort was observed. A fall flight similar to that of last year is expected.

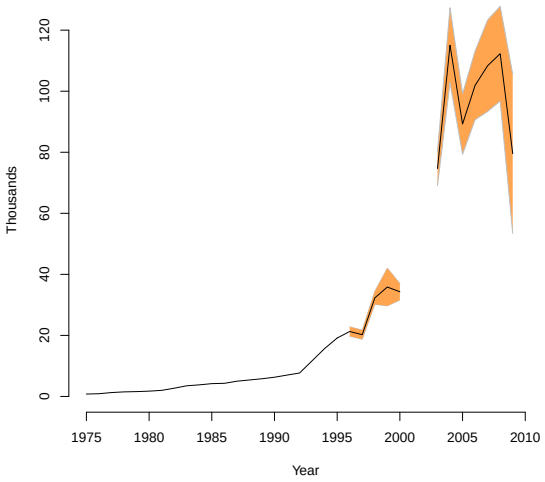


Figure 16: Estimated numbers of Aleutian Canada geese (winter geese, with 95% confidence intervals).

Status of Light Geese

The term light geese refers to both snow geese and Ross' geese (including both white and blue color phases), and the lesser (*C. c. caerulescens*) and greater (*C. c. atlantica*) snow goose subspecies. Another collective term, mid-continent light geese, includes lesser snow and Ross' geese of two populations: the Mid-continent Population and the Western Central Flyway Population.

Ross' Geese

Most Ross' geese nest in the Queen Maud Gulf region, but increasing numbers nest along the western coast of Hudson Bay, and Southampton, Baffin, and Banks Islands. Ross' geese are present in the range of three different populations of light geese and primarily winter in California, New Mexico, Texas, and Mexico, with increasing numbers in Louisiana and Arkansas (Figure 17). Ross' geese are annually surveyed at only one of their numerous nesting colonies. More comprehensive aerial photography inventories and groundwork (to identify proportions of snow and Ross' geese within colonies) are conducted periodically. The largest Ross' goose colonies are in the Queen Maud Gulf Sanctuary. Biologists at the Karrak Lake colony estimated that 726,200 adult Ross' geese nested there in 2008, a 2% decrease from the revised 2007 estimate (Figure 18.1). These estimates increased an average of 8% per year during 1999–2008 ($P < 0.001$). Colony 10, about 60 miles to the east of Karrak Lake, has grown to contain similar or higher numbers of Ross' geese. In 2009, May temperatures near the Queen Maud Gulf were 1–3°C colder than average and spring precipitation was below average. Nesting phenology at the Karrak Lake colony was 1 week later than average and near the latest on record since 1993. Biologists expect Ross' goose production in 2009 to be poor, similar to that of the last 2 years. May temperatures on Southampton Island and along the west coast of Hudson Bay were 2–4°C colder than average, likely delayed goose nesting activities 2–3 weeks, and will contribute to low Ross' goose production there.

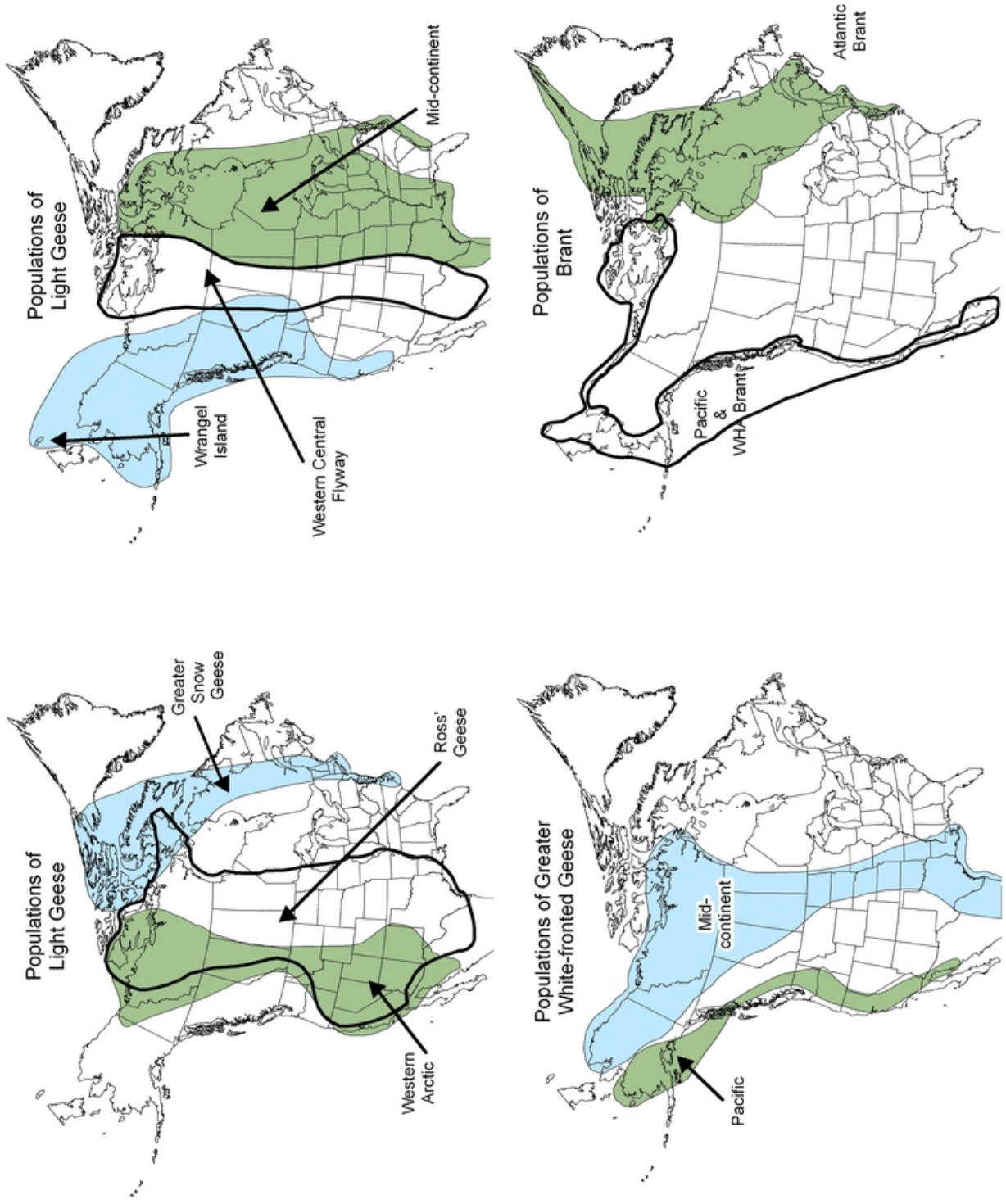
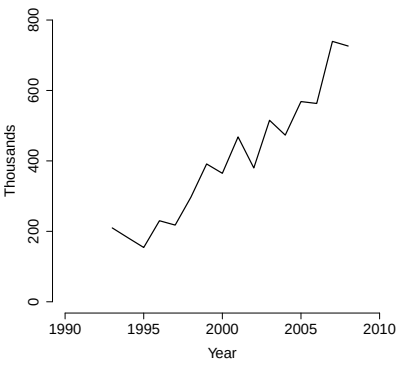
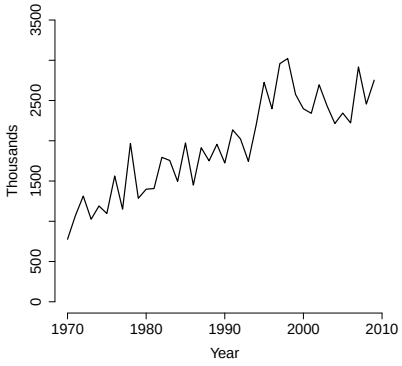


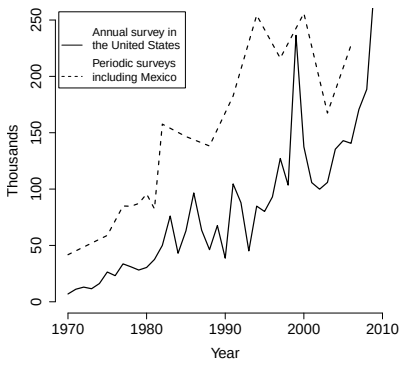
Figure 17: Approximate ranges of brant, snow, Ross', and white-fronted goose populations in North America.



18.1: Ross' Geese



18.2: Mid-continent Population Light Geese



18.3: Western Central Flyway

Figure 18: Estimated numbers of Ross' geese (nesting adults, at the Karrak Lake colony, Nunavut) and Mid-continent Population snow and Ross' geese (winter geese).

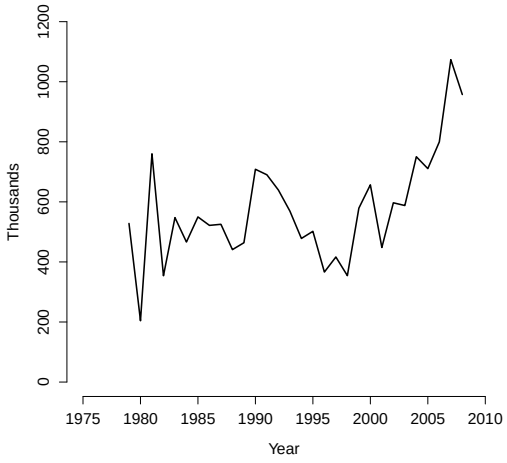
Ross' goose production in 2009 is expected to be below average.

Mid-continent Population Light Geese (MCP)

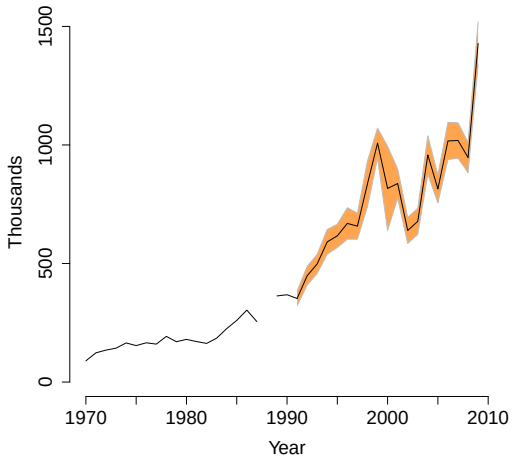
This population includes lesser snow geese and increasing numbers of Ross' geese. Geese of the MCP nest on Baffin and Southampton Islands, with smaller numbers nesting along the west coast of Hudson Bay (Figure 17). These geese winter primarily in eastern Texas, Louisiana, and Arkansas. During the 2009 MWS, biologists counted 2,753,400 light geese, 12% more than in 2008 (Figure 18.2). Winter indices during 2000–2009 have increased an average of 1% per year ($P = 0.325$). Spring temperatures on Baffin Island in 2009 were near average. In contrast, May temperatures on Southampton Island were 2–4°C colder than average in 2009 and biologists there reported spring phenology was delayed 2–3 weeks. May and June temperatures along the Hudson Bay coast in Nunavut and Manitoba were 2–5°C colder than average. Biologists at La Perouse Bay, Manitoba recorded the latest nesting phenology in 41 years in 2009, and reported a near reproductive failure at that small colony. A snowy and cold May likely also reduced snow goose productivity at goose colonies in Ontario and on Akimiski Island. Although snow goose production on Baffin Island may be near average in 2009, poor production from other nesting areas will contribute to a fall flight containing a below-average proportion of young.

Western Central Flyway Population (WCFP)

Historically, this population included predominantly snow geese, but Ross' geese continue to increase and now represent nearly one third of all WCFP geese. Geese of the WCFP nest in the central and western Canadian Arctic, with large nesting colonies near the Queen Maud Gulf and on Banks Island. These geese stage during fall in eastern Alberta and western Saskatchewan and concentrate during winter in southeastern Colorado, New Mexico, the Texas Panhandle, and the northern highlands of Mexico (Figure 17). WCFP geese wintering in the U.S. portion of their range are surveyed annually, but the entire range, including Mexico, is surveyed only once every three years. The Mexico survey that was scheduled for 2009 was not conducted this year due to sociopolitical unrest in that country. In the U.S. portion of the 2009 survey, 284,400 geese were counted, 51% more than in 2008 (Figure 18.3). These population indices have increased 9% per year during 2000–2009 ($P = 0.003$). In 2009, May temperatures near the Queen Maud Gulf were 1–3°C colder than average and spring precipitation was below average. Nesting phenology at Karrak Lake colony was one week later than average and near the latest on record since 1993. Biologists ex-



19.1: Western Arctic/Wrangel Island Population



19.2: Greater Snow Goose Population

Figure 19: Estimated numbers of Western Arctic/Wrangel Island Population snow geese (fall geese) and greater snow goose (spring staging geese, with 95% confidence intervals).

pect snow and Ross' goose production there in 2009 to be poor, similar to that of the last two years. Reports indicate that spring temperatures and snowfall on Banks Island were near average, and local contacts indicate nesting phenology was about average. Photographic survey crews reported a strong nesting effort and production was expected to be at least average there. Snow goose production from this population will be similar to that of last year.

Western Arctic/Wrangel Island Population (WAWI)

Most of the snow geese in the Pacific Flyway originate from nesting colonies in the western and central Arctic (WA: Banks Island, the Anderson and Mackenzie River Deltas, and the western Queen Maud Gulf region) or Wrangel Island (WI), located off the northern coast of Russia. The WA segment of the population winters in central and southern California, New Mexico, and Mexico; the WI segment winters in the Puget Sound area of Washington and in northern and central California (Figure 17). In winter, WA and WI segments commingle with light geese from other populations in California, complicating surveys. The fall 2008 estimate of WAWI snow geese was 957,400, 11% lower than the previous year's record-high count (Figure 19.1). Fall estimates increased 7% per year during 1999–2008 ($P = 0.003$). Reports indicate that spring conditions and nesting phenology on Banks Island was near average in 2009. Snow goose nesting efforts were below average at Kendall Island, and were extremely poor at Anderson River colonies. Nesting conditions at Wrangel Island's Tundra River colony were reported as excellent and one of the earliest nesting seasons on record. Preliminary estimates included a spring population of 135,000–140,000 adults, with 50,000–60,000 nesting pairs. Estimates of the Wrangel Island spring population have increased an average of 4% per year since 2000 ($P < 0.001$). Biologists expected excellent production from Wrangel Island with estimated nest success estimated at 80% and a mean clutch size of 4.1 eggs. A larger-than-average fall flight is expected in 2009.

Greater Snow Geese (GSG)

This subspecies principally nests on Bylot, Axel Heiberg, Ellesmere, and Baffin Islands, and on Greenland, and winters along the Atlantic coast from New Jersey to North Carolina (Figure 17). This population is monitored on their spring staging areas near the St. Lawrence Val-

ley in Quebec. The preliminary estimate from spring surveys in 2009 was 1,428,000 (±178,400) geese, 51% more than estimated last year estimate ($P < 0.001$; Figure 19.2). Spring estimates of greater snow geese have increased an average of 6% per year since 2000 ($P = 0.013$). The number of snow geese counted during the 2009 MWS in the Atlantic Flyway was 410,300, a 1% increase from the 2008 survey. Midwinter counts have increased an average of 1% per year during 2000–2009 ($P = 0.561$). The largest known greater snow goose nesting colony is on Bylot Island. Timing of snowmelt on Bylot Island in 2009 was near average and nesting phenology was about one day earlier than the long-term average. Nest density in the colony was relatively high, mean clutch size (3.4 eggs) was slightly below average (3.7), and nest success to mid-incubation was high at 88% (average is 64%). Good production and a fall flight above average are expected.

Status of Greater White-fronted Geese

Pacific Population White-fronted Geese (PP)

These geese primarily nest on the Yukon-Kuskokwim Delta (YKD) of Alaska and winter in the Central Valley of California (Figure 17). The index for this population was a fall estimate from 1979–1998. Since 1999, the index has been a fall population estimate derived from spring surveys of adults on the YKD and Bristol Bay. The 2009 fall estimate is 536,700, 14% lower than the 2008 record-high estimate (Figure 20). These estimates have increased an average of 6% per year since 2000 ($P = 0.002$). The timing of spring snowmelt on the YKD was near average and the median hatch of white-fronted geese was two days later than the long-term average. Yukon Delta nesting surveys conducted during 2009 indicated clutch sizes were near average, fox predation was reduced from the levels of recent years, and nest success was better than average. Good production and a fall flight similar to that of 2008 are expected.

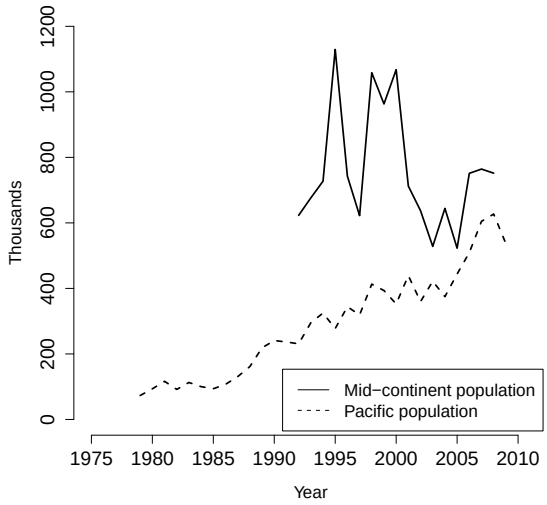


Figure 20: Estimated numbers of Mid-continent Population and Pacific Population white-fronted geese (fall geese).

Mid-continent Population White-fronted Geese (MCP)

These white-fronted geese nest across a broad region from central and northwestern Alaska to the central Arctic and the Foxe Basin. They concentrate in southern Saskatchewan during the fall and in Texas, Louisiana, Arkansas, and Mexico during winter (Figure 17). During the fall 2008 survey in Saskatchewan and Alberta, biologists counted 751,700 MCP geese, 2% fewer than during the previous survey (Figure 20). During 1999–2008, these estimates declined by an average of 3% per year ($P = 0.284$). Eastern portions (e.g., Queen Maud Gulf, Rasmussen Lowlands) of MCP white-fronted goose range experienced colder than average May temperatures and nesting activities were apparently delayed. May temperatures near the Queen Maud Gulf were 1–3°C colder than average and goose nesting phenology near Karrak Lake was one week later than average and near the latest on record since 1993. White-fronted goose production there is expected to be below average. Mild spring conditions near the Mackenzie River Delta and on Alaska's North Slope contributed to earlier-than-average spring phenology. Numbers of white-fronts observed during surveys of the North Slope were similar to recent years

and above the long-term average. Production in those areas is expected to be better than average. In Alaska's interior, snowmelt progressed early and rapidly. In general, eastern interior Alaska experienced above-average goose production, but flooding in western areas reduced nest success and gosling production. Overall, production of MCP white-fronted geese in 2009 is expected to be near average.

Status of Brant

Atlantic Brant (ATLB)

Most of this population nests on islands of the eastern Canadian Arctic. These brant winter along the Atlantic Coast from Massachusetts to North Carolina (Figure 17). The 2009 MWS estimate of brant in the Atlantic Flyway was 151,300, 7% lower than the 2008 estimate (Figure 21). These estimates have shown no trend during 2000–2009 ($P = 0.676$). May temperatures along James Bay staging areas and southerly brant nesting areas (e.g., Southampton Island) were 1–4°C colder than average and nesting phenology on Southampton Island was reportedly the latest observed since 1996. At latitudes to the north of Southampton, including Baffin and Devon Islands, spring temperatures showed far less deviation from average. Considering the harsh conditions that existed in 2009 near some nesting and important staging areas, Atlantic brant production is expected to be below average.

Pacific Brant (PACB)

These brant nest across Alaska's Yukon-Kuskokwim Delta (YKD) and North Slope, Banks Island, other islands of the western and central Arctic, the Queen Maud Gulf, and Wrangel Island. They winter as far south as Baja California and the west coast of Mexico (Figure 17). Winter surveys were not conducted in Mexico in 2009 due to sociopolitical unrest, so there is no comparable population metric for 2009. The 2008 MWS estimate of brant in the Pacific Flyway and Mexico was 147,400, 10% more than the estimate in 2007 (Figure 21).

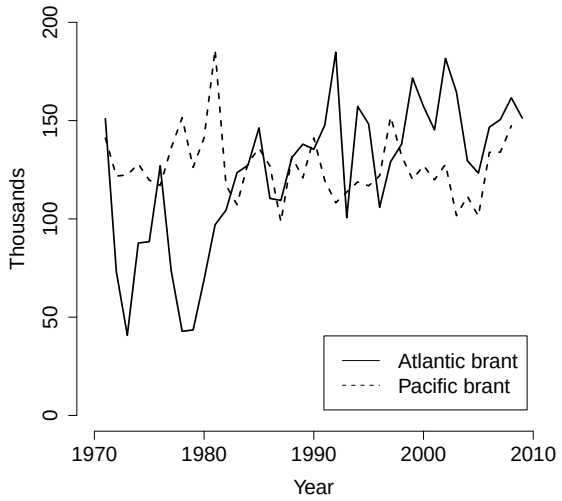


Figure 21: Numbers of Atlantic and Pacific brant estimated during winter surveys.

The estimates during 1999–2008 had increased an average of 1% per year ($P = 0.356$). The timing of spring snowmelt on the YKD was near average in 2009 and the nesting phenology of brant was three days later than the average since 1982. Brant nest densities at five primary colonies on the YKD in 2009 increased from levels in 2008, but remained below the average level since 1992. Fox predation was reduced from recent years, clutch sizes were slightly above average, and nest success measured outside the primary colonies was higher than 2008 and above the average level since 1982. Spring phenology was expected to be near average on Banks Island, and delayed near the Queen Maud Gulf. Brant production was expected to be near average on the YKD, good on Alaska's North Slope, and variable in Canadian portions of their range. The fall flight is expected to be similar to that of last year.

Western High Arctic Brant (WHA)

This population of brant nests on the Parry Islands of the Northwest Territories (Figure 17). The population stages in fall at Izembek Lagoon, Alaska. They 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. This population is monitored dur-

ing the MWS in three Washington state counties. During the 2009 MWS, 16,200 brant were counted, 76% more than in 2008. These estimates have increased an average of 7% per year during 2000–2009 ($P = 0.086$). Satellite imagery indicated moderate snowpack on the Parry Islands during the nesting period and is consistent with near-average production for WHA brant in 2009.

Status of Emperor Geese

The breeding range of emperor geese is restricted to coastal areas of the Bering Sea, with the largest concentration on the Yukon-Kuskokwim Delta (YKD) in Alaska. Emperor geese migrate relatively short distances and primarily winter in the Aleutian Islands (Figure 22). Since 1981, emperor geese have been surveyed annually on spring staging areas in southwestern Alaska. The 2009 emperor goose survey estimate was 91,900, 42% higher than in 2008 (Figure 23.1). These estimates increased an average of 2% per year during 2000–2009 ($P = 0.401$). Aerial surveys during the YKD coastal survey indicated slight decreases in the number of pairs and total birds from 2008 levels but a long-term increasing trend in both indices is still apparent. Spring phenology on the YKD was near average and emperor goose phenology was about two days later than the long-term average. Nesting surveys conducted on the YKD during 2009 indicated clutch sizes were near average and nest success was better than in 2008 and the long-term average. Good production and a fall flight similar to that of 2008 are expected.

Status of Tundra Swans

Western Population Tundra Swans

These swans nest along the coastal lowlands of western Alaska, particularly between the Yukon and Kuskokwim Rivers. They winter primarily in California, Utah, and the Pacific Northwest (Figure 22). The 2009 MWS estimate of 105,200 swans was 17% higher than the 2008 estimate (Figure 23.2). These estimates have increased by an average of 3% per year over the last 10 years ($P = 0.140$). Estimated numbers

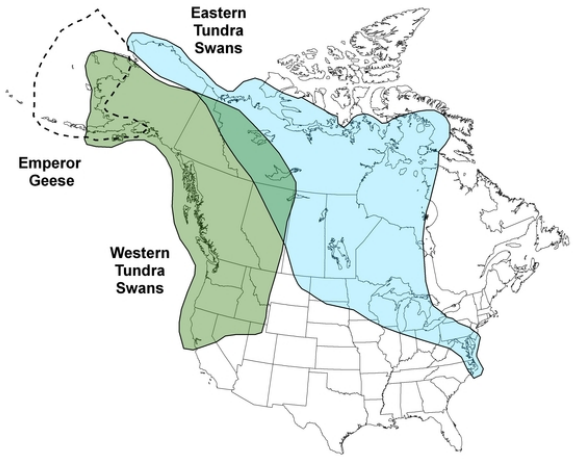
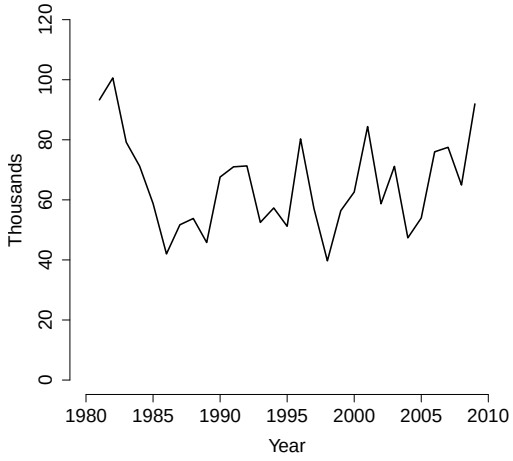


Figure 22: Approximate range of emperor geese, and Eastern and Western Populations of tundra swans in North America.

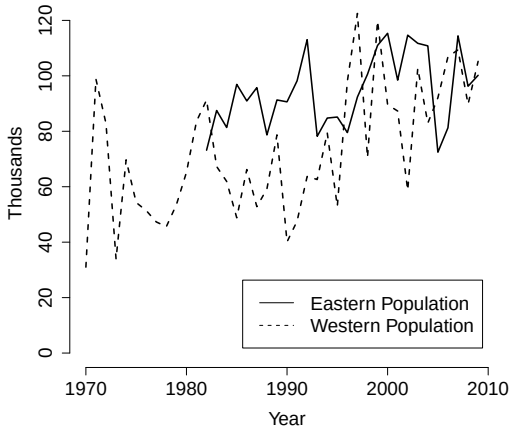
of total swans from the coastal Yukon-Kuskokwim Delta survey during spring 2009 decreased slightly, but numbers of nests and indicated pairs were up slightly compared to 2008. In 2009, the timing of spring ice breakup on the YKD was near average, swan nesting phenology was about six days later than average, clutch sizes were lower than average, and nest success was slightly lower than in 2008 and the long-term average. Swan production is expected to be fair in 2009 and contribute to a fall flight similar to that of last year.

Eastern Population Tundra Swans

Eastern Population tundra swans (EP) nest from the Seward Peninsula of Alaska to the northeast shore of Hudson Bay and Baffin Island. The Mackenzie Delta and adjacent areas are of particular importance. These birds winter in coastal areas from Maryland to North Carolina (Figure 22). The primary index for EP tundra swans includes swans counted during winter in Ontario and the Atlantic and Mississippi Flyways. During the 2009 MWS, 100,200 EP tundra swans were observed, 4% more than in 2008 (Figure 23.2). These estimates decreased by an average of 2% per year during 2000–2009 ($P = 0.361$). Spring phenology was later than average in much of the central and eastern portions of EP tundra swan range in 2009. From



23.1: Emperor geese



23.2: Tundra swans

Figure 23: Estimated numbers of emperor geese (spring staging geese), and Eastern and Western Populations of tundra swans (winter swans).

Alaska's North Slope to just east of the Mackenzie River Delta, spring conditions were more favorable for nesting swans. Spring conditions appeared to be near average on Baffin Island. Swan production in 2009 is expected to be near average.

A Individuals who supplied information for the generation of this report

A.1. Individuals who supplied information on the status of ducks.

Alaska, Yukon Territory, and Old Crow Flats (Strata 1–12)

Air E. Mallek and D. Groves

Northern Alberta, Northeastern British Columbia, and Northwest Territories (Strata 13–18, 20, and 77)

Air F. Roetker and C. Ferguson[e]

Northern Saskatchewan and Northern Manitoba (Strata 21–24)

Air W. Rhodes and J. Goldsberry[e]

Southern and Central Alberta (Strata 26–29, 75, and 76)

Air J. Bredy and D. Fronczak

Ground J. Leafloor[a], M. Gillespie[c], S. Leach[d], G. Raven[a], J. Gilligan[a], M. Ranger[c], N. Clements[b], M. Watmaugh[a], and J. Caswell[b]

Southern Saskatchewan (Strata 30–33)

Air P. Thorpe and P. Devers

Ground D. Nieman[a], P. Nieman[d], M. Oliver[a], A. Williams[a], K. Dufour[a], P. Bergen[a], N. Wiebe[c], K. Warner[a], D. Wilkinson[a], and J. Leslie[c]

Southern Manitoba (Strata 25, 34–40)

Air T. Liddick and D. Benning[e]

Ground D. Caswell[a], M. Schuster[a], P. Rakowski[a], G. Ball[b], D. Walker[c], N. Astleford[a], B. Edmundson[a] and F. Baldwin[b]

Montana and Western Dakotas (Strata 41–44)

Air R. Bentley and P. Fastbender

Ground K. Fleming and J. Klimstra

Eastern Dakotas (Strata 45–49)

Air J. Solberg and T. Lewis

Ground P. Garrettson, K. Kruse, R. Holbrook, D. Collins, and S. Gibbs

Western Ontario and Central Quebec (Strata 50, 69–70)

Air J. Wortham and G. Boomer

Central and Eastern Ontario, Hudson and James Bay Lowlands (Strata 51, 54, 57–59)

Air M. Koneff and G. Zimmerman

Southern Ontario and Southern Quebec (Strata 52–53, 55–56, and 68)

Air J. Rayfield and E. Huggins

Maine and Maritimes (Strata 62–67)

Air	J. Bidwell and D. Forsell

Canadian Wildlife Service helicopter plot survey

Quebec	D. Bordage[a], C. Lepage[a], C. Marcotte[a], and S. Orichefsky[a]
Ontario	K. Ross[a], D. McNicol[a], D. Fillman[a], R. Russell[a], and S. Meyer[a]
New Brunswick & Nova Scotia	R. Hicks[a] and B. Pollard[a]
Labrador & Newfoundland	S. Gilliland[a], P. Ryan[a], W. Barney[b], P. Padding, and C. Dwyer

California

Air	M. Weaver[b] and S. Oldenburger[b]
Ground	D. Loughman[d] and J. Kwolek[d]

Michigan

Air	B. Barlow[b], B. Berger[b], S. Chadwick[b], K. Cleveland[b], E. Kafcas[b], A. Karr[b], T. Maples[b], T. McFadden[b], M. Mills[b], J. Niewoonder[b], and J. Robison[b]

Minnesota

Air	T. Pfingsten[b] and S. Cordts[b]
Ground	S. Kelly, W. Brininger, R. Papasso, D. Hertel, F. Osland, T. Cooper, J. Kelley, P. Richert, L. Berkely, S. Zodrow, K. Bousquet, L. Deede, L. Stevenson, G. Dehmer, M. Bryand, E. Koronka, T. Warga, and T. Moser

Nebraska

M. Virtiska

Northeastern U.S.

Data Analysis	J. Klimstra
Connecticut	M. Huang[b] and K. Kubik[b]
Delaware	M. Dibona[b]
Maryland	L. Hindman[b], D. Brinker[b], T. Decker[b], B. Evans[b], C. Harris[b], R. Hill[b], R. Norris[b], D. Price[b], G. Timko[b], and D. Webster[b]
Massachusetts	Massachusetts Division of Fisheries and Wildlife personnel and cooperators
New Hampshire	J. Robinson[b], P. Tate[b], T. Walski[b], K. Bordeau[b], K. Rines[b], E. Robinson[b], A. Timmins[b], W. Staats[b], and J. Kelley[b]
New Jersey	P. Castelli[b], T. Nichols[b], A. Burnett[b], J. Garris[b], B. Kirkpatrick[d], K. Korth[b], S. Petzinger[b], J. Powers[b], S. Predl[b], L. Widjeskog[b], T. Watts[b], R. Somes[b], P. Winkler[b], M. Gnoinski[b], K. Bond[b], D. Wilkinson[b], and P. Woerner[b]
New York	Staff of New York Department of Environmental Conservation
Pennslyvania	D. Brauning[b], M. Casalena[b], J. Dunn[b], J. Gilbert[b], D. Gross[b], T. Hardisky[b], K. Jacobs[b], M. Lovallo[b], J. Morgan[b], D. Mummert[b], B. Palmer[b], M. Ternent[b], C. Thoma[b], and S. Trusso[b]

Rhode Island	J. Osenkowski[b], C. Brown[b], B. Tefft[b], M. Griffin[b], and S. Wittwer[b]
Vermont	B. Crenshaw[b], J. Gobeille[b], D. Sausville[b], J. Mlcuch[b], J. Buck[b], A. Alfiere[b], K. Royar[b], F. Hammond[b], D. Blodgett[b], and J. Flewelling[b]
Virginia	G. Costanzo[b] and T. Bidrowski[b]

Nevada

Air	C. Nicolai[b], K. Neill[b], and J. Romero[d]

Oregon

Air	B. Bales[b], B. Reishus[b], N. Leonetti[b], T. Collom[b], M. St. Louis[b], E. Miguez[b], J. Journey[b], M. Kirsch[b], N. Myatt[b], J. Thompson[b], C. Sponseller[b], R. Klus[b], D. Marvin[b], J. Nelson[b], A. Larkins[b], and Brim Aviation[d]

Washington

Air	M. Moore[b], R. Finger[b], B. Hoenes[b], J. Bernatowicz[b], W. Moore[b], M. Livingston[b], P. Fowler[b], P. Wik[b], H. Ferguson[b], M. Atamian[b], D. Base[b], D. Palmer[b], S. Fitkin[b], J. Heinlen[b], D. Volsen[b], J. Gallie[b], T. Hames[b], E. Krausz[b], J. Bohannan[b], B. Bales[b], G. Schirato[b], B. Murphie[b]

Wisconsin

Air	L. Waskow[b], P. Berringer[b], C. Cold[b], C. Kopacek[b], and C. Milestone[b]
Ground	T. Carlson[b], J. Carstens[b], J. Christian[b], G. Dunsmoor[b], E. Grossman[b], J. Huff[b], D. Hutchison[b], B. Kelly[b], R. McDonough[b], C. Mogen[b], K. Morgan[b], J. Pritzl[b], M. Rasmussen[b], J. Robaidek[b], M. Schmidt[b], M. Soergel[b], K. Van Horn[b], J. Wanner[b], R. Weide[b], D. Wyman[b], P. Charland, A. Kitchen, J. Lutes, S. Otto, S. Papon, R. Sammerdyke, G. VanVreede, and T. Walters[d]

[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

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

Flyway-wide and Regional Survey Reports: K. Bollinger, D. Caswell[a], D. Collins, J. Fischer, D. Fronczak, J. Kelley, J. Klimstra, K. Kruse, J. Leafloor[a], R. Oates, M. Otto, P. Padding, R. Raftovich, D. Sharp, and R. Trost

Information from the Breeding Population and Habitat Survey: See Appendix A

North Atlantic Population Canada Geese: J. Bidwell, S. Gilliland[a], B. Pollard[a], and G. Zimmerman

Atlantic Population Canada Geese: J. Bidwell, P. Castelli[b], R. Cotter[a], W. Harvey[b], L. Hindman[b], J. Rodrigue[a], and P. May[d]

Atlantic Flyway Resident Population Canada Geese: P. Castelli[b], G. Costanzo[b], W. Crenshaw[b], J. Dunn[b], H. Heusmann[b], L. Hindman[b], R. Hossler[b], M. Huang[b], K. Jacobs[b], J. Osenkowski[b], and E. Robinson[b]

Southern James Bay Population Canada Geese: K. Abraham[b], R. Brook[b], J. Hughes[a], and M. Koneff

Mississippi Valley Population Canada Geese: K. Abraham[b], R. Brook[b], J. Hughes[a], and M. Koneff

Mississippi Flyway Population Giant Canada Geese: K. Abraham[b], F. Baldwin[b], D. Graber[b], J. Hughes[a], D. Luukkonen[b], R. Marshalla[b], L. Naylor[b], A. Phelps[b], R. Pritchert[b], L. Reynolds[b], D. Scott[b], K. Van Horn[b], T. White[b], and G. Zenner[b]

Eastern Prairie Population Canada Geese: D. Andersen[d], F. Baldwin[b], B. Lubinski, A. Raedeke[b], M. Reiter[d], and J. Wollenberg[b]

Western Prairie and Great Plains Populations Canada Geese: M. Johnson[b], F. McNew[b], D. Nieman[a], W. Rhodes, J. Richardson[b], J. Solberg, P. Thorpe, S. Vaa[b], M. Vritiska[b]

Tall Grass Prairie Population Canada Geese: R. Alisauskas[a] , G. Gilchrist[a], D. Groves, and E. Mallek

Short Grass Prairie Population Canada Geese: R. Alisauskas[a], D. Groves, J. Ingram[a], E. Mallek, F. Roetker

Hi-Line Population Canada Geese: R. Bentley, J. Bredy, J. Gammonley[b], J. Hansen[b], W. Rhodes, L. Roberts[b], E. Silverman, and P. Thorpe

Rocky Mountain Population Canada Geese: T. Aldrich[b], J. Bredy, J. Bohne[b], J. Gammonley[b], C. Mortimore[b], R. Northrup[b], L. Roberts[b], E. Silverman, and D. Yparraguirre[b]

Pacific Population Canada Geese: B. Bales[b], A. Breault[a], T. Hemker[b], D. Kraege[b], C. Mortimore[b], R. Northrup[b], B. Reishus[b], F. Roetker, M. Weaver[b], and D. Yparraguirre[b]

Dusky Canada Geese: J. Fode[b], B. Larned, and R. Stehn

Lesser and Taverner's Canada Geese: K. Bollinger, C. Dau, D. Groves, B. Larned, E. Mallek, and M. Spindler

Table A.2: Continued.

Cackling Canada Geese: K. Bollinger and C. Dau

Aleutian Canada Geese: V. Byrd, T. Sanders, and L. Spitler

Greater Snow Geese: J. Lefebvre[a], G. Gauthier[d], and A. Reed[d]

Mid-continent Population Light Geese: K. Abraham[b], R. Brook[b], G. Gilchrist[a], B. Lubinski, and R. Rockwell[d]

Western Central Flyway Population Light Geese: R. Alisauskas[a] and J. Ingram[a]

Western Arctic/Wrangel Island Population Snow Geese: V. Baranuk[d], S. Boyd[a] J. Ingram[a], and D. Kraege[b]

Ross' Geese: R. Alisauskas[a], D. Caswell[a], J. Leafloor[a], and P. Thorpe

Pacific Population White-Fronted Geese: C. Dau, K. Bollinger, and D. Groves

Mid-continent Population White-fronted Geese: R. Alisauskas[a], R. Bentley, S. Durhams[b], D. Groves, J. Ingram[a], K. Kraii[b], B. Larned, E. Mallek, D. Nieman[a], F. Roetker, M. Spindler, and K. Warner[a]

Pacific Brant: B. Larned and H. Wilson

Atlantic Brant: G. Gilchrist[a]

Western High Arctic Brant: D. Kraege[b]

Emperor Geese: C. Dau and E. Mallek

Western Population Tundra Swans: K. Bollinger and C. Dau

Eastern Population Tundra Swans: C. Dau, B. Larned, and E. Mallek

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

B Waterfowl Breeding Population and Habitat Survey map

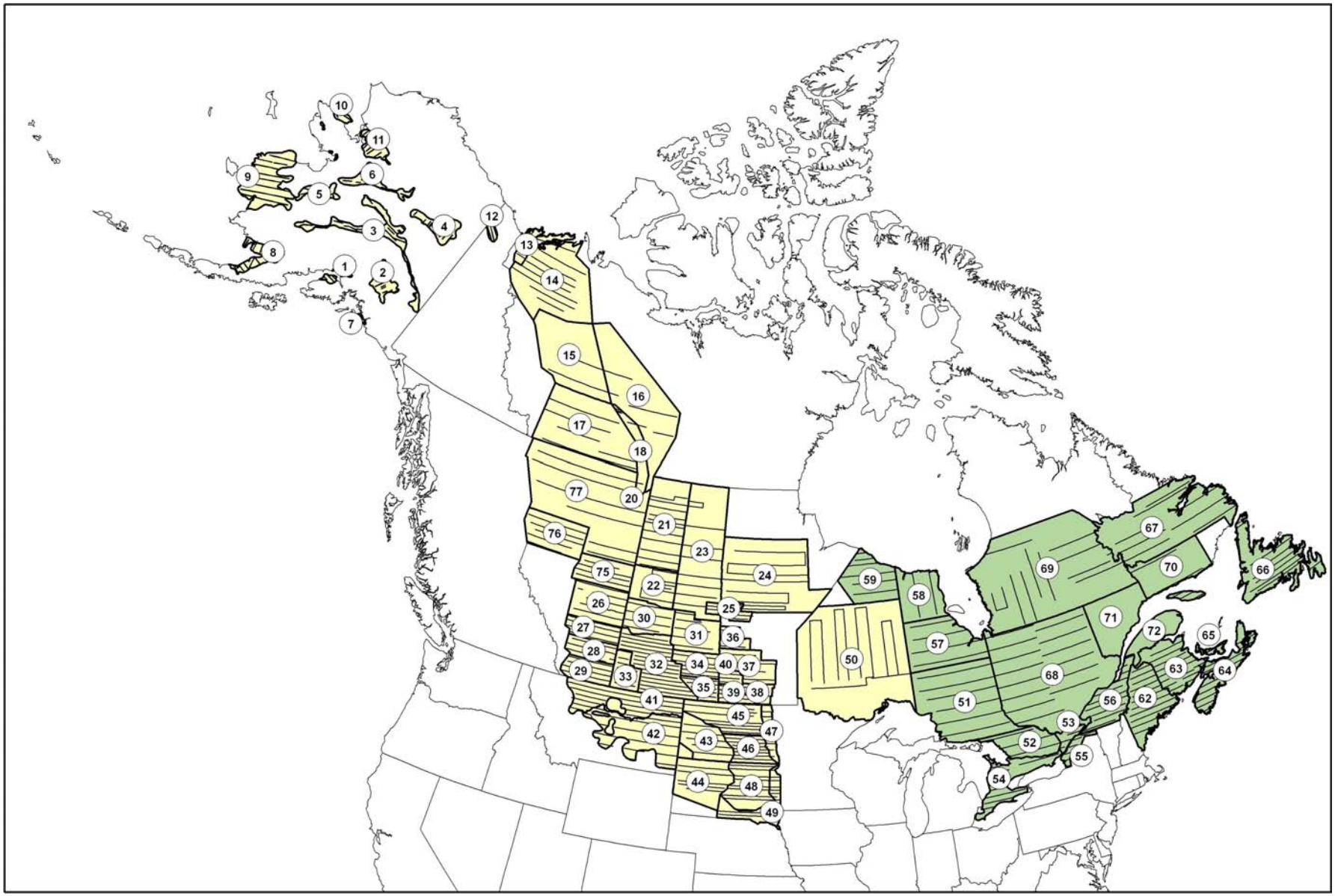


Figure B.1: Strata and transects of the of the Waterfowl Breeding Population and Habitat Survey (Yellow = traditional survey area, green = eastern survey area).

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

[a] No comparable survey data available for the north-central U.S. during 1961–73.

Table C.1: Continued.

	Prairie Canada		Northcentral U.S.		Total	
Year	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$
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
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

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[b]		California		Michigan		Minnesota		Nebraska	
Year	Total ducks	Mallards	Total ducks	Mallards	Total ducks	Mallards	Total ducks	Mallards	Total ducks	Mallards
1955									101.5	32.0
1956									94.9	25.8
1957									154.8	26.8
1958									176.4	28.1
1959									99.7	12.1
1960									143.6	21.6
1961									141.8	43.3
1962									68.9	35.8
1963									114.9	37.4
1964									124.8	66.8
1965									52.9	20.8
1966									118.8	36.0
1967									96.2	27.6
1968							368.5	83.7	96.5	24.1
1969							345.3	88.8	100.6	26.7
1970							343.8	113.9	112.4	24.5
1971							286.9	78.5	96.0	22.3
1972							237.6	62.2	91.7	15.2
1973							415.6	99.8	85.5	19.0
1974							332.8	72.8	67.4	19.5
1975							503.3	175.8	62.6	14.8
1976							759.4	117.8	87.2	20.1
1977							536.6	134.2	152.4	24.1
1978							511.3	146.8	126.0	29.0
1979							901.4	158.7	143.8	33.6
1980							740.7	172.0	133.4	37.3
1981							515.2	154.8	66.2	19.4
1982							558.4	120.5	73.2	22.3
1983							394.2	155.8	141.6	32.2
1984							563.8	188.1	154.1	36.1
1985							580.3	216.9	75.4	28.4
1986							537.5	233.6	69.5	15.1
1987	2.7	0.2					614.9	192.3	120.5	41.7
1988	4.9	0.6					752.8	271.7	126.5	27.8
1989	4.6	0.5					1,021.6	273.0	136.7	18.7
1990	4.7	0.5					886.8	232.1	81.4	14.7
1991	5.9	0.6					868.2	225.0	126.3	26.0
1992	6.2	0.6	497.4	375.8	665.8	384.0	1,127.3	360.9	63.4	24.4
1993	5.7	0.5	666.7	359.0	813.5	454.3	875.9	305.8	92.8	23.8
1994	6.6	0.6	483.2	311.7	848.3	440.6	1,320.1	426.5	118.9	17.5
1995	6.5	0.8	589.7	368.5	812.6	559.8	912.2	319.4	142.9	42.0

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

[b] Index to waterfowl use in prime waterfowl producing areas of the province.

Table C.2: Continued.

	British Columbia[b]		California		Michigan		Minnesota		Nebraska	
Year	Total ducks	Mallards	Total ducks	Mallards	Total ducks	Mallards	Total ducks	Mallards	Total ducks	Mallards
1996	6.4	0.5	843.7	536.7	790.2	395.8	1,062.4	314.8	132.3	38.9
1997	5.7	0.5	824.3	511.3	886.3	489.3	953.0	407.4	128.3	26.1
1998	7.3	0.9	706.8	353.9	1,305.2	567.1	739.6	368.5	155.7	43.4
1999	8.5	0.9	851.0	560.1	824.8	494.3	716.5	316.4	251.2	81.1
2000	8.2	0.8	562.4	347.6	1,121.7	462.8	815.3	318.1	178.8	54.3
2001	7.8	0.8	413.5	302.2	673.5	358.2	761.3	320.6	225.3	69.2
2002	9.0	0.6	392.0	265.3	997.3	336.8	1,224.1	366.6	141.8	50.6
2003	8.6	0.6	533.7	337.1	587.2	294.1	748.9	280.5	96.7	32.9
2004	6.6	0.6	412.8	262.4	701.9	328.8	1,099.3	375.3	69.9	23.2
2005	5.6	0.5	615.2	317.9	442.6	238.5	681.3	238.5	117.1	29.3
2006		103.3	649.4	399.4	353.5	207.8	529.4	160.7		
2007		99.3	627.6	388.3	723.0	315.0	495.6	242.5		
2008		73.7	554.3	297.1	457.0	189.0	740.0	297.6		
2009			510.8	302.0	530.5	258.9	507.0	236.4		

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

[b] Index to waterfowl use in prime waterfowl producing areas of the province.

Table C.2: Continued.

	Nevada		Northeastern U.S.[c]		Oregon		Washington		Wisconsin	
Year	Total ducks	Mallards	Total ducks	Mallards	Total ducks	Mallards	Total ducks	Mallards	Total ducks	Mallards
1955										
1956										
1957										
1958										
1959	14.2	2.1								
1960	14.1	2.1								
1961	13.5	2.0								
1962	13.8	1.7								
1963	23.8	2.2								
1964	23.5	3.0								
1965	29.3	3.5								
1966	25.7	3.4								
1967	11.4	1.5								
1968	10.5	1.2								
1969	18.2	1.4								
1970	19.6	1.5								
1971	18.3	1.1								
1972	19.0	0.9								
1973	20.7	0.7							412.7	107.0
1974	17.1	0.7							435.2	94.3
1975	14.5	0.6							426.9	120.5
1976	13.6	0.6							379.5	109.9
1977	16.5	1.0							323.3	91.7
1978	11.1	0.6							271.3	61.6
1979	12.8	0.6					98.6	32.1	265.7	78.6
1980	16.6	0.9					113.7	34.1	248.1	116.5
1981	26.9	1.6					148.3	41.8	505.0	142.8
1982	21.0	1.1					146.4	49.8	218.7	89.5
1983	24.3	1.5					149.5	47.6	202.3	119.5
1984	24.0	1.4					196.3	59.3	210.0	104.8
1985	24.9	1.5					216.2	63.1	192.8	73.9
1986	26.4	1.3					203.8	60.8	262.0	110.8
1987	33.4	1.5					183.6	58.3	389.8	136.9
1988	31.7	1.3					241.8	67.2	287.1	148.9
1989	18.8	1.3					162.3	49.8	462.5	180.7
1990	22.2	1.3					168.9	56.9	328.6	151.4
1991	14.6	1.4					140.8	43.7	435.8	172.4
1992	12.4	0.9					116.3	41.0	683.8	249.7
1993	14.1	1.2	1,158.1	686.6			149.8	55.0	379.4	174.5
1994	19.2	1.4	1,297.3	856.3	336.7	125.0	123.9	52.7	571.2	283.4
1995	17.9	1.0	1,408.5	864.1	227.5	85.6	147.3	58.9	592.4	242.2

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

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

Table C.2: Continued.

	Nevada[d]		Northeastern U.S.[c]		Oregon		Washington		Wisconsin	
Year	Total ducks	Mallards	Total ducks	Mallards	Total ducks	Mallards	Total ducks	Mallards	Total ducks	Mallards
1996	26.4	1.7	1,430.9	848.6	298.9	108.3	163.3	61.6	536.3	314.4
1997	25.3	2.5	1,423.5	795.2	370.9	127.7	172.8	67.0	409.3	181.0
1998	27.9	2.1	1,444.0	775.2	358.0	132.9	185.3	79.0	412.8	186.9
1999	29.9	2.3	1,522.7	880.0	334.3	133.6	200.2	86.2	476.6	248.4
2000	26.1	2.1	1,933.5	762.6	324.4	116.3	143.6	47.7	744.4	454.0
2001	22.2	2.0	1,397.4	809.4			146.4	50.5	440.1	183.5
2002	11.7	0.7	1,466.2	833.7	276.2	112.2	133.3	44.7	740.8	378.5
2003	21.1	1.7	1,266.2	731.9	258.7	96.9	127.8	39.8	533.5	261.3
2004	12.0	1.7	1,416.9	805.9	245.6	92.3	114.9	40.0	651.5	229.2
2005	10.7	0.7	1,416.2	753.6	226.1	83.5	111.5	40.8	724.3	317.2
2006	37.4	1.8	1,384.2	725.2	263.5	88.4	135.4	45.5	522.6	219.5
2007	11.4	2.1	1,500.4	687.6	336.5	101.7	128.3	46.1	470.6	210.0
2008	11.5	1.9	1,197.1	619.1	239.9	84.3	120.9	50.6	626.9	188.4
2009	105.5	1.3	1,271.1	666.8	198.3	79.5	116.5	47.5	502.4	200.5

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

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

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).

	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

Table C.3: Continued.

	Mallard		Gadwall		American wigeon		Green-winged teal		Blue-winged teal	
Year	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$
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
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

Table C.3: Continued.

	Northern shoveler		Northern pintail		Redhead		Canvasback		Scaup	
Year	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$
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

Table C.3: Continued.

	Northern shoveler		Northern pintail		Redhead		Canvasback		Scaup	
Year	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$
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
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

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

	Traditional Survey Area[a]	
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

Table C.4: Continued.

	Traditional Survey Area[a]	
Year	$\widehat{N}$	$\widehat{SE}$
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
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

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

Table C.5: Breeding population estimates and 90% confidence intervals or credibility intervals (CIs; in thousands) for the 10 most abundant species of ducks in the eastern survey area, 1990–2009[a].

	Mergansers[b]		Mallard		American black duck		American wigeon		Green-winged teal	
Year	$\hat{N}$	90% CI	$\hat{N}$	90% CI	$\hat{N}$	90% CI	$\hat{N}$	90% CI	$\hat{N}$	90% CI
1990	382.5	(319.4, 466.1)	339.0	(219.6, 570.1)	439.0	(389.6, 498.9)	13.5	(1.4, 25.7)	241.9	(188.8, 319.4)
1991	475.5	(393.7, 591.7)	383.8	(250.0, 637.8)	442.7	(388.7, 511.6)	15.2	(2.1, 28.3)	231.3	(179.9, 308.6)
1992	458.5	(373.3, 587.9)	384.0	(247.8, 643.9)	421.6	(371.5, 482.3)	5.1	(0.5, 9.7)	217.9	(167.7, 291.9)
1993	431.7	(352.6, 542.8)	389.4	(252.4, 648.6)	420.7	(368.2, 482.9)	10.4	(3.4, 17.5)	198.2	(151.3, 266.8)
1994	449.6	(358.8, 601.4)	405.0	(261.4, 678.2)	385.8	(336.8, 444.0)	10.2	(2.4, 18.1)	209.8	(160.8, 285.4)
1995	505.0	(404.0, 660.8)	336.9	(214.6, 573.9)	439.9	(383.6, 506.1)	9.5	(0.0, 21.4)	214.4	(163.3, 290.9)
1996	425.1	(356.4, 517.8)	362.2	(233.3, 611.8)	509.3	(454.5, 575.0)	10.0	(3.8, 16.3)	277.5	(219.4, 363.3)
1997	441.0	(368.4, 538.9)	385.4	(248.9, 648.5)	457.8	(410.0, 514.5)	18.2	(10.2, 26.2)	216.3	(169.7, 283.4)
1998	359.2	(300.6, 437.5)	427.7	(279.5, 702.2)	490.8	(439.9, 551.9)	58.1	(21.8, 94.5)	206.4	(162.7, 268.2)
1999	427.2	(356.0, 526.4)	435.5	(286.1, 716.1)	547.1	(490.3, 617.0)	14.1	(10.1, 18.1)	250.7	(197.1, 327.9)
2000	438.8	(368.4, 533.1)	390.3	(256.2, 643.3)	506.2	(454.1, 567.2)	38.1	(6.0, 70.2)	271.9	(216.5, 350.3)
2001	413.1	(346.9, 501.6)	425.0	(279.6, 698.4)	475.4	(426.1, 533.7)	43.9	(24.5, 63.3)	222.4	(175.1, 288.7)
2002	550.1	(460.3, 669.6)	420.3	(277.6, 684.6)	528.1	(474.5, 592.6)	13.1	(4.7, 21.4)	265.5	(209.2, 348.1)
2003	486.6	(406.4, 596.7)	434.0	(284.7, 715.4)	477.5	(427.9, 536.0)	11.6	(3.4, 19.8)	255.5	(201.3, 334.2)
2004	501.6	(422.4, 605.7)	456.8	(302.0, 743.6)	491.6	(440.0, 552.5)	22.8	(11.0, 34.5)	295.1	(232.2, 388.5)
2005	478.7	(399.9, 587.4)	442.8	(289.2, 733.2)	480.0	(428.9, 540.9)	31.1	(17.6, 44.7)	234.9	(186.0, 306.6)
2006	438.6	(368.4, 533.4)	411.4	(272.1, 678.0)	501.5	(448.8, 564.1)	11.5	(5.2, 17.8)	238.4	(187.9, 310.9)
2007	476.7	(397.1, 589.0)	455.1	(298.2, 744.5)	576.4	(512.3, 652.5)	14.0	(5.0, 23.0)	272.4	(215.4, 353.7)
2008	459.7	(385.3, 559.6)	451.1	(298.7, 735.3)	499.3	(446.6, 562.5)	8.4	(2.5, 14.4)	270.0	(211.5, 356.9)
2009	460.2	(386.2, 558.9)	462.7	(305.8, 750.7)	463.6	(414.6, 522.1)	12.0	(6.0, 18.0)	272.6	(213.4, 357.8)

[a] Estimates for mallards, American black ducks, green-winged teal, ring-necked duck, bufflehead, goldeneyes, and mergansers from Bayesian hierarchical analysis using FWS and CWS data from strata 51, 52, 63, 64, 66–68, 70–72. All others were computed as variance-weighted means of FWS and CWS estimates for strata 51, 52, 63, 64, 66–68, 70–72.

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

Table C.5: Continued

	Scaup[c]		Ring-necked duck		Goldeneyes[d]		Bufflehead		Scoters[e]	
Year	$\hat{N}$	90% CI	$\hat{N}$	90% CI	$\hat{N}$	90% CI	$\hat{N}$	90% CI	$\hat{N}$	90% CI
1990	50.9	(4.2, 97.6)	543.2	(428.9, 707.1)	360.9	(283.4, 475.0)	35.5	(23.4, 47.6)	99.5	(0.1, 199.5)
1991	38.8	(17.0, 60.6)	479.9	(379.4, 622.9)	374.5	(294.1, 493.0)	28.4	(14.9, 41.9)	89.8	(24.7, 154.9)
1992	36.9	(3.9, 69.8)	484.6	(385.0, 626.0)	389.2	(305.9, 512.4)	45.3	(27.3, 63.2)	85.2	(0.1, 190.7)
1993	12.0	(3.1, 21.0)	440.5	(349.3, 570.6)	373.5	(291.4, 494.9)	6.6	(3.0, 10.3)	104.4	(18.3, 190.5)
1994	36.7	(6.4, 66.9)	458.6	(360.4, 598.6)	383.9	(299.2, 505.9)	24.3	(7.5, 41.2)	162.2	(38.6, 285.9)
1995	16.5	(0.0, 34.6)	475.5	(373.4, 627.0)	340.8	(264.0, 453.0)	10.3	(4.2, 16.4)	25.9	(7.8, 44.1)
1996	20.4	(2.4, 38.4)	584.1	(465.4, 751.2)	397.9	(312.2, 525.0)	36.1	(23.1, 49.1)	31.6	(16.2, 47.0)
1997	37.4	(5.5, 69.3)	522.7	(418.1, 671.5)	398.4	(313.3, 522.8)	15.3	(8.1, 22.5)	52.6	(28.7, 76.5)
1998	15.6	(1.0, 30.1)	461.7	(367.4, 593.6)	358.6	(282.2, 472.3)	26.8	(19.3, 34.3)	58.9	(35.3, 82.6)
1999	22.3	(2.2, 42.4)	532.9	(427.1, 682.5)	433.8	(336.7, 576.9)	15.0	(9.3, 20.7)	24.2	(8.7, 39.7)
2000	37.9	(18.4, 57.4)	563.1	(449.7, 724.7)	419.6	(328.4, 555.1)	15.9	(9.4, 22.4)	51.7	(28.9, 74.4)
2001	137.9	(0.3, 286.3)	512.4	(409.6, 659.1)	484.5	(378.3, 640.7)	40.4	(24.4, 56.5)	57.1	(28.5, 85.7)
2002	68.8	(0.3, 150.8)	513.4	(408.6, 665.5)	564.2	(425.8, 774.5)	53.2	(35.9, 70.4)	202.1	(0.6, 469.6)
2003	38.7	(12.1, 65.4)	535.6	(428.5, 687.9)	419.0	(328.1, 550.4)	18.9	(11.9, 26.0)	73.4	(27.3, 119.5)
2004	22.8	(10.3, 35.3)	582.2	(462.0, 755.9)	405.4	(321.3, 528.7)	17.3	(10.1, 24.6)	103.3	(57.3, 149.2)
2005	30.0	(14.0, 46.0)	535.6	(430.2, 680.9)	378.7	(299.2, 495.4)	18.8	(8.9, 28.8)	74.8	(45.6, 104.1)
2006	36.9	(18.9, 54.9)	552.2	(441.0, 708.1)	384.1	(303.2, 500.8)	15.1	(9.1, 21.1)	78.8	(27.6, 130.1)
2007	31.3	(18.6, 43.9)	668.1	(530.2, 860.2)	449.4	(352.0, 594.5)	15.7	(8.8, 22.6)	103.2	(40.7, 165.7)
2008	32.5	(21.3, 43.6)	545.8	(437.3, 698.0)	421.5	(330.3, 555.7)	30.2	(19.5, 40.9)	85.6	(56.0, 115.2)
2009	38.4	(20.7, 56.1)	551.4	(438.8, 711.1)	396.5	(312.0, 519.1)	26.9	(18.6, 35.2)	101.4	(62.2, 140.7)

[c] Greater and lesser.

[d] Common and Barrow's.

[e] Black, white-winged, and surf.

D Historical estimates of goose and swan populations

Table D.1: Abundance indices (in thousands) for North American Canada goose populations, 1969–2009.

Year	North Atlantic[a,b]	Atlantic[a,b]	Atlantic Flyway Resident[a]	Southern James Bay[a]	Miss. Valley[a]	Miss. Flyway Giant[a,b]	Eastern Prairie[a]
1969/70							
1970/71							
1971/72							95.0
1972/73							116.6
1973/74							96.7
1974/75							121.5
1975/76							168.4
1976/77							110.8
1977/78							111.2
1978/79							72.8
1979/80							
1980/81							78.9
1981/82							96.4
1982/83							92.8
1983/84							112.0
1984/85							105.6
1985/86							126.4
1986/87							145.9
1987/88		118.0					137.0
1988/89					380.0		132.1
1989/90				92.1	494.0		163.4
1990/91				72.4	237.0		167.4
1991/92				73.0	414.2		158.4
1992/93		91.3		50.7	402.4	855.3	136.2
1993/94		40.1		45.7	390.0	1007.6	136.2
1994/95		29.3		74.1	375.3	1069.8	139.0
1995/96	99.6	46.1		71.1	350.5	1208.0	141.0
1996/97	64.4	63.2		87.0	414.7	1137.1	130.5
1997/98	53.9	42.2		70.3	297.5	1338.7	99.3
1998/99	96.8	77.5		108.1	454.0	1398.8	139.5
1999/00	58.0	93.2		78.7	345.0	1652.3	130.0
2000/01	57.8	146.7		68.4	329.0	1564.9	122.2
2001/02	62.0	164.8		55.2	286.5	1761.2	152.0
2002/03	60.8	156.9	1126.7	90.2	360.1	1804.0	122.4
2003/04	67.8	174.8	1048.7	75.2	276.3	1782.2	145.5
2004/05	51.3	162.4	1167.1	42.2	344.9	1792.6	161.6
2005/06	49.2	160.2	1144.0	128.9	384.4	1993.5	134.8
2006/07	69.9	195.7	1128.0	64.8	402.6	1861.6	153.4
2007/08	41.9	169.7	1024.9	92.3	305.2	1894.6	161.1
2008/09	53.7	176.1	1006.1	69.2	239.6	1906.6	169.2

[a] Surveys conducted in spring.

[b] Number of breeding pairs.

Table D.1: Continued

Year	W. Prairie & Great Plains[b]	Tall Grass Prairie[b,c]	Short Grass Prairie[d]	Hi-line[d]	Rocky Mountain[a]	Dusky[e]	Cackling[f]	Aleutian[e]
1969/70			151.2	44.2				
1970/71		131.1	148.5	40.5	43.9			
1971/72		159.6	160.9	31.4	30.5			
1972/73		147.2	259.4	35.6	34.4			
1973/74		158.5	153.6	24.5	38.3			
1974/75		125.6	123.7	41.2	38.1			0.8
1975/76		201.5	242.5	55.6	25.4			0.9
1976/77		167.9	210.0	67.6	29.6			1.3
1977/78		211.3	134.0	65.1	43.0			1.5
1978/79		180.5	163.7	33.8	58.8		64.1	1.6
1979/80		155.2	213.0	67.3	36.4		127.4	1.7
1980/81		244.9	168.2	94.4	59.9		87.1	2.0
1981/82	175.0	268.6	156.0	81.9	65.8		54.1	2.7
1982/83	242.0	165.5	173.2	75.9	49.5		26.2	3.5
1983/84	150.0	260.7	143.5	39.5	48.1		25.8	3.8
1984/85	230.0	197.3	179.1	76.4	49.8		32.1	4.2
1985/86	115.0	189.4	181.0	69.8	68.3	17.1	51.4	4.3
1986/87	324.0	159.0	190.9	98.1	70.1	15.8	54.8	5.0
1987/88	272.1	306.1	139.1	66.8	107.0	16.0	69.9	5.4
1988/89	330.3	213.0	284.8	100.1	95.0	17.4	76.8	5.8
1989/90	271.0	146.5	378.1	105.9	90.6	16.3	110.2	6.3
1990/91	390.0	305.1	508.5	116.6	85.5	10.7	104.6	7.0
1991/92	341.9	276.3	620.2	140.5	102.2	17.8	149.3	7.7
1992/93	318.0	235.3	328.2	118.5	116.5	16.5	164.3	11.7
1993/94	272.5	224.2	434.1	164.3	138.3	16.3	152.5	15.7
1994/95	352.5	245.0	697.8	174.4	146.6	12.1	161.4	19.2
1995/96	403.3	264.0	561.2	167.5	145.3	12.0	134.6	21.3
1996/97	453.4	262.9	460.7	148.5	103.0	13.5	205.1	20.2
1997/98	482.3	331.8	440.6	191.0	145.2	14.5	148.6	32.3
1998/99	467.2	548.2	403.2	119.5	164.3	10.5	169.6	35.8
1999/00	594.7	295.7	200.0	270.7	181.3	10.3	175.0	34.3
2000/01	682.7	149.1	164.1	252.9	177.5	11.1	176.2	
2001/02	710.3	504.7	160.9	217.1	150.0	12.4	127.9	
2002/03	561.0	611.9	156.7	205.9	147.6	9.8	165.2	74.7
2003/04	622.1	458.7	203.6	215.6	164.2	11.2	130.2	115.1
2004/05	415.1	400.8	177.2	207.4	165.7	16.1	156.9	89.3
2005/06	444.4	499.8	234.7	247.3	146.0	12.1	169.3	101.9
2006/07	446.0	680.3	190.5	180.2	151.2	10.2	173.4	108.3
2007/08	669.5	402.7	212.4	269.3	217.6	9.1	193.3	112.3
2008/09	628.0	309.9	220.3	223.4	128.4	6.7	160.6	79.5

[a] Surveys conducted in spring.

[b] Surveys conducted in December until 1998; in 1999 a January survey replaced the December count.

[c] Only Tall Grass Prairie Population geese counted in Central Flyway range are included.

[d] Surveys conducted in January.

[e] Indirect or preliminary estimate.

[f] Surveys conducted in fall through 1998; from 1999 to present a fall index is predicted from breeding ground surveys (total indicated pairs).

Table D.2: Abundance indices for snow, Ross', white-fronted, and emperor goose populations.

	Snow and Ross' geese				White-fronted geese		Emperor geese[a]
Year	Greater snow geese[a]	Mid-continent[b]	Western Central Flyway[c]	Western Arctic & Wrangel Isl.[d]	Mid-continent[d]	Pacific[e]	
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			73.1	
1979/80	180.0	1,398.1	30.4	528.1		93.5	
1980/81	170.8	1,406.7	37.6	204.2		116.5	93.3
1981/82	163.0	1,794.1	50.0	759.9		91.7	100.6
1982/83	185.0	1,755.5	76.1	354.1		112.9	79.2
1983/84	225.4	1,494.5	43.0	547.6		100.2	71.2
1984/85	260.0	1,973.0	62.9	466.3		93.8	58.8
1985/86	303.5	1,449.4	96.6	549.8		107.1	42.0
1986/87	255.0	1,913.8	63.5	521.7		130.6	51.7
1987/88		1,750.7	46.2	525.3		161.5	53.8
1988/89	363.2	1,956.2	67.6	441.0		218.8	45.8
1989/90	368.3	1,724.3	38.7	463.9		240.8	67.6
1990/91	352.6	2,135.8	104.6	708.5		236.5	71.0
1991/92	448.1	2,021.9	87.9	690.1		230.9	71.3
1992/93	498.4	1,744.1	45.1	639.3	622.9	295.1	52.5
1993/94	591.4	2,200.8	84.9	569.2	676.3	324.8	57.3
1994/95	616.6	2,725.1	80.1	478.2	727.3	277.5	51.2
1995/96	669.1	2,398.1	93.1	501.9	1,129.4	344.1	80.3
1996/97	657.5	2,957.7	127.2	366.3	742.5	319.0	57.1
1997/98	836.6	3,022.2	103.5	416.4	622.2	413.1	39.7
1998/99	803.4	2,575.7	236.4	354.3	1,058.3	393.4	54.6
1999/00	813.9	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	639.3	2,696.1	99.9	448.1	712.3	359.7	58.7
2002/03	678.0	2,435.0	105.9	596.9	637.2	422.0	71.2
2003/04	957.6	2,214.3	135.4	587.8	528.2	374.9	47.4
2004/05	814.6	2,344.2	143.0	750.3	644.3	443.9	54.0
2005/06	1,017.0	2,221.7	140.6	710.7	522.8	509.3	76.0
2006/07	1,019.0	2,917.1	170.6	799.7	751.3	604.7	77.5
2007/08	947.0	2,455.1	188.5	1,073.5	764.3	627.0	64.9
2008/09	1,428.0	2,753.4	284.4	957.4	751.7	536.7	91.9

[a] Surveys conducted in spring.

[b] Surveys conducted in December until 1997/98; surveys since 1998/99 were conducted in January.

[c] Surveys conducted in January.

[d] Surveys conducted in autumn.

[e] Surveys conducted in fall through 1998; from 1999 to present a fall index is predicted from breeding ground surveys (total indicated birds).

[f] Incomplete or preliminary.

Table D.3: Abundance indices of North American brant and swan populations from January surveys, 1969–2009.

	Brant			Tundra swans	
Year	Atlantic	Pacific[a]	Western High Arctic	Western	Eastern
1969/70		136.6	5.1	31.0	
1970/71	151.0	141.1	8.1	98.8	
1971/72	73.2	121.8	3.0	82.8	
1972/73	40.8	122.4	2.7	33.9	
1973/74	87.7	128.0	2.7	69.7	
1974/75	88.4	119.7	3.7	54.3	
1975/76	127.0	117.1	5.0	51.4	
1976/77	73.6	136.1	10.9	47.3	
1977/78	42.8	151.5	11.4	45.6	
1978/79	43.5	126.2	3.2	53.5	
1979/80	69.2	141.3	5.1	65.2	
1980/81	97.0	186.1	8.1	83.6	
1981/82	104.5	117.1	4.0	91.3	73.2
1982/83	123.5	107.2	2.1	67.3	87.5
1983/84	127.3	128.4	5.1	61.9	81.4
1984/85	146.3	136.0	8.8	48.8	96.9
1985/86	110.4	126.9	9.4	66.2	90.9
1986/87	109.4	98.5	10.4	52.8	95.8
1987/88	131.2	131.6	15.3	59.2	78.7
1988/89	138.0	120.9	14.3	78.7	91.3
1989/90	135.4	141.1	10.5	40.1	90.6
1990/91	147.7	119.5	12.2	47.6	98.2
1991/92	184.8	108.2	9.5	63.7	113.0
1992/93	100.6	113.6	10.8	62.6	78.2
1993/94	157.2	118.8	11.2	79.4	84.8
1994/95	148.2	116.8	16.9	52.9	85.1
1995/96	105.9	122.0	4.9	98.1	79.5
1996/97	129.1	151.9	6.0	122.5	92.4
1997/98	138.0	132.1	6.3	70.5	100.6
1998/99	171.6	120.0	9.2	119.8	111.0
1999/00	157.2	127.1	7.9	89.6	115.3
2000/01	145.3	119.9	4.9	87.3	98.4
2001/02	181.6	127.8	9.0	58.7	114.7
2002/03	164.5	101.7	4.9	102.7	111.7
2003/04	129.6	111.5	7.7	83.0	110.8
2004/05	123.2	101.4	10.0	92.1	72.5
2005/06	146.6	133.9	9.5	106.9	81.3
2006/07	150.6	133.9	6.1	109.4	114.4
2007/08	161.6	147.4	9.2	89.7	96.2
2008/09	151.3		16.2	105.2	100.2

[a] Totals exclude Western High Arctic brant. Beginning in 1986, counts of Pacific brant in Alaska were included with the remainder of the Pacific flyway.

Division of Migratory Bird Management
11510 American Holly Dr.
Laurel, MD 20708-4016

U.S. Fish and Wildlife Service
http://www.fws.gov

For state transfer relay service
TTY/Voice: 711