2011

Waterfowl: Population Status, 2011

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Waterfowl

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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 & Wildlife Service (USFWS), the Canadian Wildlife Service (CWS), various state and provincial conservation agencies, and private conservation organizations. This report is intended to aid the development of waterfowl harvest regulations in the United States for the 2011–2012 hunting season.

Cover: 2011–2012 Duck stamp. White-fronted Geese (*Anser albifrons*) by James Hautman, winner of the 2010 federal duck stamp design competition.

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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 & 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 & Wildlife Service, Division of Migratory Bird Management, Population and Habitat Assessment Branch. The principal authors were Kathy Fleming, Pamela Garrettson, Walt Rhodes, and Nathan Zimpfer. The authors compiled information from numerous sources to provide an assessment of the status of waterfowl populations.

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In Memoriam

Each year in North America, pilot-biologists and observers from federal, State, and provincial agencies take part in aerial population surveys to collect data on breeding and wintering migratory birds. These surveys provide information on bird abundance and distribution critical to both harvest and habitat management. Participation in surveys requires passion and a commitment to stewardship of our migratory bird resource, training in specialized skills, and often a sacrifice in time spent in remote regions away from friends and family.

We dedicate this report to three members of the U.S. Fish & Wildlife Service family who have recently perished in the line of duty, conducting or training for aerial surveys: pilot-biologist Ray Bentley, biologist Dave Pitkin, and pilot-biologist Thom Lewis. These three men shared a love of wildlife and a passionate conservation ethic, and each greatly contributed to our understanding of migratory bird populations. We will not forget their sacrifice.

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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 45.6 ± 0.8 [SE] million birds. This estimate represents an 11% increase over last year's estimate of 40.9 ± 0.7 million birds and was 35% above the long-term average (1955–2010). Estimated mallard (*Anas platyrhynchos*) abundance was 9.2 ± 0.3 million birds, which was 9% above the 2010 estimate of 8.4 ± 0.3 million birds and 22% above the long-term average. Estimated abundance of gadwall (*A. strepera*; 3.3 ± 0.2 million) was similar to the 2010 estimate and 80% above the long-term average. Estimated abundance of American wigeon (*A. americana*; 2.1 ± 0.1 million) was 14% below the 2010 estimate and 20% below the long-term average. The estimated abundance of green-winged teal (*A. crecca*) was 2.9 ± 0.2 million, which was 17% below the 2010 estimate and 47% above their long-term average. The estimate of blue-winged teal abundance (*A. discor*s) was 8.9 ± 0.4 million, which was 41% above the 2010 estimate and 91% above their long-term average. The estimate for northern pintails (*A. acuta*; 4.4 ± 0.3 million) was 26% above the 2010 estimate, and similar to the long-term average. The northern shoveler estimate (*A. clypeata*) was 4.6 ± 0.2 million, which was 14% above the 2010 estimate and 98% above the long-term average. Redhead abundance (*Aythya americana*; 1.4 ± 0.1 million) was 27% above the 2010 estimate and 106% above the long-term average. The canvasback estimate (*A. valisineria*; 0.7 ± 0.05 million) was similar to the 2010 estimate and 21% above the long-term average. Estimated abundance of scaup (*A. affinis* and *A. marila* combined; 4.3 ± 0.3 million) was similar to that of 2010 and 15% below the long-term average of 5.1 ± 0.05 million. Habitat conditions during the 2011 Waterfowl Breeding Population and Habitat Survey were characterized by average to above-average moisture and a normal winter and spring across the traditional and eastern survey areas. The exception was the west-central portion of the traditional survey area that received below-average moisture. The total pond estimate (Prairie Canada and U.S. combined) was 8.1 ± 0.2 million. This was 22% above the 2010 estimate and 62% above the long-term average (1974–2010) of 5.0 ± 0.03 million ponds. The 2011 estimate of ponds in Prairie Canada was 4.9 ± 0.2 million. This was 31% above last year's estimate (3.7 ± 0.2 million) and 43% above the long-term average (1961–2010; 3.4 ± 0.03 million). The 2011 pond estimate for the north-central U.S. was 3.2 ± 0.1 million, which was similar to last year's estimate (2.9 ± 0.1 million) and 102% above the long-term average (1974–2010; 1.6 ± 0.02 million). The projected mallard fall-flight index is 11.9 ± 1.1 million birds. The eastern survey area was restratified in 2005 and is now composed of strata 51–72. Estimated abundance of mallards in the eastern survey area was 0.4 ± 0.1 million, which was similar to the 2010 estimate and the long-term average (1990–2010). Abundance estimates of green-winged teal, ring-necked duck (*A. collaris*), goldeneyes (common [*Bucephala clangula*] and Barrow's [*B. islandica*]), and mergansers (red-breasted [*Mergus serrator*], common [*M. merganser*], and hooded [*Lophodytes cucullatus*]) were all similar to their 2010 estimates and long-term averages. The American black duck (*Anas rubripes*) estimate was 0.55 ± 0.04 million, which was similar to the 2010 estimate and 13% below the long-term average of 0.63 million.

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 and harvest. This report details abundance estimates; harvest survey results are discussed in separate reports. The data and analyses were the most current available when this report was written. Future analyses may yield slightly different results as databases are updated and new analytical procedures become available.

Methods

Waterfowl Breeding Population and Habitat Survey

Federal, provincial, and state agencies conduct surveys each spring to estimate the size of breeding waterfowl populations and to evaluate habitat conditions. These surveys are conducted using airplanes and helicopters, and cover over 2.0 million square miles that encompass principal breeding areas of North America. The traditional survey area (strata 1–18, 20–50, and 75–77) comprises parts of Alaska, Canada, and the north-central U.S., and covers approximately 1.3 million square miles (Appendix B). 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). In Prairie and Parkland Canada and the north-central 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. Annual estimates of duck abundance are available since 1955 for the traditional survey area and since 1996 for all strata (except 57–59 and 69) in the eastern survey area. However, some portions of the eastern survey area have been surveyed since 1990. In the traditional survey area, estimates of pond abundance in Prairie Canada are available since 1961, and in the north-central 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 & Wildlife Service (USFWS) has conducted aerial transect surveys using airplanes in eastern Canada and the northeast U.S., similar to those in the mid-continent, 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., mergansers, goldeneyes), estimates were produced for multispecies 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 airplane survey transects and CWS helicopter plots or (2) only helicopter plots (strata 71 and 72). For widely distributed and abundant species (American black ducks, mallards, green-winged teal, ring-necked ducks, goldeneyes and mergansers), composite estimates of 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 airplane survey population estimates. For each stratum, these visibility corrections were calculated based on years in which both surveys were conducted within the stratum. 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 the following species that occur at lower densities and are more patchily distributed in the eastern survey area: scaup, scoters (black [*Melanitta nigra*], white-winged [*M. fusca*], and surf [*M. perspicillata*], bufflehead (*Bucephala albeola*), and American wigeon. In previous years, we used design-based estimates and an overall mean weighted by precision to derive integrated annual population indices until the hierarchical models could adequately analyze the data for these species. Due to concerns about (1) the appropriateness of weighting estimates from these surveys by their precision, and (2) whether estimates for some species should be integrated given the data quality and coverage in the eastern survey, we have discontinued deriving these estimates. 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. 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 for indicated pairs 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 not had the 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 has been considered separately in setting regulations for the Pacific Flyway, and thus Alaska–Yukon mallards

(strata 1–12) have been removed from the mid-continent stock. 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 2011).

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 16 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. We are currently addressing several issues, including the delineation of survey strata, methods of variance estimation, visibility corrections, and population change detection. These analyses, along with results from related investigations, 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

2010 in Review

Habitat conditions during the 2010 Waterfowl Breeding Population and Habitat Survey were characterized by average to below-average moisture, a mild winter, and early spring across the entire traditional (including northern locations) and eastern survey areas. The total pond estimate (Prairie Canada and U.S. combined) was 6.7 ± 0.2 million. This was similar to the 2009 estimate and 34% above the long-term average of 5.0 ± 0.03 million ponds. Conditions across the Canadian prairies were similar to 2009. Portions of southern Alberta, Saskatchewan, and Manitoba improved but a large area along the Alberta and Saskatchewan border remained dry, and moisture levels in portions of Manitoba declined from 2009. The 2010 estimate of ponds in Prairie Canada was 3.7 ± 0.2 million. This was similar to the 2009 estimate (3.6 ± 0.1 million) and to the 1961–2009 average (3.4 ± 0.03 million). Residual water remained in the parklands and these were classified as fair to good. Most of the prairie–parkland region of Canada received abundant to historically high levels of precipitation during and after the survey which possibly flooded some nests, but likely produced excellent brood-rearing habitat for successful nesters and lessened the summer drawdown, leading to beneficial wetland conditions next spring.

Wetland numbers and conditions remained fair to good in the eastern U.S. prairies, but habitat conditions declined through the western Dakotas and Montana. The 2010 pond estimate for the north-central U.S. was 2.9 ± 0.1 million, which was similar to the 2009 estimate (2.9 ± 0.1 million) and 87% above the long-term average (1.6 ± 0.02 million). Fall and winter precipitation in the eastern Dakotas generally improved the good habitat conditions already present. However, at the time of the survey, wetlands in the western Dakotas and Montana were not recharged, resulting in a deterioration of conditions from 2009. In the bush regions of the traditional survey area (Alaska, Yukon, Northwest Territories, northern Manitoba, northern Saskatchewan, and western Ontario), spring break up was early. Unlike in 2009,

the majority of habitats were ice free for arriving waterfowl. Habitat in most of the bush region, with the exception of Alaska and the Northwest Territories, was classified as fair due to below-average moisture, but the early spring likely benefited waterfowl across the entire area.

The boreal forest and Canadian Maritimes of the eastern survey area experienced an early spring in 2010 as well. Much of southern Quebec and Ontario were classified as poor to fair due to dry conditions, with the exception of an area of adequate moisture in west-central Ontario. More northern boreal forest locations benefited from near-normal precipitation and early ice-free conditions. Although winter precipitation from southwestern Ontario along the St. Lawrence River Valley and into Maine was below average, waterfowl habitat was classified as good to excellent, as in 2009. The James and Hudson Bay Lowlands of Ontario (strata 57–59) were not surveyed in 2010, but reports indicated an early spring in these locations as well.

In the traditional survey area, which includes strata 1–18, 20–50, and 75–77, the 2010 total duck population estimate (excluding scoters, eiders, long-tailed ducks, mergansers and wood ducks) was 40.9 ± 0.7 million birds. This estimate was similar to the 2009 estimate of 42.0 ± 0.7 million birds and was 21% above the long-term average (1955–2009). In the eastern Dakotas, total duck numbers were similar to the 2009 estimate and 167% above the long-term average. The total duck estimate in southern Alberta was 20% below the 2009 estimate, and 38% below the long-term average. The total duck estimate was 15% below 2009 in southern Saskatchewan, and 9% below the long-term average. In southern Manitoba, the total duck population estimate was 20% lower than in 2009, and 28% below the long-term average. The total duck estimate in central and northern Alberta, northeastern British Columbia, and the Northwest Territories was 26% higher than in 2009 and 23% above the long-term average. The estimate in northern Saskatchewan–northern Manitoba–western Ontario was 44% lower than the 2009 estimate and 39% below the long-term average. The total duck estimate in the western Dakotas–eastern Montana area was 20% below the 2009 estimate and 22% above the long-term average. In the Alaska–Yukon Territory–Old Crow Flats region the total duck estimate was 28% higher than in 2009, and 52% 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 northeast U.S., Oregon, and Wisconsin, measures of precision for survey estimates are available. In Oregon, the total duck estimate in 2010 was similar to that in 2009, and 23% below the long-term average. The total duck estimate in California was similar to the 2009 estimate and the long-term average. Wisconsin's total duck estimate was 23% lower than in 2009, and similar to its long-term average. The total breeding duck estimate in the northeast U.S. was similar to 2009 and the long-term average. Of the states without measures of precision for total duck numbers, the 2010 total duck estimates in both Michigan and Minnesota were similar to those in 2009, while the total duck estimates in Washington and Nevada were both less than in 2009.

In the traditional survey area the 2010 mallard estimate was 8.4 ± 0.3 million birds, which was similar to the 2009 estimate of 8.5 ± 0.2 million birds and 12% above the long-term average. The blue-winged teal estimate was 6.3 ± 0.4 million, which was 14% below the 2009 estimate and 36% above their long-term average of 4.7 ± 0.04 million. The gadwall estimate (3.0 ± 0.2 million) was similar to the 2009 estimate and 67% above the long-term average. Estimated American wigeon abundance (2.4 ± 0.1 million) was similar to 2009 and the long-term average (2.6 ± 0.03 million). The green-winged teal estimate was 3.5 ± 0.2 million, which was similar to the 2009 estimate and 78% above their long-term average of 1.9 ± 0.02 million. Estimates of northern shovelers (4.1 ± 0.2 million) and redheads (1.1 ± 0.1 million) were similar to their 2009 estimates and were 76% and 63% above their long-term averages of 2.3 ± 0.02 million and 0.7 ± 0.01 million, respectively. The estimate for northern pintails (3.5 ± 0.2 million)

Table 1: Estimated number (in thousands) of May ponds in portions of Prairie and Parkland Canada and the north-central U.S.

			Change from 2010			Change from LTA	
Region	2011	2010	%	*P*	LTA[a]	%	*P*
Prairie Canada							
S. Alberta	1,086	678	+60	<0.001	739	+47	<0.001
S. Saskatchewan	3,151	2,668	+18	0.064	2,011	+57	<0.001
S. Manitoba	656	382	+72	<0.001	670	-2	0.750
Subtotal	4,893	3,729	+31	<0.001	3,419	+43	<0.001
North-central U.S.							
Montana & Western Dakotas	969	595	+63	<0.001	552	+76	<0.001
Eastern Dakotas	2,271	2,341	-3	0.682	1,056	+115	<0.001
Subtotal	3,239	2,936	+10	0.112	1,608	+102	<0.001
Total	8,132	6,665	+22	<0.001	5,005	+62	<0.001

[a] Long-term average. Prairie and Parkland Canada, 1961–2010; north-central U.S. and Total, 1974–2010.

was similar to the 2009 estimate, and 13% below the long-term average of 4.0 ± 0.04 million. The canvasback estimate (0.6 ± 0.05 million) was similar to the 2009 estimate and to the long-term average. The combined scaup estimate (4.2 ± 0.2 million) was similar to that of 2009 and 16% below the long-term average of 5.1 ± 0.05 million. In the eastern survey area, the population estimate for mergansers was 386.4 thousand, which was 15% below the 2009 estimate, and 14% below the long-term average of 450.8 thousand. Mallards, green-winged teal, American wigeon, scaup, ring-necked duck, goldeneye, bufflehead, and scoters surveyed in the eastern survey area were similar to last year and to their 1990–2009 averages.

2011 Breeding Populations and Habitat Conditions

Overall Habitat and Population Status

Habitat conditions during the 2011 Waterfowl Breeding Population and Habitat Survey were characterized by average to above-average moisture and a normal winter and spring across both the traditional and eastern survey areas. The exception was a portion of the west-central traditional survey area that had received below-average moisture. The total pond estimate (Prairie Canada and U.S. combined) was 8.1 ± 0.2 million (Table 1, Figure 1). This was 22% above the 2010 estimate of 6.7 ± 0.2 million ponds, and 62% above the long-term average of 5.0 ± 0.03 million ponds. Conditions across the Canadian prairies were greatly improved relative to last year. Building on excellent conditions from 2010 in portions of southern Alberta, Saskatchewan and Manitoba, the area of excellent conditions in the prairies expanded in 2011, including a region along the Alberta and Saskatchewan border that had been poor for the last two years. The 2011 estimate of ponds in Prairie Canada was 4.9 ± 0.2 million. This was 31% above last year's estimate (3.7 ± 0.2 million) and 43% above the 1961–2010 average (3.4 ± 0.03 million). As expected, residual water from summer 2010 precipitation remained in the parklands and the majority of the area was classified as good. Fair-to-poor conditions, however, were observed in the parklands of Alberta.

Wetland numbers and conditions were excellent in the U.S. prairies. The 2011 pond estimate for the north-central U.S. was 3.2 ± 0.1 million, which was similar to last year's estimate (2.9 ± 0.1 million) and 102% above the 1974–2010 average (1.6 ± 0.02 million). The eastern U.S. prairies benefited from abundant moisture in 2010 and the entire U.S. prairies experienced above-average winter and spring

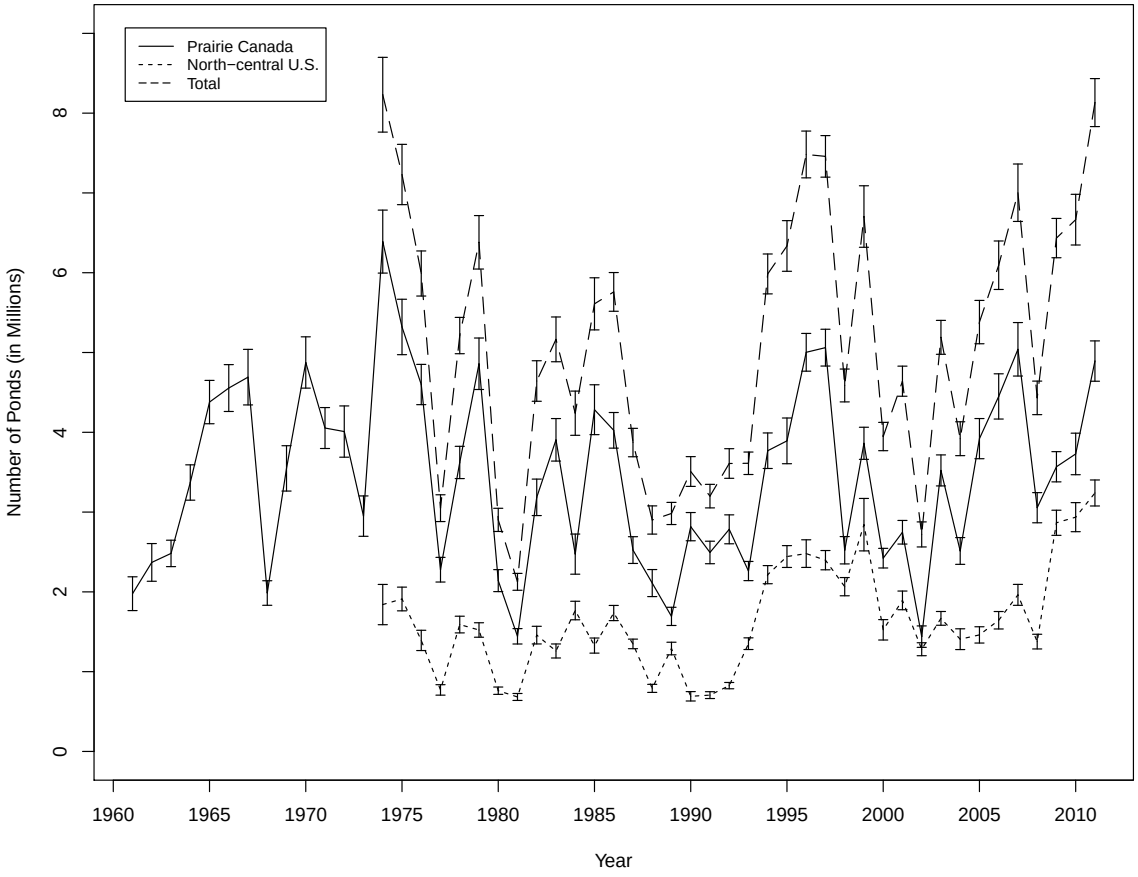

Figure 1: Number of ponds in May and 90% confidence intervals in Prairie Canada and the north-central U.S.

precipitation in 2010 and 2011, resulting in good-to-excellent conditions across nearly the entire region. The western Dakotas and eastern Montana were extremely dry in 2010. However, conditions there improved from fair to poor in 2010 to good to excellent in 2011. Further, the abundant moisture and delayed farming operations in the north-central U.S. and southern Canadian prairies likely benefited early-nesting waterfowl. In the bush regions of the traditional survey area (Northwest Territories, northern Manitoba, northern Saskatchewan, and western Ontario), spring breakup was late in 2011. However, a period of warm, fair weather just prior to the survey greatly accelerated ice-out. Habitats improved from 2010 across most of northern Saskatchewan and Manitoba as a result of average to above-average summer and fall precipitation in 2010. Habitat conditions in the Northwest Territories and Alaska were classified as good in 2011. Dry conditions in the boreal forest of Alberta in 2010 persisted into 2011 as habitat conditions were again rated as fair to poor. The dry conditions in this region contributed to numerous forest fires during the 2011 survey.

In the eastern survey area, winter temperatures were above average and precipitation was below average over most of the region, with the exception of the Maritimes and Maine, which had colder-than-normal temperatures and above-average precipitation. Despite regional differences in winter conditions, above-average spring precipitation recharged deficient wetlands, subsequently providing good-to-excellent production habitat across the region. The boreal forest and Canadian Maritimes of the eastern survey area continued

to have good-to-excellent habitat conditions in 2011. Habitat conditions in Ontario and southern Quebec improved from poor to fair in 2010 to good to excellent. Northern sections of the eastern survey area continued to remain in good-to-excellent condition in 2011.

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 45.6 ± 0.8 million birds. This estimate is 11% higher than the 2010 estimate of 40.9 ± 0.7 million birds and was 35% above the long-term average (1955–2010; Table 2, Appendix C.4). In the eastern Dakotas, total duck numbers were similar to the 2010 estimate and 172% above the long-term average. The total duck estimate in southern Alberta was 66% above last year's estimate and similar to the long-term average. The total duck estimate was 56% higher than in 2010 in southern Saskatchewan, and 43% above the long-term average. In southern Manitoba, the total duck population estimate was 41% higher than last year's estimate and similar to the long-term average. The total duck estimate in central and northern Alberta, northeastern British Columbia, and the Northwest Territories was 19% lower than last year and similar to the long-term average. The estimate in the northern Saskatchewan–northern Manitoba–western Ontario survey area was similar to the 2010 estimate and 30% below the long-term average. The total duck estimate in the western Dakotas–eastern Montana area was 59% above the 2010 estimate and 92% above the long-term average. In the Alaska–Yukon Territory–Old Crow Flats region the total duck estimate was 32% lower than last year, and similar to 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 northeast U.S., Oregon, and Wisconsin, measures of precision for survey estimates are available (Table 2). In Oregon, the total duck estimate was 23% less than in 2010, and 40% below the long-term average (1994–2010). The total duck estimate in California was similar to the 2010 estimate and the long-term average (1992–2010). Wisconsin's total duck estimate was 33% above the 2010 estimate, and similar to its long-term average (1973–2010). The total breeding duck estimate in the northeast U.S. was similar to 2010 and the long-term average (1993–2010). Of the states without measures of precision for total duck numbers, the 2011 estimate of total ducks in Michigan was lower than in 2010, while total ducks in Minnesota were higher than in 2010. Total duck estimates increased in Washington from 2010, and decreased in Nevada (see Regional Habitat and Population Status section for estimates).

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. The mallard estimate in the traditional survey area was 9.2 ± 0.3 million birds, which was 9% above the 2010 estimate of 8.4 ± 0.3 million birds and 22% above the long-term average (Table 3). The mallard estimate in southern Alberta was 57% above last year's and was 12% below the long-term average. In the eastern Dakotas, the mallard estimate was similar to last year's count, and 170% above the long-term average. In the eastern Montana–western Dakotas survey area, mallard counts were 57% higher than the 2010 estimate and 67% higher than the long-term average. In the central and northern Alberta–northeastern British Columbia–Northwest Territories region the mallard estimate was 31% lower than 2010 and similar to the long-term average. In the northern Saskatchewan–northern Manitoba–western Ontario survey area, the mallard estimate was similar to that of 2010, and 27% below the long-term average. Mallard numbers were 31% lower than the 2010 estimate and similar to their long-term average in the Alaska–Yukon Territory–Old Crow Flats region. In the southern Manitoba survey area, the mallard estimate was 49% above last year's and 37% above the long-term average. In southern Saskatchewan, mallard

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

			Change from 2010			Change from LTA	
Region	2011	2010	%	*P*	LTA[b]	%	*P*
Alaska–Yukon Territory–Old Crow Flats	3,756	5,556	-32	<0.001	3,688	+2	0.660
C. & N. Alberta–N.E. British Columbia–NWT	7,095	8,717	-19	0.001	7,119	0	0.942
N. Saskatchewan –N. Manitoba–W. Ontario	2,439	2,149	+13	0.189	3,509	-30	<0.001
S. Alberta	4,372	2,641	+66	<0.001	4,240	+3	0.472
S. Saskatchewan	10,681	6,839	+56	<0.001	7,495	+43	<0.001
S. Manitoba	1,554	1,104	+41	<0.001	1,528	+2	0.755
Montana & Western Dakotas	3,135	1,977	+59	<0.001	1,632	+92	<0.001
Eastern Dakotas	12,523	11,910	+5	0.365	4,598	+172	<0.001
Total	45,554	40,894	+11	<0.001	33,809	+35	<0.001
Other regions							
California	559	541	+3	0.836	592	−6	0.579
Northeast U.S.[c]	1,265	1,302	−3	0.784	1,402	−10	0.187
Oregon	169	220	−23	0.040	282	−40	<0.001
Wisconsin	514	387	+33	0.041	438	+17	0.123

[a] Includes 10 species in Appendix C.3 plus American black duck, ring-necked duck, goldeneyes, bufflehead, and ruddy duck (*Oxyura jamaicensis*); excludes eiders, long-tailed duck, scoters, mergansers, and wood duck.
[b] Long-term average for the traditional survey area, 1955–2010; 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.

numbers were 23% above last year and similar to the long-term average. Mallard abundance with estimates of precision are also available for other areas where surveys are conducted (California, Nevada, Oregon, Wisconsin, the northeast U.S., as well as Michigan and Minnesota). Mallard numbers in California were similar to last year and the long-term average. The mallard estimate in Nevada was lower than in 2010 (due to changes in survey design, Nevada estimates prior to 2009 are not comparable with those from the present survey). In Wisconsin, mallards were similar to last year and the long-term average. The mallard estimate in Oregon was similar to 2010, but 34% lower than the long-term average. The mallard estimate was similar to the 2010 estimate in the northeast U.S., but was 23% below the long-term average. In Michigan, mallard estimates were 34% below the 2010 estimates and 40% below the long-term average (1992–2010). In Minnesota, the 2010 mallard estimate was similar to last year's and the long-term average (1968–2010). In Washington, mallards increased relative to 2010.

In the traditional survey area the blue-winged teal estimate was 8.9 ± 0.4 million, which was 41% above the 2010 estimate and 91% above their long-term average of 4.7 ± 0.04 million. The gadwall estimate (3.3 ± 0.2 million) was similar to the 2010 estimate and 80% above the long-term average. Estimated American wigeon abundance (2.1 ± 0.1 million) was 14% below the 2010 estimate and 20% below the long-term average (2.6 ± 0.03 million). The green-winged teal estimate was 2.9 ± 0.2 million, which was 17% below the 2010 estimate and 47% above their long-term average of 2.0 ± 0.02 million. The estimate of northern shovelers (4.6 ± 0.2 million) was 14% above the 2010 estimate and 98% above

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

			Change from 2010			Change from LTA	
Region	2011	2010	%	*P*	LTA[a]	%	*P*
Alaska–Yukon Territory–Old Crow Flats	416	606	-31	0.004	374	+11	0.289
C. & N. Alberta–N.E. British Columbia–NWT	975	1,423	-31	0.004	1,078	-10	0.249
N. Saskatchewan –N. Manitoba–W. Ontario	828	801	+3	0.851	1,132	-27	0.001
S. Alberta	939	598	+57	<0.001	1,071	-12	0.042
S. Saskatchewan	2,093	1,699	+23	0.023	2,056	+2	0.785
S. Manitoba	521	351	+49	0.006	381	+37	0.009
Montana & Western Dakotas	837	533	+57	<0.001	501	+67	<0.001
Eastern Dakotas	2,574	2,420	+6	0.519	952	+170	<0.001
Total	9,183	8,430	+9	0.054	7,545	+22	<0.001
Eastern survey area	403	488	−17	−−[b]	424	−5	−−[b]
Other regions							
California	315	368	−14	0.456	364	−14	0.293
Michigan	225	340	−34	0.020	374	−40	<0.001
Minnesota	283	242	+17	0.490	225	+26	0.243
Northeast U.S.[c]	586	653	−10	0.308	764	−20	<0.001
Oregon	68	75	−10	0.324	103	−34	<0.001
Wisconsin	188	199	−6	0.733	182	+3	0.818

[a] Long-term average. Traditional survey area 1955–2010; eastern survey area 1990–2010; years for other regions vary (see Appendix C.2).
[b] *P*-values not provided 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 long-term average. The estimate for northern pintails (4.4 ± 0.3 million) was 26% above the 2010 estimate, and similar to the long-term average of 4.0 ± 0.04 million. Redhead abundance (1.4 ± 0.1 million) was 27% above the 2010 estimate and 106% above the long-term average of 0.7 ± 0.01 million. The canvasback estimate (0.7 ± 0.05 million) was similar to the 2010 estimate and 21% above the long-term average. The combined scaup estimate (4.3 ± 0.3 million) was similar to that of 2010 and 15% below the long-term average of 5.1 ± 0.05 million. In the eastern survey area, estimated abundance of mallards was 0.4 ± 0.1 million, which was similar to the 2010 estimate and the long-term average. Abundance estimates for goldeneyes, green-winged teal, ring-necked duck, and mergansers were similar to last year's estimates and their 1990–2010 averages (Table 13, Figure 3, 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 (Figure 2). In 2011, the total midwinter count of American black ducks in both flyways combined was 187,200, which was 21% below the most recent 10-year average (2001–2010) of 237,400. In the Atlantic Flyway, the black duck midwinter index was 168,100, which was 21% below the flyway's 10-year average of 211,900. In the Missis-

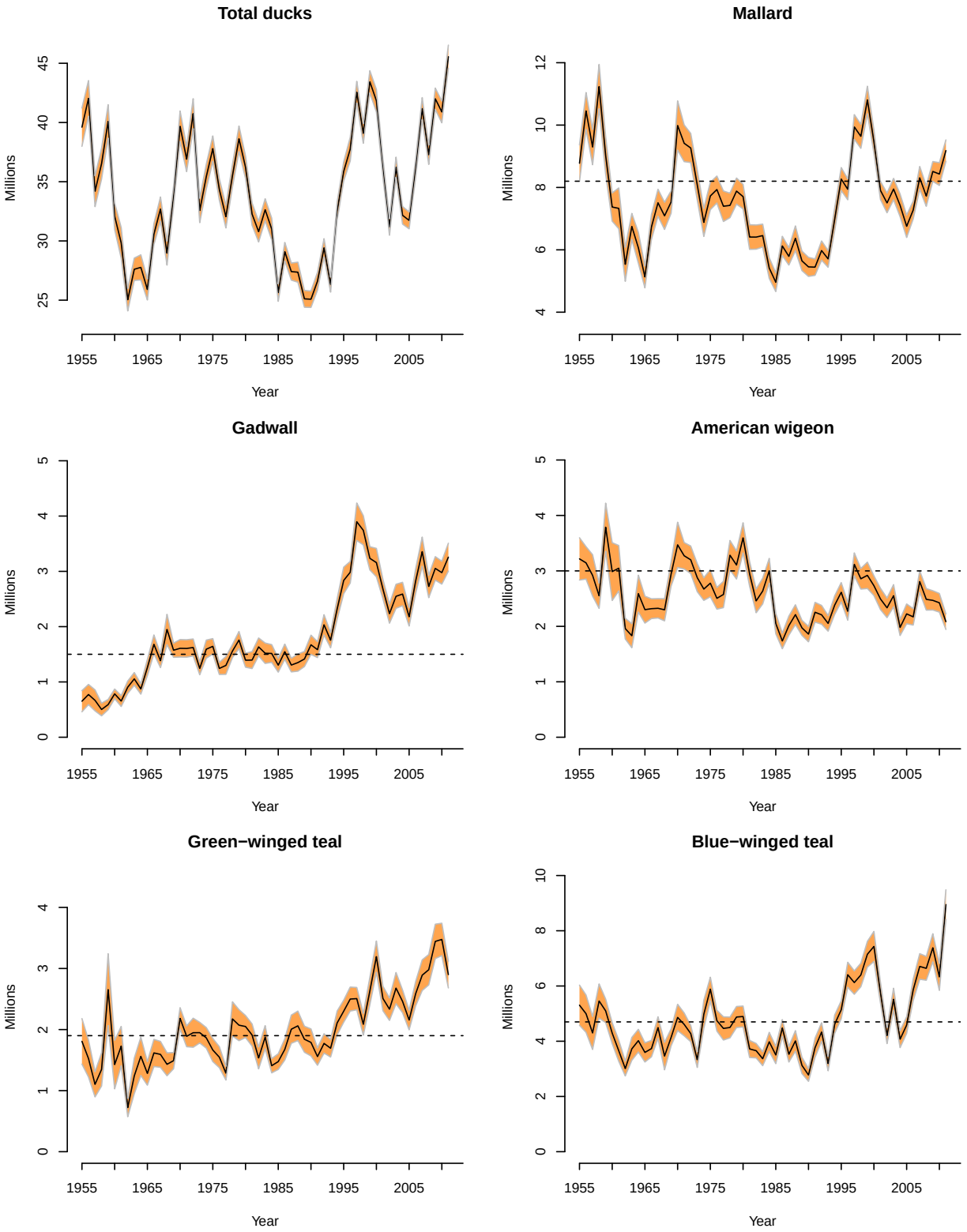

Figure 2: Breeding population estimates, 90% confidence intervals, and North American Waterfowl Management Plan population goals (dashed line) for selected species in the traditional survey area (strata 1–18, 20–50, 75–77), and midwinter counts of American black duck.

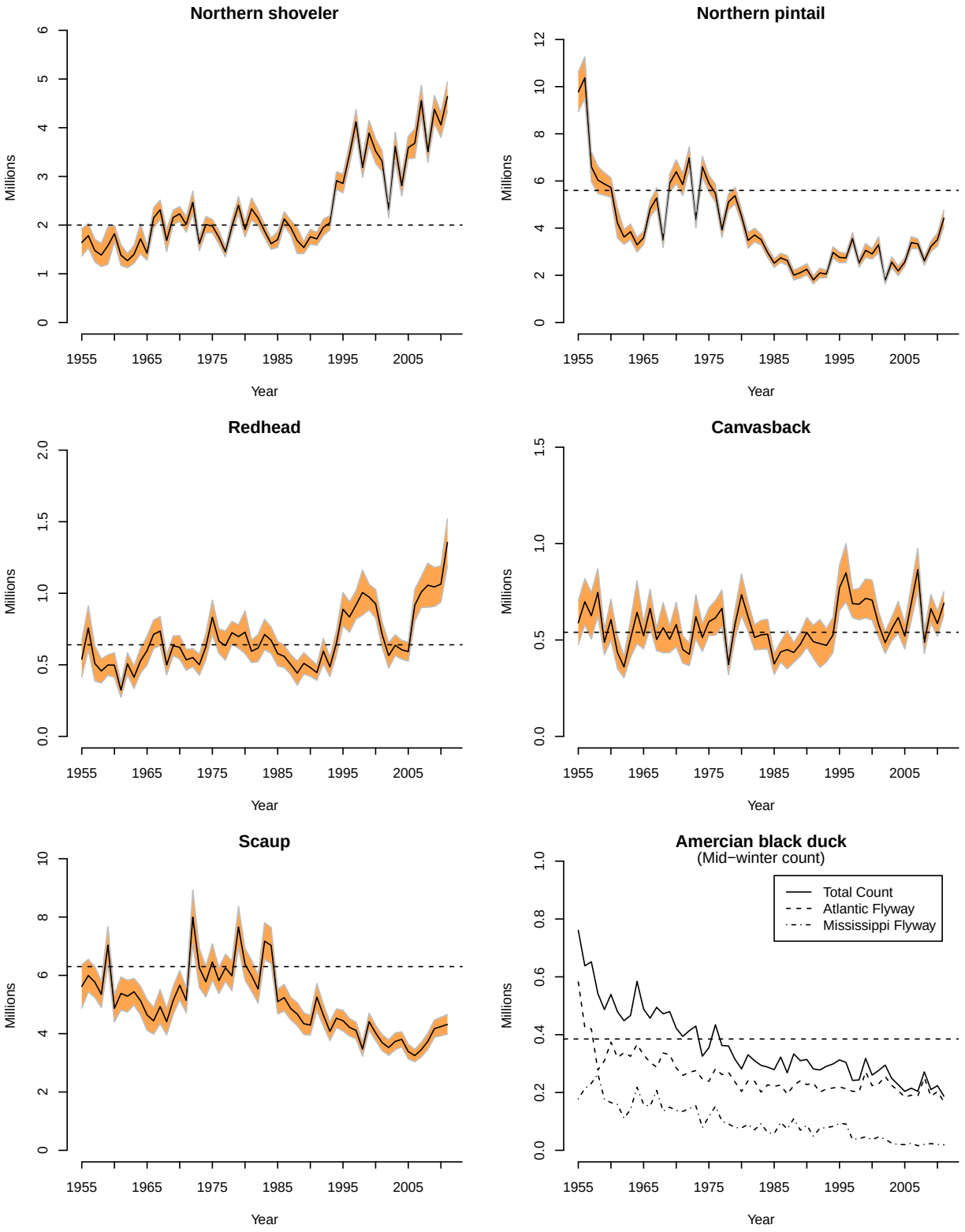

Figure 2: Continued.

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

			Change from 2010			Change from LTA	
Region	2011	2010	%	*P*	LTA[a]	%	*P*
Alaska–Yukon Territory–Old Crow Flats	1	3	-54	0.454	2	-32	0.646
C. & N. Alberta–N.E. British Columbia–NWT	41	51	-20	0.656	51	-20	0.284
N. Saskatchewan –N. Manitoba–W. Ontario	33	14	+128	0.009	26	+25	0.274
S. Alberta	347	323	+7	0.693	316	+10	0.506
S. Saskatchewan	1,020	913	+12	0.445	604	+69	<0.001
S. Manitoba	92	102	-9	0.680	71	+30	0.176
Montana & Western Dakotas	470	392	+20	0.444	201	+133	<0.001
Eastern Dakotas	1,253	1,178	+6	0.668	536	+134	<0.001
Total	3,257	2,977	+9	0.271	1,808	+80	<0.001

[a] Long-term average, 1955–2010.

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

			Change from 2010			Change from LTA	
Region	2011	2010	%	*P*	LTA[a]	%	*P*
Alaska–Yukon Territory–Old Crow Flats	621	1,053	-41	<0.001	550	+13	0.173
C. & N. Alberta–N.E. British Columbia–NWT	650	597	+9	0.607	895	-27	0.001
N. Saskatchewan –N. Manitoba–W. Ontario	126	73	+72	0.078	240	-48	<0.001
S. Alberta	200	124	+61	0.036	284	-30	0.010
S. Saskatchewan	281	193	+46	0.063	412	-32	0.002
S. Manitoba	5	11	-56	0.062	57	-92	<0.001
Montana & Western Dakotas	92	166	-45	0.031	111	-17	0.396
Eastern Dakotas	109	206	-47	0.019	53	+104	0.001
Total	2,084	2,425	-14	0.047	2,604	-20	<0.001

[a] Long-term average, 1955–2010.

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

			Change from 2010			Change from LTA	
Region	2011	2010	%	*P*	LTA[a]	%	*P*
Alaska–Yukon Territory–Old Crow Flats	641	954	-33	0.004	395	+62	<0.001
C. & N. Alberta–N.E. British Columbia–NWT	1,251	1,464	-15	0.293	781	+60	0.001
N. Saskatchewan –N. Manitoba–W. Ontario	126	105	+20	0.368	205	-38	<0.001
S. Alberta	275	130	+112	0.015	195	+41	0.134
S. Saskatchewan	422	398	+6	0.780	254	+66	0.004
S. Manitoba	55	48	+14	0.620	51	+8	0.729
Montana & Western Dakotas	19	39	-51	0.080	42	-55	0.002
Eastern Dakotas	110	337	-67	0.007	52	+114	0.027
Total	2,900	3,476	-17	0.032	1,975	+47	<0.001

[a] Long-term average, 1955–2010.

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

			Change from 2010			Change from LTA	
Region	2011	2010	%	*P*	LTA[a]	%	*P*
Alaska–Yukon Territory–Old Crow Flats	1	4	-63	0.569	1	-2	0.982
C. & N. Alberta–N.E. British Columbia–NWT	144	279	-48	0.047	275	-48	0.008
N. Saskatchewan –N. Manitoba–W. Ontario	31	5	+576	0.041	249	-88	<0.001
S. Alberta	470	294	+60	0.004	610	-23	0.014
S. Saskatchewan	2,489	1,363	+83	<0.001	1,288	+93	<0.001
S. Manitoba	393	212	+85	0.002	374	+5	0.716
Montana & Western Dakotas	894	308	+191	<0.001	267	+235	<0.001
Eastern Dakotas	4,526	3,865	+17	0.159	1,622	+179	<0.001
Total	8,948	6,329	+41	<0.001	4,687	+91	<0.001

[a] Long-term average, 1955–2010.

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

			Change from 2010			Change from LTA	
Region	2011	2010	%	*P*	LTA[a]	%	*P*
Alaska–Yukon Territory–Old Crow Flats	322	626	-49	<0.001	288	+12	0.311
C. & N. Alberta–N.E. British Columbia–NWT	133	297	-55	0.004	220	-40	0.007
N. Saskatchewan –N. Manitoba–W. Ontario	7	4	+88	0.291	41	-83	<0.001
S. Alberta	878	475	+85	<0.001	387	+127	<0.001
S. Saskatchewan	1,496	795	+88	<0.001	699	+114	<0.001
S. Manitoba	148	87	+71	0.002	109	+37	0.007
Montana & Western Dakotas	430	221	+95	0.026	156	+176	0.002
Eastern Dakotas	1,227	1,553	-21	0.151	443	+177	<0.001
Total	4,641	4,057	+14	0.056	2,343	+98	<0.001

[a] Long-term average, 1955–2010.

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

			Change from 2010			Change from LTA	
Region	2011	2010	%	*P*	LTA[a]	%	*P*
Alaska–Yukon Territory–Old Crow Flats	746	1,164	-36	0.003	930	-20	0.027
C. & N. Alberta–N.E. British Columbia–NWT	121	338	-64	0.004	367	-67	<0.001
N. Saskatchewan –N. Manitoba–W. Ontario	10	6	+77	0.336	38	-74	<0.001
S. Alberta	655	242	+171	<0.001	685	-4	0.736
S. Saskatchewan	1,106	332	+233	<0.001	1,166	-5	0.579
S. Manitoba	38	18	+109	0.015	105	-63	<0.001
Montana & Western Dakotas	279	177	+58	0.108	263	+6	0.772
Eastern Dakotas	1,473	1,233	+20	0.349	477	+209	<0.001
Total	4,429	3,509	+26	0.008	4,031	+10	0.142

[a] Long-term average, 1955–2010.

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

			Change from 2010			Change from LTA	
Region	2011	2010	%	*P*	LTA[a]	%	*P*
Alaska–Yukon Territory–Old Crow Flats	1	1	-40	0.692	2	-46	0.440
C. & N. Alberta–N.E. British Columbia–NWT	15	51	-71	0.030	40	-63	<0.001
N. Saskatchewan –N. Manitoba–W. Ontario	17	3	+390	0.017	26	-37	0.080
S. Alberta	167	90	+85	0.027	122	+37	0.148
S. Saskatchewan	438	316	+38	0.129	206	+113	<0.001
S. Manitoba	65	107	-39	0.355	73	-11	0.664
Montana & Western Dakotas	40	50	-21	0.597	10	+279	0.005
Eastern Dakotas	614	444	+38	0.178	180	+241	<0.001
Total	1,356	1,064	+27	0.072	659	+106	<0.001

[a] Long-term average, 1955–2010.

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

			Change from 2010			Change from LTA	
Region	2011	2010	%	*P*	LTA[a]	%	*P*
Alaska–Yukon Territory–Old Crow Flats	22	57	-60	0.040	89	-75	<0.001
C. & N. Alberta–N.E. British Columbia–NWT	51	72	-29	0.322	75	-32	0.042
N. Saskatchewan –N. Manitoba–W. Ontario	31	18	+67	0.173	53	-42	0.008
S. Alberta	33	39	-15	0.510	65	-49	<0.001
S. Saskatchewan	335	192	+74	0.002	188	+78	<0.001
S. Manitoba	68	35	+95	0.002	56	+21	0.188
Montana & Western Dakotas	17	41	-59	0.057	9	+90	0.303
Eastern Dakotas	135	131	+3	0.921	36	+278	<0.001
Total	692	585	+18	0.121	571	+21	0.010

[a] Long-term average, 1955–2010.

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

			Change from 2010			Change from LTA	
Region	2011	2010	%	*P*	LTA[a]	%	*P*
Alaska–Yukon Territory–Old Crow Flats	847	947	-11	0.418	921	-8	0.389
C. & N. Alberta–N.E. British Columbia–NWT	2,165	2,378	-9	0.497	2,538	-15	0.107
N. Saskatchewan –N. Manitoba–W. Ontario	367	208	+76	0.005	568	-35	<0.001
S. Alberta	228	127	+80	0.102	339	-33	0.045
S. Saskatchewan	347	246	+41	0.129	406	-15	0.232
S. Manitoba	85	53	+61	0.116	129	-34	0.012
Montana & Western Dakotas	38	14	+160	0.004	50	-26	0.090
Eastern Dakotas	242	271	-11	0.657	106	+128	0.001
Total	4,319	4,244	+2	0.835	5,058	-15	0.005

[a] Long-term average, 1955–2010.

sippi Flyway, the black duck midwinter index in 2011 was 19,100, which was 25% below the 10-year flyway average of 25,500. 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). The American black duck estimate in the eastern survey area was 545,000, similar to the 2010 estimate of 566,000 and 13% below the 1990–2010 average of 627,000. 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 2011 survey (38,700) was not significantly different from the 2010 estimate (38,200) but was 41% below the 1993–2010 average (65,100).

Trends in wood duck populations are available from the North American Breeding Bird Survey (BBS). The BBS, a series of roadside routes surveyed during May and June each year, provides the only long-term range-wide breeding population index for this species. Wood ducks are encountered with low frequency along BBS routes, which limits the amount and quality of available information (Sauer and Droege 1990). However, hierarchical analysis of these data (J. Sauer, U.S. Geological Survey, Biological Resources Division, unpublished data) incorporated adjustments for spatial and temporal variation in BBS route quality, observer skill, and other factors that may affect detectability (Link and Sauer 2002). This analysis also produces annual abundance indices and measures of variance (95% credible intervals), in addition to the trend estimates (average % per year) and associated 95% credible intervals presented here. In the Atlantic and Mississippi flyways combined, the BBS wood duck index increased by an average of 2.0% (UCL 2.6%, LCL 1.4%) per year over the entire survey period (1966–2010), 2.4% (UCL 3.3%, LCL 1.5%) over the past 20 years (1991–2010), and 3.3% (UCL 4.8%, LCL 1.9%) over the most recent (2001–2010) 10-year period. The Atlantic Flyway wood duck index increased by an average of 1.5% (UCL 2.3%, LCL 0.7%) annually over the entire time series (1966–2010), by 2.1% (UCL 3.5%, LCL 0.2%) over the past 20 years (1991–2010), and by 3.2% (UCL 5.5%, LCL 1.1%) from 2001–2010. In the Mississippi Flyway, the corresponding BBS wood duck indices increased by 2.2% (UCL 3.0%, LCL 1.4%, 1966–2010), 2.6% (UCL 3.7%, LCL 1.5%, 1991–2010), and 3.3% (UCL 5.1%, LCL 1.7%, 2001–2010; J. Sauer, U.S. Geological Survey, Biological Resources Division, unpublished data).

Table 13: Duck breeding population estimates[a] (in thousands) for the 6 most abundant species in the eastern survey area.

Species	2011	2010	% Change from 2010	Average[b]	% Change from average
Mallard	427	378	+13	397	+8
American black duck	545	566	-4	627	-13[c]
Green-winged teal	256	273	-6	258	-1
Ring-necked duck	484	515	-6	489	-1
Goldeneyes (common and Barrow's)	399	395	+1	415	-4
Mergansers (common, red-breasted, and hooded)	401	377	+7	436	-8

[a] Estimates from Bayesian hierarchical analysis using FWS and CWS data from strata 51, 52, 63, 64, 66–68, 70–72.
[b] Average for 1990–2010.
[c] Indicates significant change. Significance determined by non-overlap of Bayesian credibility intervals.

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 2011 survey (382,700) was similar to the 2010 estimate (409,600) and to the 1993–2010 average (377,900).

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 are no longer 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)

Most of southern Alberta experienced a colder and wetter winter and spring in 2010–2011. A series of cold, wet winter storms continued to move across the province through the end of April, recharging many wetlands. A slow-moving low-pressure system brought significant moisture to southern Alberta the last week of May, further enhancing the already excellent wetland conditions present. Several other storms brought more rain to southern Alberta through the first part of June. Habitat conditions were good-to-excellent in the area from the Montana border to the area between Edmonton and Red Deer, in contrast to the dry conditions of two years ago, and were even an improvement from 2010. Habitat conditions became drier towards Edmonton. This trend continued to deteriorate farther north, with the Peace River region still experiencing a dry cycle.

Overall, May ponds were 60% higher than the 2010 estimate and 47% higher than the long-term average. The total duck estimate was 66% higher than 2010 and similar to the long-term average. The mallard estimate in this survey area was 57% higher than 2010, and 12% lower than the long-term average. Blue-winged teal were 60% above the 2010 estimate, but 23% below the long-term average. The gadwall estimate was similar to 2010 and the long-term average. American wigeon were 61% higher than last year but 30% lower than the long-term average. Green-winged teal were 112% higher than last year and similar to their long-term average. The northern shoveler estimate was 85% higher than 2010 and 127% above the long-term average. Northern pintails were 171% higher than 2010 and similar to the long-term average. Red-

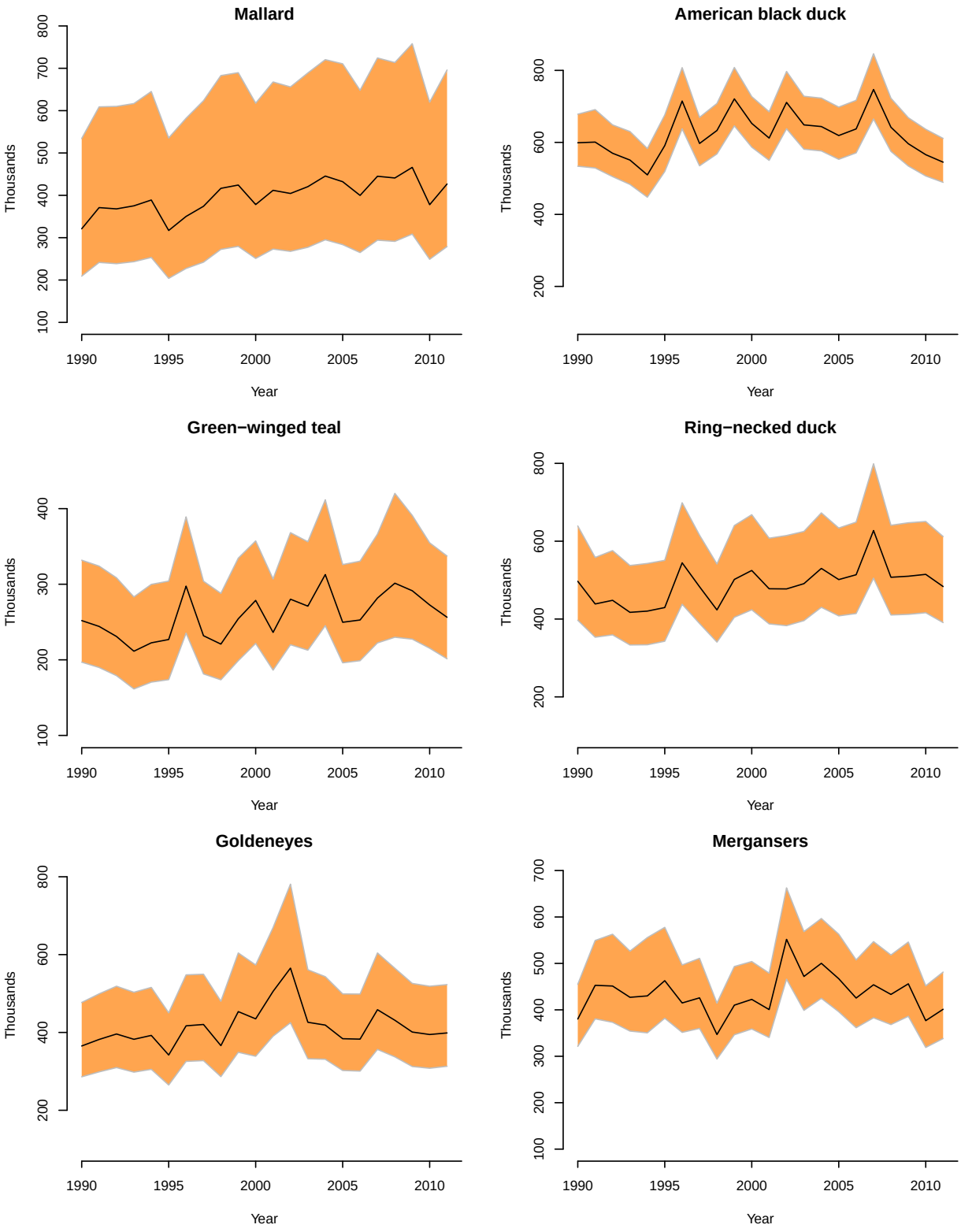

Figure 3: Breeding population estimates and 90% credible intervals from Bayesian hierarchical models for species in the eastern survey area (strata 51, 52, 63, 64, 66–68, 70–72).

heads were 85% higher than 2010 and similar to their long-term average. Both canvasback and scaup estimates were similar to last year, but 49% and 33% lower than their long-term averages, respectively.

Southern Saskatchewan (strata 30–33)

Habitat conditions for nesting and brood-rearing waterfowl were generally good to excellent across the survey area. Excellent conditions were found across the southern grasslands and mirrored the above-average precipitation the region has received since the summer of 2010 (Agriculture and Agri-Food Canada 2011). Conditions were good across the northern grasslands and into the parklands. A small area in the northeast parklands was considered fair for potential production and recruitment because some wetland areas were not as wet as in previous years.

The majority of the precipitation that has improved wetland and upland habitat conditions occurred during the summer of 2010. Between June and September precipitation was well-above normal (>150%). A more normal pattern of precipitation returned in the fall across the southwest, southeast, and northeast parts of the grainbelt, but below-average precipitation was received in the western parklands and grasslands and central portions of the survey area. Winter precipitation was well below average in most of the parklands and across the center of the survey area. A band of normal to above-normal precipitation was received in the southwest shortgrass prairie and extended northeast to Prince Albert and into parts of the northeast parklands during the winter. April continued to be a fairly dry month, with below-average precipitation across the parklands and northern grasslands. However, the southern grasslands received above-normal precipitation in April and that weather pattern extended into May. During the survey, the southern quarter of the province received precipitation from several low-pressure systems that moved across the northern U.S. The southern grasslands received above-normal precipitation, which tapered out to normal precipitation and then dried out to below-normal precipitation into the parklands. Temperatures were considered normal across the survey area from the summer of 2010 through January 2011. Below-average temperatures characterized the late winter and spring. May temperatures were considered normal compared to historic averages.

The increased number of wetlands and the large areas of idle cropland due to the well-above-average moisture on the landscape should provide excellent conditions for production and recruitment from the grasslands of southern Saskatchewan during 2011. The survey area parklands received normal to below-normal precipitation, except for the areas southeast of Saskatoon, which received above-normal precipitation. Much of the parklands west of Saskatoon were in good condition, but appeared to be on the drier side and may have benefited from summer rains to maintain water levels and brood habitat. Habitat conditions of the parklands are often opposite those of the grasslands: when grasslands are wet, the parklands tend to be dry and vice versa. It was a rare year in the province, with both the parklands and the grasslands in good-to-excellent habitat condition, and ducks returned in large numbers to take advantage of these improved conditions.

The May pond estimate in this survey area was 18% higher than in 2010, and 57% higher than the long-term average. Total duck numbers were 56% higher than 2010, and 43% above the long-term average. Mallards were 23% higher than 2010 but similar to the long-term average. Blue-winged teal were 83% above last year and 93% above the long-term average. Northern shovelers were 88% above 2010 and 114% above the long-term average. The green-winged teal estimate was similar to last year, but still 66% above its long-term average. Gadwall numbers were similar to 2010 and 69% above their long-term average. American wigeon were 46% higher than last year but 32% lower than their long-term average. Northern pintails were 233% higher than in 2010, and similar to their long-term average. Redheads were similar to 2010 and 113% above their long-term average. Canvasback were 74% higher than in 2010 and 78% higher than their long-term average. The scaup estimate was similar to 2010 and the long-term

average.

Southern Manitoba (strata 34–40; includes southeast Saskatchewan)

The 2010 trend of above-average precipitation in southern Manitoba and western Saskatchewan continued into 2011. The exception was a relatively small area near Regina in stratum 34 where precipitation was 60–85% of normal. Overall, soils saturated from rain last fall absorbed little of the melting snow pack, and this snowmelt combined with spring rain caused many areas to flood. The Assiniboine River in southern Manitoba experienced a 1 in 300-year flood event, with the highest river levels ever recorded.

During April and May 2010, the survey area experienced temperatures that were 2–3° C warmer than average, whereas in 2011 temperatures were 1–2° C cooler than average. Spring phenology of vegetation was delayed, as grass and perennial vegetation was not established until mid-May. However, this delay was not expected to significantly affect waterfowl production.

Due to the above-average precipitation over the past year, wetland habitat was ubiquitous across the landscape. Pond and wetland basins were 100% full, with most 120% or greater. Nearly all streams were full or at flood stage. The extremely wet soil delayed farming, and according to local farmers, many fields will sit fallow during 2011. The net effect of increased habitat availability and delayed farming should mean excellent conditions and above-average waterfowl production across most of the survey area.

The May pond estimate was 72% higher than the 2010 estimate and similar to the long-term average. The total duck estimate was 41% higher than in 2010, and similar to the long-term average. Mallard numbers were 49% higher than 2010 and 37% higher than the long-term average. The gadwall and green-winged teal estimates were similar to last year's estimates and their long-term averages. Blue-winged teal were 85% higher than in 2010 and similar to their long-term averages. The northern shoveler estimate was 71% above the 2010 estimate and 37% above the long-term average. American wigeon were 56% below the 2010 estimate and 92% below their long-term average. Northern pintails were 109% above the 2010 estimate, but 63% lower than the long-term average. Redhead estimates were similar to last year and the long-term average. Canvasback were 95% higher than 2010 but similar to the long-term average. Scaup were similar to 2010 and 34% below their long-term average in this survey area.

Montana and Western Dakotas (strata 41–44)

May 2011 habitat conditions across the entire survey area were wet to extremely wet compared to previous years. At the initiation of the survey, upland vegetation had already begun to green up but trees were further behind in leaf out. The water levels in the majority of western South Dakota (stratum 44) were good, with most basins full but not overflowing. Habitat conditions in northern South Dakota were excellent with all basins full to overflowing. Southwestern North Dakota habitats were rated as good, while the majority of the area in stratum 43 was rated as excellent. The excellent conditions were due to record snowfall along with spring rains, which caused flooding in much of this area. Habitat conditions in east-central Montana (stratum 42) were good and were much wetter compared to previous years. The western portion of stratum 42 is generally poor waterfowl habitat; however, habitat conditions were excellent this year because of heavy snow during winter coupled with spring rainfall. The northern portion of Montana along the Canadian border (stratum 41) experienced record snow fall and record spring rains, resulting in excellent habitat conditions. Most regions within the crew area received their yearly total rainfall in about a 4–5-day period. Rains continued after the completion of the survey, causing major flooding and cool wet conditions which may have jeopardized broods.

The 2011 May pond count in this survey area increased by 63% from last year, and 76% from the long-term average. Total duck numbers increased by 59% from 2010, and were 92% above the long-term average. The mallard estimate was 57% higher than in 2010 and 67% higher

than the long-term average. The gadwall estimate was similar to 2010, but was 133% above the long-term average. American wigeon were 45% lower than in 2010 but similar to the long-term average. Green-winged teal were 51% lower than in 2010 and 55% below their long-term average, while blue-winged teal were 191% above the 2010 estimate and 235% above the long-term average. The northern shoveler estimate was 95% above the 2010 estimate and 176% above the long-term average. Northern pintails were similar to 2010 and the long-term average. Redheads were similar to 2010 and 279% above their long-term average. Canvasback numbers were 59% lower than in 2010, and similar to their long-term average in this survey area. The scaup estimate was 160% higher than in 2010 and 26% lower than the long-term average.

Eastern Dakotas (strata 45–49)

May 2011 habitat conditions in the survey area were as wet or wetter as those in 2010. The survey area was wet in 2010 due to abundant snow during winter 2009–2010 and rain the following spring. This trend continued through the winter of 2010–2011 and above-average snow and spring rain continued in 2011. Spring phenology appeared to be slightly delayed in 2011 but was comparable to 2010. Upland vegetation had barely begun to green up and trees had little more than buds at the beginning of the survey.

Conditions were excellent in eastern South Dakota (strata 48 and 49). Wetland basins exceeded 100% full, with most being 120% or greater. Likewise, most, if not all streams and rivers were well outside of their banks. Even drained wetland basins were holding some water. There was little evidence of farming activity due to the abundance of moisture. Waterfowl nesting throughout South Dakota should benefit from the delayed farming activity.

Northern and eastern North Dakota (strata 45 and 46) habitat conditions also were good to excellent. Like South Dakota, virtually all of the wetland basins were full to overflowing. The Souris River in northwest North Dakota was well outside of its banks, providing excellent habitat along its course. The Red River Valley (stratum 47) was drier than any of the other strata due to extensive draining and tiling. However, even in the well-drained areas pools of water were still observed as there was too much water to drain efficiently. Despite the abundant water conditions, the lack of nesting cover in this stratum resulted in fair habitat conditions. By the end of the survey, slightly more farming activity was observed in North Dakota, but farming was delayed in this state as well.

Overall, conditions in the Eastern Dakotas were excellent and should be extremely productive for waterfowl populations. Many flood gates along the Missouri River dams were being opened at the conclusion of the survey to alleviate pressure on levees throughout both states, causing extensive flooding along the river which may have resulted in the loss of nests in the floodplain. However, these losses should not impact the overall success in the rest of the survey area. Delayed farm activities, combined with excellent water conditions and good grassland conditions, should produce a banner year for duck production in the Eastern Dakotas.

In this survey area, the 2011 May pond estimate was similar to 2010, and 115% higher than the long-term average. The total duck estimate was similar to last year and 172% above the long-term average. Mallard numbers were similar to 2010 and 170% higher than the long-term average. The gadwall estimate was similar to 2010 and 134% above the long-term average. The American wigeon estimate decreased 47% from 2010, but was still 104% above the long-term average. Green-winged teal decreased 67% from 2010, but were higher (114%) than the long-term average. Blue-winged teal were similar to last year and 179% higher than their long-term average. Northern shoveler and northern pintail estimates were both similar to their 2010 estimates, and were 177% and 209% higher than their long-term averages, respectively. The redhead and canvasback estimates were both similar to 2010 and were 241% and 278% above their respective long-term averages. Scaup numbers were similar to last year and 128% above their long-term average in this survey area.

Northern Saskatchewan, Northern Manitoba, and Western Ontario (strata 21–25, 50)

The survey area received below-average to above-average precipitation, with temperatures that ranged from near normal to below average since May 2010. Precipitation ranged from 40% to as much as 150% of average, with above-average moisture stretched across the southern and eastern portions of the survey area. Most of the abundant moisture that fell was in the form of rain during the summer of 2010. Winter precipitation was mainly below average (<40–85%) across the entire region, with the exception of normal to above-average precipitation near Prince Albert and west of La Ronge, Saskatchewan. Below-average precipitation stretched in a large swath from Gillam and Thompson, Manitoba, northwestward through Lynn Lake, Manitoba, up to Stony Rapids, Saskatchewan.

Temperatures during summer 2010 were near average across the entire survey area. Mean monthly temperatures from October through December 2010 ranged from 1–4° C above normal, particularly in the northern Manitoba. Conversely, January–April 2011 mean-monthly temperatures were as much as 4° C below normal. Temperatures were near normal when the survey began May 2011. Normal winter and spring temperatures prevailed throughout much of western Ontario (stratum 50) but snowfall accumulation was above average. Habitats were good to excellent throughout western Ontario, with conditions slightly drier nearing the western border with Manitoba, but beavers were active and drainages well-charged.

Although spring of 2011 initially appeared to be delayed, a period of warm, clear weather prevailed at the start of the survey and continued throughout May. Trees quickly leafed out and ice swiftly melted from small- to mid-sized wetlands. Only the larger lakes remained ice covered yet margins were open for arriving waterfowl. Runoff and river levels were expected to be near normal within the survey area. The rapid warm-up combined with enhanced moisture across most of the survey area improved habitat conditions from 2010.

The 2011 total duck estimate in this survey area was similar to last year and 30% lower than the long-term average. The mallard estimate was similar to last year and 27% lower than the long-term average. Gadwall numbers were 128% higher than in 2010 and similar to the long-term average. The American wigeon estimate was 72% higher than 2010, and 48% lower than the long-term average. Green-winged teal were similar to last year and 38% lower than the long-term average. Blue-winged teal estimates were 576% higher than 2010, but still 88% lower than their long-term average. Northern shovelers and northern pintails were both similar to last year but 83% and 74% lower than their respective long-term averages. The redhead estimate was 390% higher than 2010 and 37% lower than the long-term average. Canvasback were similar to 2010 and 42% lower than the long-term average. The scaup estimate was 76% higher than in 2010 but 35% lower than the long-term average.

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

Northern Alberta experienced below-normal precipitation over the winter and spring. As a result, wetlands were recessed. Many smaller wetlands were dry. Forest fires were prevalent during the survey. In the Northwest Territories conditions were better, and were classified as good over most of the region. However, ice jams on the Mackenzie River caused extensive flooding that overtopped margins and uplands associated with Mackenzie River Delta wetlands.

The total duck estimate for 2011 was 19% lower than in 2010 and similar to the long-term average. Mallard numbers were 31% lower than 2010 and similar to the long-term average. The American wigeon estimate was similar to 2010 and 27% lower than the long-term average. Gadwall were similar to last year and the long-term average. Green-winged teal were similar to 2010 and 60% above the long-term average. Blue-winged teal were 48% below both the 2010 estimate and the long-term average. Northern shovelers were 55% below the 2010 estimate and 40% below the long-term average. Northern pintails

were 64% below 2010 and 67% below the long-term average. Redheads were 71% below 2010 and 63% below the long-term average. Canvasback were similar to last year and 32% below the long-term average. Scaup were similar to last year and the long-term average.

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

Earlier springs the past several years have led to an earlier starting date for the survey in this area. The spring of 2011 was early as well and timing was good. Overall habitat conditions were good, with but varied slightly across the region. Habitat conditions are generally more consistent in Alaska than in most of the other parts of the traditional survey area. Some minor flooding was noted in certain areas. The Yukon–Kuskokwim Delta was normal to slightly earlier than normal with good conditions.

The total duck estimate in this survey area was 32% lower than in 2010, but similar to the long-term average. Mallard numbers were 31% lower than last year and similar to the long-term average. Gadwall, blue-winged teal, redhead, and scaup were all similar to their 2010 estimates and long-term averages. The American wigeon estimate was 41% lower than 2010, and similar to the long-term average. Green-winged teal were 33% lower than 2010 and 62% higher than the long-term average. The northern shoveler estimate was 49% lower than last year and similar to the long-term average. Northern pintails were 36% lower than 2010 and were 20% lower than their long-term average. The canvasback estimate was 60% lower than 2010 and 75% lower than the long-term average.

Eastern survey area (strata 51–72)

A number of areas in southern Ontario experienced winter precipitation that was as much as 40% below normal for the season but this deficit was erased entirely by spring precipitation. All of eastern Ontario (strata 51, 52, 54, 57) received normal to above-normal precipitation during April 2011. Small areas of standing water were regularly observed on agricultural fields in stratum 54, while rivers, lakes and other wetlands were full. Many areas were at 150% or more of normal precipitation for the period between mid-April and mid-May (Agriculture and Agri-Food Canada 2011). Habitat conditions were likewise excellent in the boreal forest regions of strata 51. While fire danger maps reported moderate danger in some areas of stratum 57 (Ontario Ministry of Natural Resources 2011), rivers were still full or nearly so, and sphagnum bogs, beaver ponds and other wetlands were full.

Despite some reports of a late spring in 2011, a string of warm days helped melt snow, advance tree leaf out and green up wetland vegetation in Ontario. There was no ice on any inland water bodies, although James Bay was still in the break-up phase.

Southern Quebec (strata 53, 56 and 68) experienced a winter that for the most part had normal to slightly cooler-than-normal temperatures. Precipitation was variable with normal-to-wet conditions across most of the survey area. The habitat conditions across the survey area were uniformly excellent. All wetland types (rivers, streams, ponds, lakes, bogs and muskeg) were mostly full. Spring was evident over the entire area with snow and ice confined to only higher elevations and more northern areas. Where ice was present wetland margins had thawed and were available for use by waterfowl. Good-to-excellent waterfowl production was expected based on the habitat conditions.

Above-average winter and spring temperatures combined with average precipitation produced an abundance of excellent habitat for breeding waterfowl in northern Quebec (stratum 69). Virtually all marsh habitat was ice free and available for nesting birds upon their arrival. Conditions were slightly drier along the coasts of James and Hudson Bays but gradually became wetter eastward toward Labrador. Conditions along Quebec's north shore (Gulf of St. Lawrence) were wetter still to the point of flooding in low-lying areas, but still provided good nesting cover for waterfowl.

Habitats in northern New York (stratum 55) were excellent this year. Marshes and bogs were lush and wet with abundant nesting cover for black ducks, wood ducks, mallards and Canada geese. Mild flooding on rivers and some streams

did not hinder cavity-nesting waterfowl; moreover these full streams likely provided good brood-rearing habitat.

Winter 2010–2011 in eastern Maine and the Maritime provinces (strata 62–67) was cold with above-average snowfall. Snowmelt and ice break-up in eastern portions of Maine and the Maritimes occurred at a moderate pace. In the higher elevations of Maine and New Brunswick, ice-out was delayed by persistent cool temperatures; however, most lakes were ice free by the second week of May. Several periods of extended blocking patterns in the upper atmosphere caused widespread and persistent rainfall and cool temperatures across Maine and Maritimes for much of May. Some moderate flooding occurred in the St. Johns River Valley of New Brunswick. The region, however, was spared the major flooding that has occurred in recent years. Spring rains left wetland habitats in overall good condition across Maine and the Maritimes at the time of the survey. Good waterfowl production was anticipated from this region. Western and central Newfoundland and Labrador received lower-than-normal snowfall amounts, but spring rains supplemented runoff and habitats across this region were in good condition. Cool, damp weather prevailed in Newfoundland throughout much of May, but good waterfowl production was expected, barring extreme weather events during the brood-rearing period.

Estimated abundance of mallards in the eastern survey area was similar to the 2010 estimate and the long-term average. The estimated abundance of American black ducks was similar to the 2010 estimate and 13% below the long-term average of 0.63 million. Abundance estimates for goldeneyes, green-winged teal, ring-necked duck, and mergansers were similar to last year's estimates and their 1990–2010 averages.

Other areas

Overall, spring precipitation contributed to improved habitat conditions in the Pacific Flyway relative to last year. In California, habitat conditions in the Central Valley and the northeastern part of the state were good to excellent. April snow pack was 59% above the seasonal average in the northern Sierra Mountains which resulted in good to excellent conditions for wetland basins in northeastern California. Late spring rains in the Central Valley were abundant and precipitation was above average, especially in March; this resulted in good nesting conditions for most waterfowl species, especially mallards. In California, the total duck estimate in 2011 was 558,600, which was similar to last year's estimate and their long-term average of 591,700. The mallard estimate in 2011 was 314,700, also similar to the 2010 estimate and their long-term average (363,900). Following a spectacular winter and early spring for precipitation in most Nevada watersheds, conditions during the Nevada breeding waterfowl survey were good to excellent across the survey area. Most marshes were at or near 100% capacity; the main exception was the Humboldt sink which remained empty. The total duck estimate for Nevada was 11,700, which was lower than the 2010 estimate of 68,900 (due to changes in Nevada's survey design, estimates prior to 2009 are not comparable with the present survey). The Nevada mallard estimate was 2,300, which was lower than the 2010 estimate of 8,900.

In western Oregon, spring precipitation contributed to good to excellent wetland conditions. Conditions in southeastern Oregon were excellent due to increased precipitation and snow pack runoff, with many basins holding water for the first time in several years. Wetland areas in other areas of eastern Oregon were also well above average, again due to increased precipitation and snow pack runoff. However, flooding in several areas of the state during May and June may have impacted nesting success for some species of waterfowl. In Oregon, the total duck estimate in 2011 was 168,900, which was 23% lower than 2010, and 40% below the long-term average. The 2011 mallard count was 67,900, which was similar to last year, but 34% lower than the long-term average. In Washington, the estimate for total ducks (122,300) increased from last year, but was below the long-term average. Total mallards in the eastern Washington breeding population were estimated at 54,900, an increase from 2010, and slightly above the long-term average. All dabblers, with the exception of blue-winged and cinnamon teal (*Anas*

cyanoptera), increased over the previous year's indices. Redheads continued a long-term decline in eastern Washington, with the 2011 estimate lower than the previous year and below the long-term average. Among other common divers, scaup increased since 2010, but remained below the long-term average. Total duck numbers were up 28% in the wetland habitats associated with the irrigation projects of the Yakima Valley and the Columbia Basin where water levels remain more stable. Pond counts in the precipitation-dependent potholes of eastern Washington increased 57% from 2010.

In British Columbia, habitat conditions overall were fair, a marginal improvement over the poor conditions of the previous several years. The 2010–2011 winter was associated with the La Niña phase of the climate cycle and resulted in cooler than normal temperatures throughout the B.C. interior. Total precipitation and snowpack accumulation were near or above normal across the interior. Typically, the transition from snow accumulation to snowmelt occurs near the middle of April at most locations in the province, but this year cool April weather led to an increase in snowpack throughout the province and the snow melt was delayed by approximately two weeks compared to average (British Columbia Ministry of Forests, Lands, and Natural Resource Operations 2011). Wetland water levels were marginally or substantially higher this year than last year, although low- or mid-elevation wetlands in the most productive waterfowl areas of the province are still below long-term water levels following 4 consecutive years of drying. Some higher-elevation waterfowl habitat was unavailable this year due to high snow pack and unseasonal presence of ice. The 2010 total duck estimate in British Columbia was 253,200, which was lower than last year and the previous 5-year average (2006–2010). The mallard estimate was 68,300, which was lower than last year and the previous 5-year average.

In the midwest U.S., habitat conditions were influenced by abundant spring precipitation. Habitat conditions in the Nebraska Sandhills this year were good to excellent. Precipitation continued through the spring and conditions were good to excellent through early summer. Production in the Sandhills this year was predicted to be above average. In Michigan, the 2011 statewide wetland abundance estimate was 438,100 ponds, which was 9% above the 2010 estimate, but 7% below the long-term average. Habitat conditions were variable across the state: ponds in the northern forested region increased 60% from last year, while ponds decreased 12% in southern Michigan. The 2011 estimate of total ducks was 424,300, 43% below the long-term average. The 2011 estimate for mallards was 224,600, 34% below the 2010 estimate and 40% below the long-term average. In Wisconsin, fall and winter precipitation (Oct–Feb) was 5% below normal. Spring (March–May) precipitation ranged from slightly above normal in the south to near normal in the north, with significant increases (22% and 33% above normal) in the southeast and east-central regions, respectively. Overall, average statewide spring precipitation was 6% above normal. The total Wisconsin breeding duck population estimate of 513,700 was 33% higher than 2010 and similar to the long-term average, reflecting an improvement in wetland conditions. The 2011 total mallard population estimate of 187,900 was similar to the 2010 estimate of 199,100 and the long-term average. In Minnesota, spring wetland habitat conditions were excellent across the survey area. Spring temperatures were below normal in April and May and precipitation was above normal. The number of permanent or semi-permanent wetlands increased 33% compared to 2010, were well above both the 10-year (+37%) and long-term (+44%) averages, and were the highest count on record. The estimated mallard breeding population was 283,300, which was similar to last year's estimate of 241,900 mallards and the long-term average. The estimate of total duck abundance, including scaup, was 709,700, which was higher than last year's estimate and the long-term average.

Habitat conditions in the northeast U.S. were impacted by heavy rainfall in late April and May, with substantial flooding in some areas. With a few exceptions, spring phenology appeared to be near normal in most states. In Pennsylvania, prolonged staging and migra-

tion of birds, especially scaup and ring-necked ducks, was observed this spring. Precipitation was more than 100% above average across much of northern and central Pennsylvania from April to mid-May, overlapping the peak of nest incubation and hatching. Precipitation in southern areas of the state was 10% to 30% above normal, with observations indicating some negative impacts on nest, hatching and early brood survival rates. In New Jersey, water levels were generally below average in mid-April; however, several heavy rain events in late April resulted in severe flooding in the northern part of the state. Duck nest initiation in Virginia was 1–2 weeks later than average. Habitat conditions in early spring were fair to somewhat unfavorable; however, high tides in mid-May resulted in flooding of many coastal marsh and island nesting birds, especially black ducks. Hot temperatures early in June hastened the drying of some wetlands and may have curtailed renesting efforts. Overall, duck production in Virginia this year is expected to be below average. In Delaware, early spring habitat conditions were very good. During March and April the state experienced slightly above-average precipitation and temperature. In the month of May, temperatures were again above average but precipitation was below average. In Rhode Island, waterfowl nest initiation was average despite an unusually cool and wet spring. However, productivity and survival were predicted to be lower than average due to the prolonged wet weather and cool temperatures. Maryland experienced above-average temperatures from March through May. Precipitation was above average for March and April, but below average for May. Some flooding occurred along the Potomac River and smaller tributaries that may have impacted some ground-nesting ducks, but overall nesting effort and hatching success appeared normal. Brood-rearing conditions in Maryland were very good. New Hampshire, Massachusetts, Connecticut, and New York experienced a colder and wetter spring than normal. Timing of nest initiation appeared normal; however, cool and rainy weather in early May may have impacted brood survival. The eastern part of Connecticut experienced an early spring, while in the western part of the state, spring was delayed 1–2 weeks. Vermont received historic levels of rainfall in the Champlain Valley and northern half of the state during April and May. Significant amounts of flooding occurred with record levels being set for Lake Champlain. Many grassland nesting areas were flooded. Prolonged high-water levels may have reduced renesting effort and impacted brood cover. High water levels may significantly reduce the amount of natural food sources found within the marshes for breeding and migrating waterfowl. Total duck numbers from the 2011 Atlantic Flyway Breeding Waterfowl survey were 1.3 million, which was similar to the 2010 estimate and the long-term (1993–2010) average of 1.4 million. Mallard numbers (586,100) were similar to the 2010 estimate of 651,700 and 23% below their long-term average of 763,900.

Mallard Fall-flight Index

The mid-continent mallard population is composed of mallards from the traditional survey area (revised in 2008 to exclude Alaska mallards), Michigan, Minnesota, and Wisconsin, and is estimated to be 11.9 ± 1.1 million birds in 2011(Figure 4). This is similar to the 2010 estimate of 10.3 ± 0.9 million.

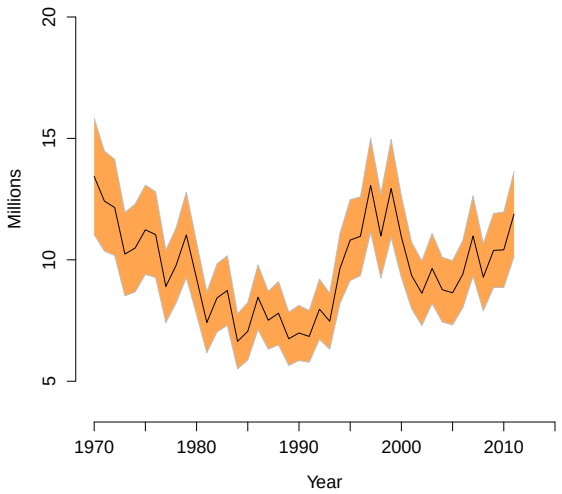

Figure 4: Estimates and 90% confidence intervals for the predicted size of the mallard population in the fall.

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2 Status of Geese

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's geese (*C. rossii*), emperor geese (*C. canagica*), white-fronted geese (*Anser albifrons*), and tundra swans (*Cygnus columbianus*). Production of arctic-nesting geese depends heavily upon the timing of snow and ice melt, and on spring and early summer temperatures. In 2011, snowmelt timing was average to slightly below average throughout most of the important goose breeding areas, and most of North America will see average, or slightly below-average fall flights of geese this year. Conditions in the central Arctic, especially near Queen Maud Gulf, improved relative to last year's very late spring, so improved production of snow and Ross's geese and mid-continent white-fronted geese is expected. Gosling production of Canada goose populations that migrate to the Atlantic and Mississippi Flyways should generally be good in 2011, with the possible exceptions of the Eastern Prairie and Mississippi Valley populations. Conditions throughout Alaska and northwestern Canada were very good. As a result, Pacific Flyway white-fronted geese, brant, and most Canada geese experienced average to above-average production. Indices of wetland abundance in the Canadian and U.S. prairies in 2011 were generally excellent, and were particularly improved relative to 2010 in Canada. This likely improved nesting and brood rearing success of temperate-nesting Canada geese this year. However, flooding along many river systems may have destroyed some nests. Well above or near-average wetland abundance in the U.S. and Canadian prairie regions and mild spring temperatures in many other temperate regions will likely improve production of Canada geese that nest at southern latitudes. Primary abundance indices decreased ($\leq -10\%$) for 7 goose populations and increased ($> 10\%$) for 10 goose populations from 2010 to 2011. Indices of 12 other populations remained similar among years. Primary abundance indices decreased for western tundra swans and remained unchanged for eastern tundra swans.The following populations displayed significant positive trends during the most recent 10-year period ($P < 0.05$): Mississippi Flyway Giant, Short Grass Prairie, and Hi-line Canada geese; Western Arctic/Wrangel Island and Western Central Flyway light geese; Pacific white-fronted geese and Pacific brant. Only the Atlantic Flyway Resident goose population showed a significant negative 10-year trend. The forecast for the production of geese and swans in North America for 2011 is regionally variable, but production by most populations will be similar this year compared to 2010.

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 5), 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.

Figure 5: Important goose and swan nesting areas in Arctic and subarctic North America.

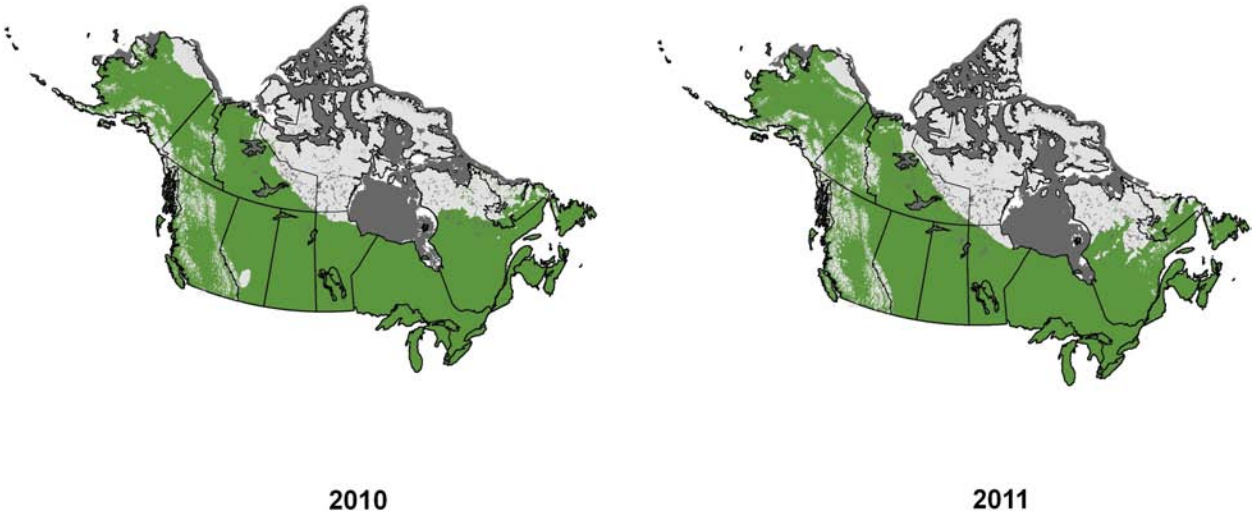


Figure 6: The extent of snow (light gray) and ice (dark gray) cover in North America on 2 June 2010 and 2 June 2011 (National Ice Center 2011).

Methods

We have used the most widely accepted nomenclature for various waterfowl populations but they may differ from other published information. Species nomenclature follows the List of Migratory Birds in Title 50 of the Code of Federal Regulations, Section 10.13, revised March 1, 2010 (75 FR 9282). Some of the goose populations described herein are composed of more than one subspecies and some light goose populations contain two species (i.e., snow and Ross's geese).

Population estimates for geese (Appendices D.1, D.2, and D.3) are derived from a variety of surveys conducted by biologists from federal, state, and provincial agencies, or from universities (Appendix A). Surveys include the Midwinter Survey (MWS, conducted each January in wintering areas), the Waterfowl Breeding Population and Habitat Survey (WBPHS, see Status of Ducks section of this report), and surveys that are specifically designed for various goose populations. When survey methodology allowed, 95% confidence intervals were presented in parentheses following 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 two-tailed z-test using the sum of sampling variances for the two estimates. All statistical tests and analyses were conducted using an alpha level of 0.5. Primary abundance indices, that are those related to management plan population objectives, are the first of those presented in population-specific sections and are also presented in graphs.

Because this report was completed prior to final annual assessments 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

Production of Arctic-nesting geese depends heavily upon the timing of snow and ice melt, and spring and early summer temperatures. In 2011, snowmelt timing was average to slightly below average throughout most of the important

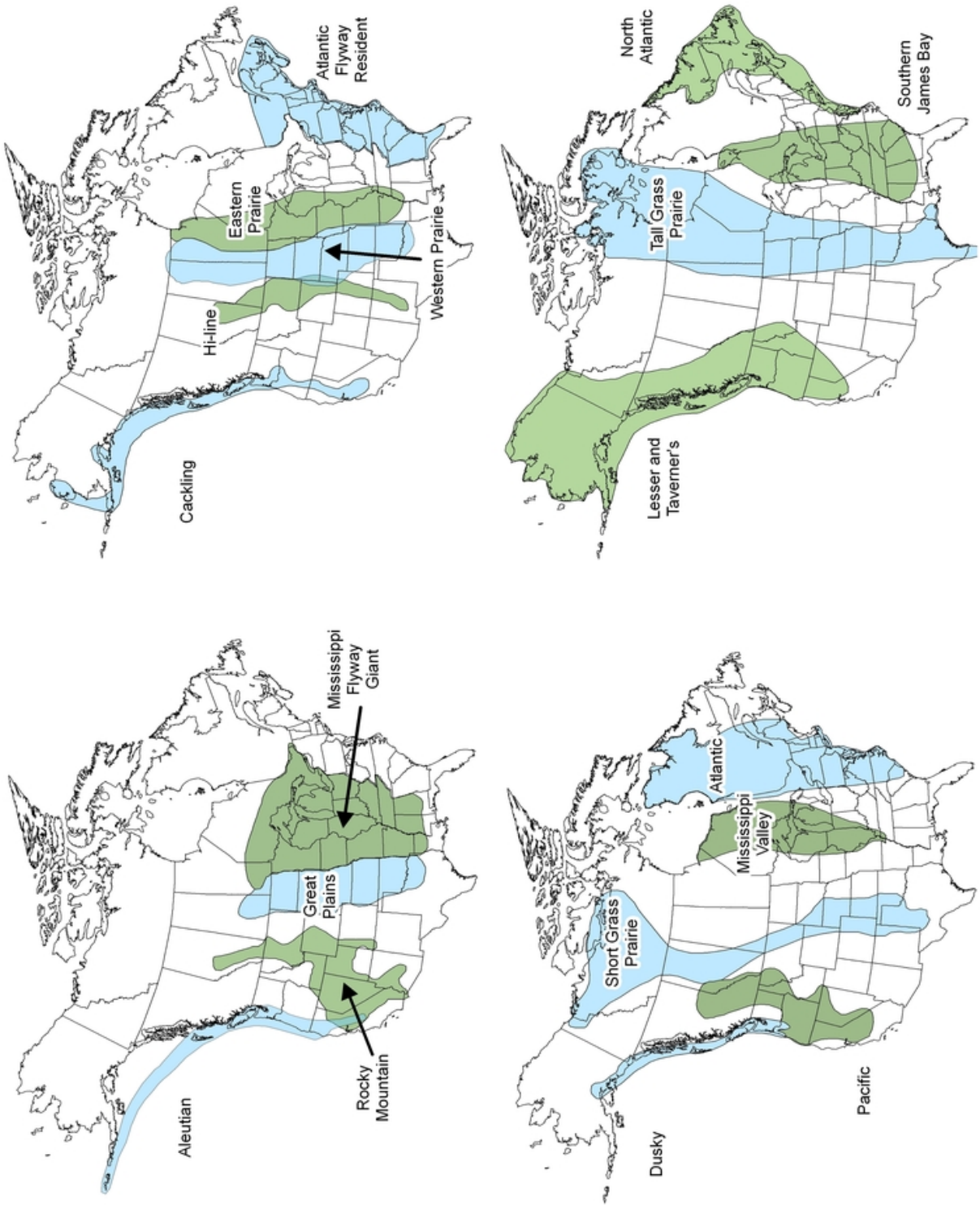


Figure 7: Approximate ranges of Canada goose populations in North America.

goose breeding areas, and most of North America will see average, or slightly below-average fall flights of geese this year. Gosling production of Canada goose populations that migrate to the Atlantic and Mississippi Flyways should generally be good in 2011. Counts of the Atlantic Population and the Southern James Bay Population of Canada Geese were up, and the outlook for production looks good. The Eastern Prairie Population estimate was down from last year's, and the Mississippi Valley Population is recovering from the poor production years of 2009 and 2010. Most snow goose populations experienced favorable nesting conditions. Overall, we expect to see another abundant fall flight of snow geese with many goslings in 2011. Conditions in the central Arctic, especially near Queen Maud Gulf, improved relative to last year's very late spring, so improved production of Ross's geese and mid-continent white-fronted geese is expected. Conditions throughout Alaska and northwestern Canada were very good. Pacific Flyway white-fronted geese, brant, and most Canada geese experienced average to above-average production. These geese migrate to portions of the Central, Mississippi, and Pacific Flyways. The extent of snow cover on 2 June 2011 was similar to the same date in 2010, except that snow cover extended further south along the western edge of the Hudson Bay (Figure 6; National Ice Center 2011. IMS daily Northern Hemisphere snow and ice analysis at 4 km and 24 km resolution. Boulder, CO: National Snow and Ice Data Center.).

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 subarctic. 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 2011 were generally excellent, and were particularly improved relative to 2010 in Canada. This may have contributed to improved nesting and brood rearing success this year. However, flooding in many portions of the prairies may have destroyed some nests, although the worst flooding occurred after most nests should have hatched. Generally favorable nesting conditions were reported in most areas inhabited by temperate-nesting geese in southern Canada and the eastern United States. In several southern and midwestern states (e.g., AR, MO, IN, MI, and WY) flooding reduced production potential, and in the northeastern U.S., cool wet weather may have lowered gosling survival. Overall, production of temperate-nesting Canada geese from most of their North American range is expected to be above average in 2011.

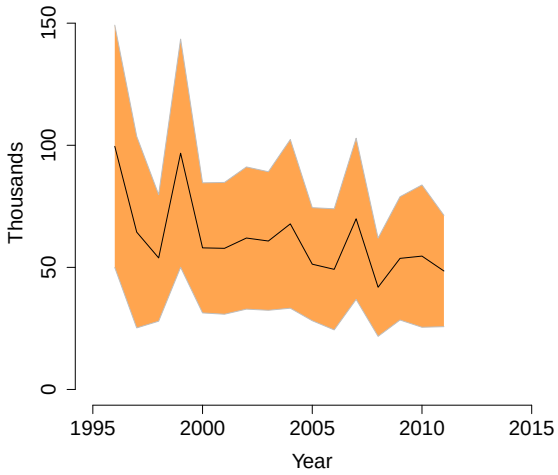
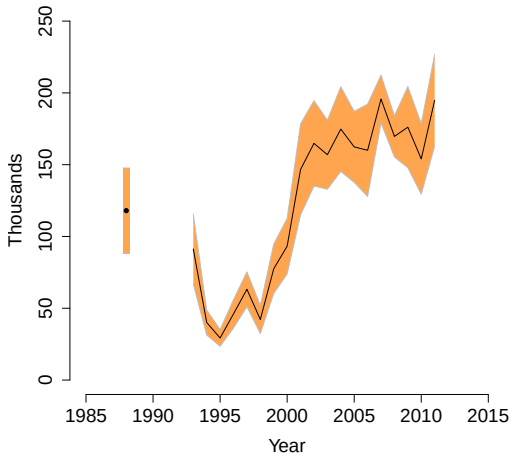


Figure 8: Estimated numbers (and 95% confidence intervals) of North Atlantic Population Canada geese (indicated pairs).

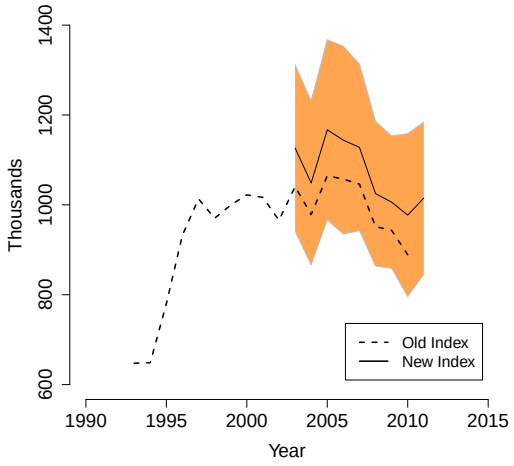
Status of Canada Geese

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 7). 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. During the 2011 WBPHS,



9.1: Atlantic Population



9.2: Atlantic Flyway Resident Population

Figure 9: Estimated numbers (and 95% confidence intervals) of Atlantic Population (breeding pairs) and Atlantic Flyway Resident Population (breeding adults) Canada geese.

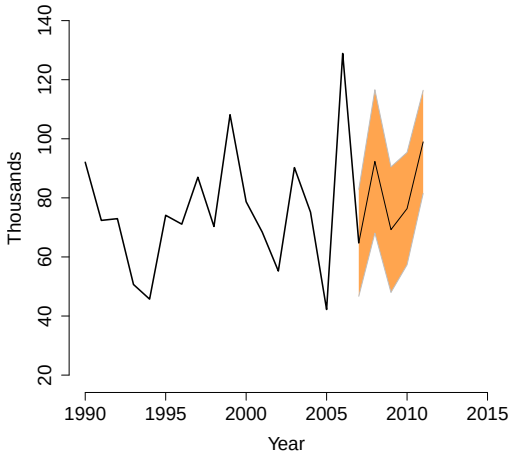
biologists estimated 48,500 (25,700–71,300) indicated pairs (single birds plus pairs) within the NAP range (strata 66 and 67), 11% fewer than in 2010 ($P = 0.747$; Figure 8). Indicated pair estimates declined an average of 3% per year during 2002–2011 ($P = 0.141$). The 2011 estimate of 152,800 (79,500–232,300) total NAP Canada geese (including grouped birds) was similar to last year's estimate ($P = 0.949$). Western and central Newfoundland and Labrador received lower than normal snowfall amounts, but cool, damp weather prevailed in Newfoundland throughout much of May 2011. However, good production was expected, barring extreme weather events during the brood rearing period. Overall, conditions in Newfoundland and lowland portions of Labrador were favorable for NAP geese. A fall flight similar to that of 2010 is expected.

Atlantic Population (AP)

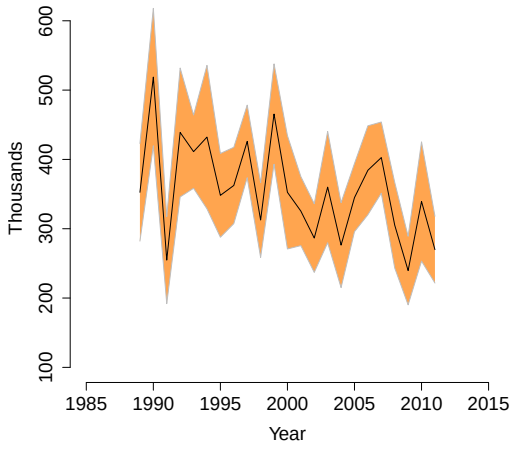
AP Canada geese nest throughout much of Quebec, especially along Ungava Bay, the eastern shore of Hudson Bay, and on the Ungava Peninsula. The AP winters from New England to South Carolina, but the largest concentrations occur on the Delmarva Peninsula (Figure 7). Spring surveys in 2011 yielded an estimate of 194,900 (162,900–226,800) breeding pairs, 27% higher than the 2010 estimate ($P = 0.047$; Figure 9.1). Breeding pair estimates indicate no trend from 2002 to 2011 ($P = 0.275$). In 2011, 49% of indicated pairs were observed as singles, similar to the 19-year average of 51%. The estimated total spring population of 919,300 (780,600–1,058,000) in 2011 was 18% higher than in 2010 ($P = 0.111$). In Quebec, winter temperatures were below normal, but so was winter snowfall. Spring thaw occurred slowly; temperatures in late May and early June were cold, and conditions were rated average to slightly below average on the Ungava Peninsula in mid-June. Nesting studies along Ungava Bay estimated a mean nest initiation date of 31 May, two days later than the long-term average and three days earlier than last year. Average clutch size in 2011 was 3.4 eggs, slightly below the long-term average. In 2011, slightly below-average gosling production and a fall flight similar to that of 2010 are expected for AP geese.

Atlantic Flyway Resident Population (AFRP)

This population of large Canada geese inhabits southern Quebec, the southern Maritime provinces, and all states of the Atlantic Fly-



10.1: Southern James Bay Population



10.2: Mississippi Valley Population

Figure 10: Estimated numbers (and 95% confidence intervals) of Southern James Bay Population (breeding adults) Canada geese and Mississippi Valley Population (breeding adults) Canada geese.

way (Figure 7). The Atlantic Flyway Breeding Waterfowl Plot Survey produced an estimate of 1,015,100 (845,600–1,184,600) AFRP Canada geese during the spring of 2011, similar to the 2010 estimate ($P = 0.764$; Figure 9.2). Since 2003, total indicated bird indices have been calculated by doubling pairs and single birds and adding them birds observed in groups. These indices have declined by an average of 2% per year since 2003 ($P = 0.029$). The spring of 2011 was generally characterized as cooler and wetter than average throughout most of the AFRP range. This was particularly true from New England south to New Jersey, which may have lowered production. April and May temperatures in Maryland and Delaware were above average, favorable for goose production. In general, biologists expect AFRP production to be average, with a fall flight 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 7). The estimated number of breeding SJBP geese in spring 2011 was 86,900 (69,400–104,400), 30% higher than last year's index ($P = 0.426$; Figure 10.1). These indices of SJBP geese have increased an average of 3% per year since 2002 ($P = 0.487$). Transect level analyses of this year's breeding pair estimates appeared similar to those of the previous five years on Akimiski Island and the mainland. The 2011 survey indicated a total spring population of 98,900 (80,600–117,300) Canada geese, 13% more than in 2010 ($P = 0.406$). Surveys in 2011 were conducted from 17–20 May under good to excellent weather conditions. On Akimiski Island, timing of snowmelt was near average, as was timing of nesting. Nest density was average and average clutch size during late incubation was above average, the latter likely reflecting a drop in nest predation relative to last year's high rates. Conditions on the mainland portion of the SJBP range were also good, but no nesting information was available from there. Biologists expect gosling production in 2011 to be average or slightly above average, and anticipate a fall flight higher than in 2010.

Mississippi Valley Population (MVP)

The nesting range of this population is in northern Ontario, principally in the Hud-

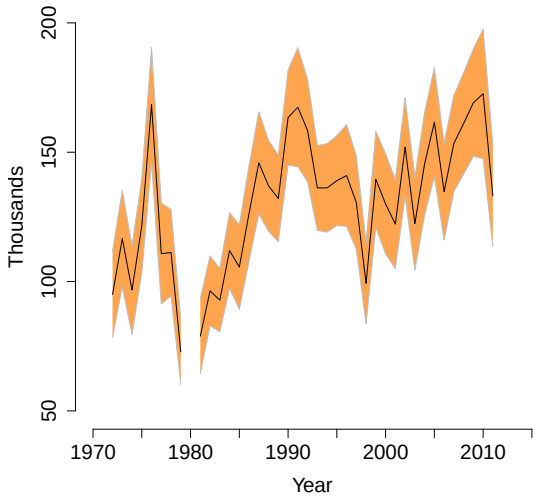
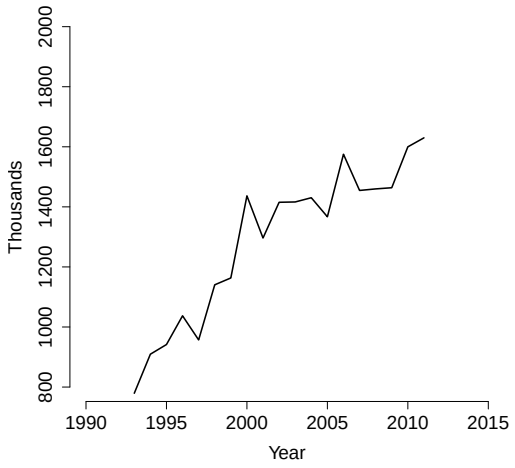


Figure 11: Estimated numbers (and 95% confidence intervals) of Eastern Prairie Population (indicated pairs) Canada geese.

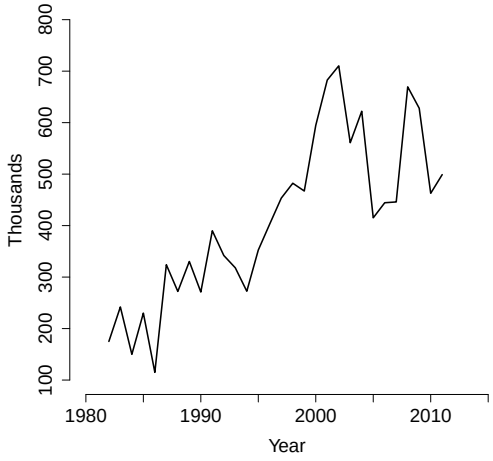
son Bay Lowlands, west of Hudson and James Bays. MVP Canada geese primarily concentrate during fall and winter in Wisconsin, Illinois, and Michigan (Figure 7). Breeding ground surveys conducted in 2011 indicated the presence of 269,800 (221,600–318,000) MVP breeding adults, 20% fewer than in 2010 ($P = 0.167$; Figure 10.2). Estimates of breeding adults show little evidence of trend during 2002–2011 ($P = 0.549$). However, transect-level counts indicated that in 2011, breeding pairs were below the 2006–2011 average. Surveys indicated a total population of 300,200 (248,200–352,200), which was well below average and reflected major nesting failures in 2009 and 2010 that led to an absence of non-breeding yearlings. In 2011, spring phenology was near average but variable across the MVP range, as ice and snow persisted longer in a northern area along the coast that typically has the highest nesting densities. Ground studies near Peawanuck, Ontario indicated average breeding effort. Nest depredation was lower than the past two years, however still remained above average. Biologists expect improved productivity relative to 2010, but a below-average fall flight.

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 7). The 2011 survey estimate of single and paired EPP geese was 133,100 (113,500–152,700), 23% lower than last year ($P = 0.015$; Figure 11). Estimates of these population components have increased an average of 1% per year during 2002–2011 ($P = 0.335$). The 2011 spring estimate of total geese was 192,900 (168,500–217,200), 23% lower than the 2010 estimate ($P = 0.140$). The estimated number of productive geese (birds observed as nesting pairs and singles) was 57,600 (47,200–67,900) in 2011, significantly lower than the good production year of 2010, when the estimate was 80,000. Range-wide in 2011, snowfall was below normal, and it was cooler and drier than normal. Despite cooler temperatures, phenology was considered average. Biologists at the Nestor One field station near Cape Churchill did not conduct ground-based nesting surveys, but examination of small samples of nests predicted median hatch dates of 20 June at Churchill and 27 June at Cape Churchill. The median hatch date at Cape Churchill was about 1 day later than the 1990–2010 average, and the difference in nesting phenology between the two areas was typical. A



12.1: Mississippi Flyway Giant Population



12.2: Western Prairie/Great Plains Population

Figure 12: Numbers of Mississippi Flyway Giant Population (breeding adults) Canada geese and Western Prairie/Great Plains Population Canada geese (winter geese).

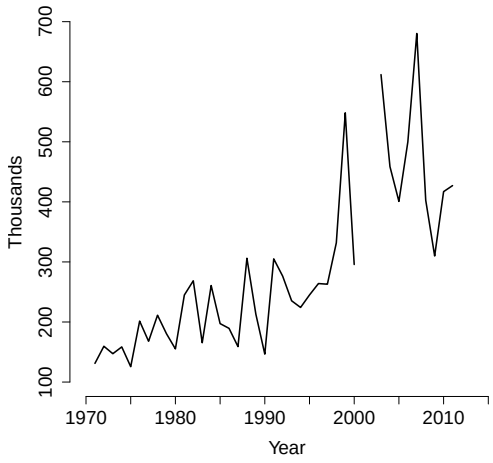
below-average fall flight is expected.

Mississippi Flyway Giant Population (MFGP)

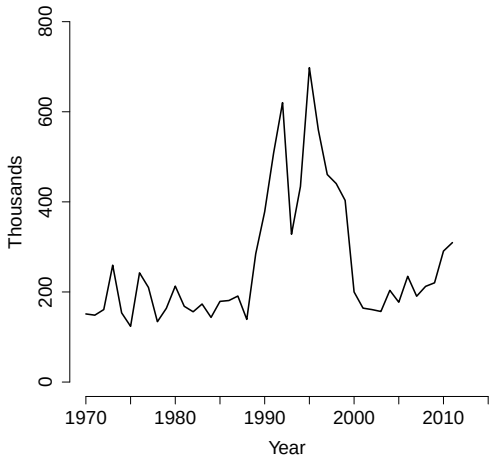
Giant Canada geese have been reestablished or introduced in all Mississippi Flyway states. This subspecies now represents a large proportion of all Canada geese in the Mississippi Flyway (Figure 7). Biologists estimated a record-high 1,629,800 MFGP geese during the spring of 2011 (using new indices that incorporate new estimation procedures for ON and MB), similar to the revised 2010 estimate of 1,599,900 (Figure 12.1). This is considered an over-abundant population, currently managed with the goal of reducing it. While this population has continued to grow, it appears that population growth has slowed in recent years; the trend estimate for the period 1993–2000 was 7.2% (95% CI −1%, 16%) annual growth, while the estimate for the period 2001–2011 indicates a growth rate of 2.5% (95% CI −2%, -7%) annually. Manitoba, Alabama and Minnesota reported above-average nesting conditions in 2011. However, extensive flooding reduced nest success in many areas, especially Arkansas, Missouri, Indiana, and Michigan. Overall, biologists expect average production this year.

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 7). These two populations are managed jointly and surveyed during winter. During the 2011 MWS, 499,000 WPP/GPP geese were counted, 8% more than the 462,800 recorded in 2010 (Figure 12.2). These indices have decreased an average of 2% per year since 2002 ($P = 0.421$). In 2011, the estimated spring population in the portion of WPP/GPP range included in the WBPHS was 1,171,700 (997,200–1,346,200) geese, 17% higher than last year's estimate of 998,900 ($P = 0.142$). The WBPHS estimates have increased an average of 7% per year since 2002 ($P < 0.001$). The northern WPP range experienced average spring phenology in 2011. Wetland abundance was high throughout the GPP range. Goose pro-



13.1: Tall Grass Prairie Population



13.2: Short Grass Prairie Population

Figure 13: Estimated numbers of Tall Grass Prairie and Short Grass Prairie Population Canada geese estimated during winter surveys.

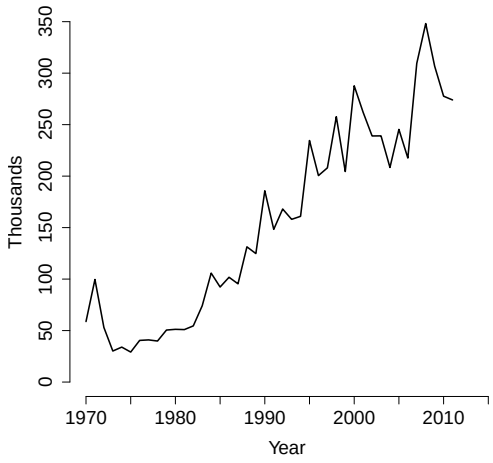
duction is expected to be excellent in South and North Dakota, and near average in Oklahoma. Drought in Texas may have hampered production. An improved fall flight relative to that of 2010 is expected.

Tall Grass Prairie Population (TGPP)

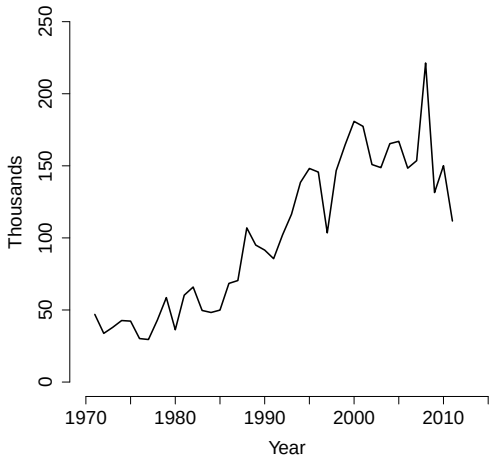
These small Canada geese nest on Baffin (particularly on the Great Plain of the Koukdjuak), Southampton, and King William Islands; north of the Maguse and McConnell Rivers on the Hudson Bay coast; and in the eastern Queen Maud Gulf region. TGPP Canada geese winter mainly in Oklahoma, Texas, and northeastern Mexico (Figure 7). These geese mix with other Canada geese on wintering areas, making it difficult to estimate the size of the winter population. During the 2011 MWS in the Central Flyway, 427,100 TGPP geese were counted, 2% more than in 2010 (Figure 13.1). Biologists on Southampton and Baffin Islands reported average goose nesting phenology and expect good production from TGPP geese there in 2011. Nesting was slightly delayed near the Queen Maud Gulf, about 2 days later than average. Available information suggests that the production of TGPP Canada geese will be similar to that of 2010.

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 7). The MWS index of SGPP Canada geese in 2011 was 309,600, similar (+6%) to the 2010 estimate of 290,700 (Figure 13.2). These indices have increased an average of 7% per year since 2002 ($P < 0.001$). In 2011, the estimated spring population of SGPP geese in the Northwest Territories (WBPHS strata 13–18) was 225,100 (128,500–321,800), similar to last year's estimate of 247,300 (115,400–359,200; $P = 0.769$). WBPHS estimates have increased an average of 9% per year since 2002 ($P = 0.026$). Nesting phenology in the Queen Maud Gulf Sanctuary was approximately two days later than average. In western SGPP range (i.e., West Victoria Island and near Inuvik), phenology appeared slightly later than normal. Wetland conditions in boreal forest SGPP nesting areas were assessed as good. Production of SGPP geese in 2011 is expected to be slightly below average.



14.1: Hi-line Population



14.2: Rocky Mountain Population

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

Hi-line Population (HLP)

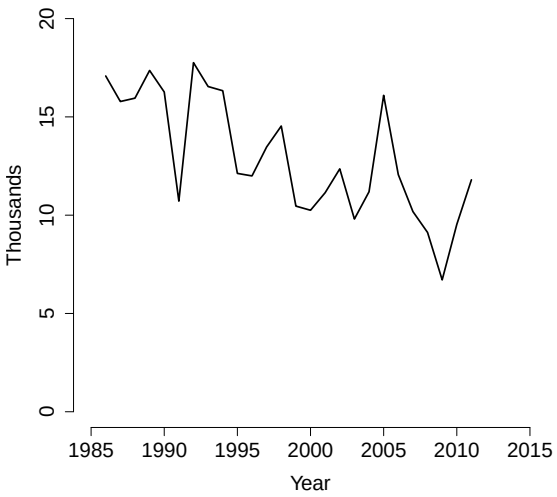
These large Canada geese nest in southeastern Alberta, southwestern Saskatchewan, eastern Montana and Wyoming, and in Colorado. They winter in these states and central New Mexico (Figure 7). The primary index of this population is based on WBPHS surveys in Alberta, Saskatchewan, and Montana, and state surveys in Wyoming. In 2011, these surveys yielded an estimate of 274,000 geese, similar to last year's value of 277,600 (Figure 14.1). The breeding population survey estimates have increased an average of 3% per year during 2002–2011 ($P = 0.055$). Wetland conditions in HLP range were generally excellent, although flooding could have affected some nests. In particular, poor recruitment was reported in Wyoming. The fall flight of HLP geese is expected to be similar to or higher than that of 2010.

Rocky Mountain Population (RMP)

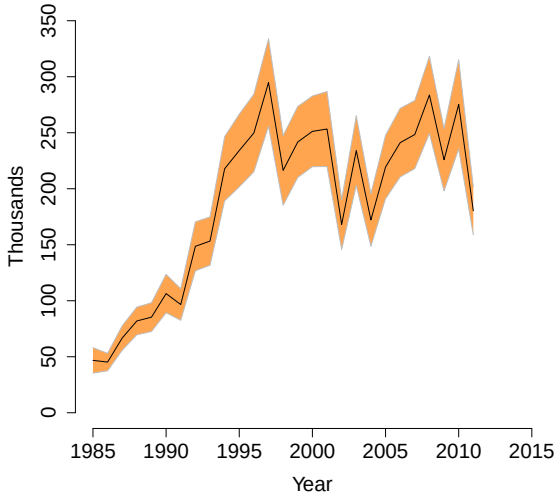
These large Canada geese nest in southern Alberta and western Montana, and the inter-mountain regions of Utah, Idaho, Nevada, Wyoming, and Colorado. They winter mainly in central and southern California, Arizona, Nevada, Utah, Idaho, and Montana (Figure 7). Spring population estimates from RMP states and provinces in 2011 totaled 111,700 geese, 26% fewer than the estimate from 2010 (Figure 14.2). These estimates declined 2% per year during 2002–2011 ($P = 0.390$). Population indices in 2011 increased in Alberta, but decreased in Montana, likely because 3 of 7 survey segments were missed owing to weather. Indices increased in Wyoming, Colorado, and Idaho, and decreased in Utah, Nevada, and Arizona. High water and flooding reduced recruitment in Wyoming, but likely did not affect nesting in Colorado. The fall flight of RMP geese is expected to be above 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 7). The index of their population is based on WBPHS estimates and results from state and provincial surveys. The PP goose index in 2011 was 166,300, 15% higher than last year. These indices increased by 4% per year over they past 10-years ($P = 0.218$). Most PP geese are surveyed in Alberta (WBPHS strata 76–77) where 111,200 (59,600–162,700) were esti-



15.1: Dusky Canada Geese



15.2: Cackling Canada Geese

Figure 15: Estimated numbers of Dusky (breeding adults) and Cackling Canada geese (predicted fall goose population, with 95% confidence intervals).

mated in 2011, 22% higher than the 2010 estimate ($P = 0.538$). WBPHS estimates have increased by an average of 5% per year since 2002 ($P = 0.223$). Conditions in Alberta were rated fair to poor, and were dry, with wildfires in some areas. Gosling production in 2011 may be lower than in 2010, but a fall flight similar to or slightly lower than that of last year is expected.

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 7). Dusky Canada geese are surveyed near the Copper River Delta and Middleton Island, Alaska. The 2011 spring population estimate was 11,800 DCG, 24% above last year's count (Figure 15.1); however, the presence of flocked birds suggested a large number of young non-breeders. These estimates have decreased an average of 3% per year during 2002–2011 ($P = 0.246$). Phenology on the Copper River Delta was near average in 2011. Gosling production is expected to be near average in 2011.

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 7). The analyses used to calculate the primary index of this population were changed this year. From 1998–2010 an estimated fall population was derived based on the historical relationship between spring surveys of adults on the YKD and direct counts conducted in the fall. Currently, spring counts of adult geese on the YKD are adjusted using the average ratio of population estimates generated from mark–resight studies in the fall and total indicated breeding bird counts from 1989–2003. We present the revised time series (Appendix D.1). The revised estimate for 2011 is 180,200 (158,800–201,600) geese, 35% lower than last year's revised estimate of 275,300 (235,500–315,200). However, the difference between estimates may reflect factors other than true population size. Over the past 10 years these revised estimates have increased by an average of 2% per year ($P = 0.272$; Figure 15.2). Spring phenology on the YKD ranged from normal to slightly later than normal. Counts

of nests were 20% lower than last year, but nest survival to mid-incubation was above 90%. Overall, production and a fall flight lower than that of last year are expected.

Lesser and Taverner's Canada Geese

These populations nest throughout Alaska and winter in Washington, Oregon, and California (Figure 7). 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 2011 estimate of Canada geese within WBPHS strata predominantly occupied by these subspecies (strata 1–6, 8, 10–12) was 47,500 (27,400–67,600), 39% lower than the 2010 estimate ($P = 0.108$). These estimates have declined an average of 2% per year since 2002 ($P = 0.457$). Overall, conditions in Alaska were good in 2011 despite mild flooding in some areas, with phenology slightly earlier than normal. Spring phenology on the YKD ranged from normal to slightly earlier than normal, and good conditions were reported there. In general, average to slightly above-average production of lesser Canada geese was expected in interior areas, and above-average production of Taverner's geese is expected on the YKD. Goose nesting phenology appeared normal on the North Slope, and Taverner's production is expected to be average there. Overall, an average production year is expected for lesser and Taverner's Canada geese.

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 7). Aleutian goose population estimates since 1996 are based on mark–resight analysis of

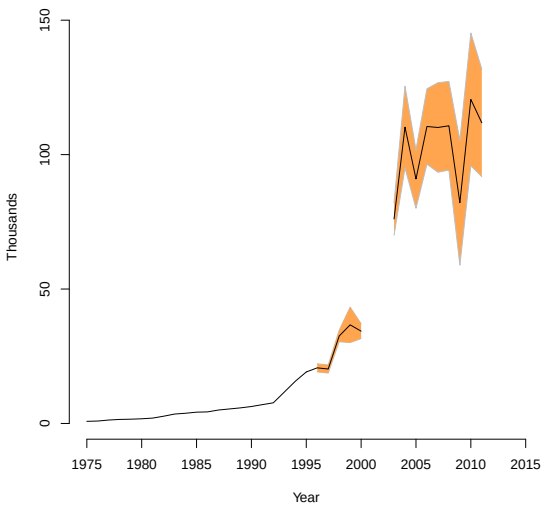


Figure 16: Estimated numbers of Aleutian Canada geese (winter geese, with 95% confidence intervals).

observations of neck-banded geese in California, and thus this time series is revised annually. The preliminary population estimate during the winter of 2011 was 111,800 (91,800–131,800), similar to the revised 2010 estimate of 120,500 (95,800–145,200; Figure 16). These estimates have increased an average of 3% per year since 2003 ($P = 0.218$), and the latest is well above the 1996 estimate of 20,700 (19,200–22,200). Biologists working on Buldir Island reported that snowmelt and vegetation green-up occurred early on the Aleutian Islands. Average clutch size of a small sample of nests was 4.3, lower than the long-term average of 4.8. Mean laying date was 4 June, yielding an estimated hatch date of 1 July, slightly later than average. However, nests were found incidental to other work and might not necessarily represent core breeding areas with more mature, experienced birds. A fall flight similar to or slightly below that of last year is expected.

Status of Light Geese

The term light geese refers to both snow geese and Ross's 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

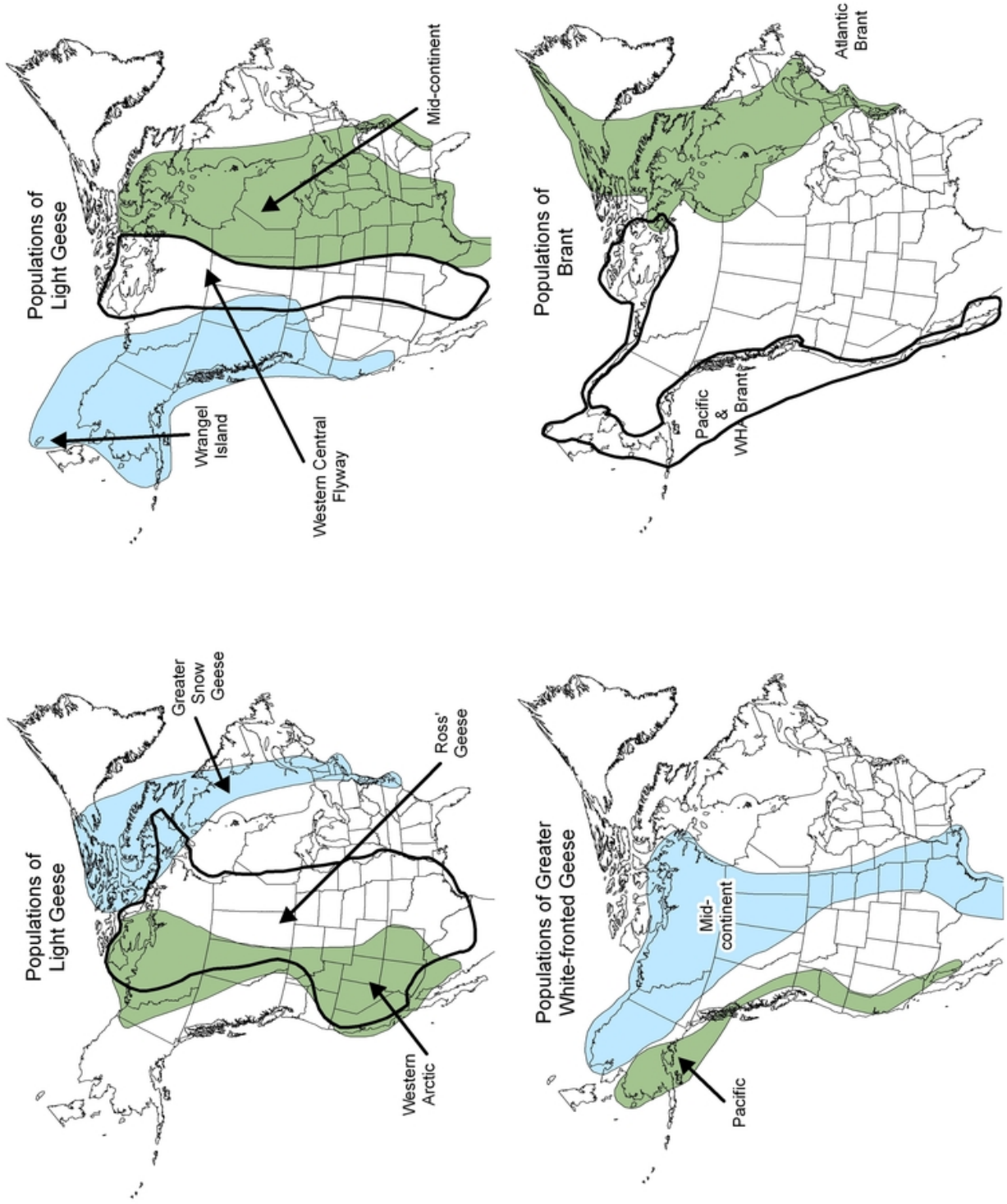


Figure 17: Approximate ranges of brant and snow, Ross's, and white-fronted goose populations in North America.

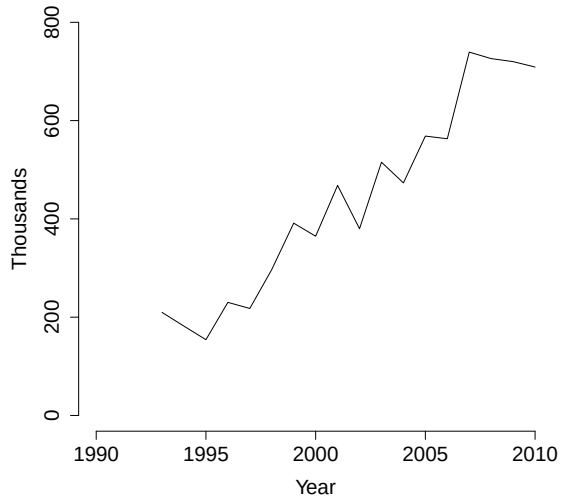


Figure 18: Estimated numbers of nesting adult Ross's geese at the Karrak Lake colony, Nunavut.

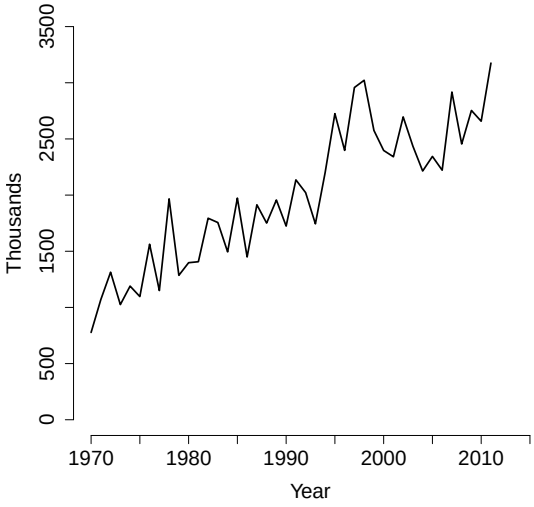
light geese, includes lesser snow and Ross's geese of two populations: the Mid-continent Population and the Western Central Flyway Population.

Ross's Geese

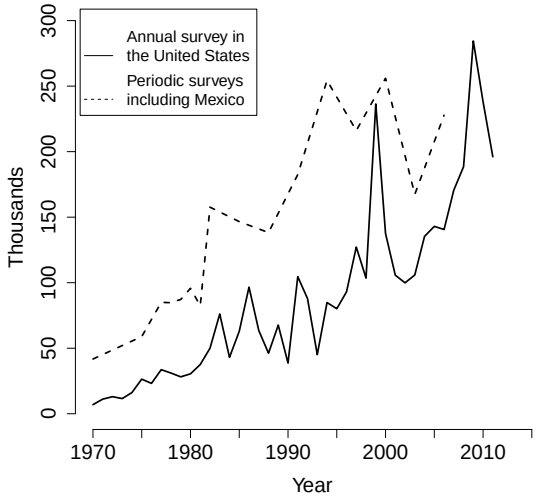
Most Ross's geese nest in the Queen Maud Gulf region, but increasing numbers nest on Southampton, Baffin, and Banks Islands, and along the western coast of Hudson Bay. Ross's geese are present in the range of three different populations of light geese and primarily winter in California, New Mexico, Texas, and Mexico, with increasing numbers in Louisiana and Arkansas (Figure 17). Ross's 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's geese within colonies) are conducted periodically. The largest Ross's goose colonies are in the Queen Maud Gulf Sanctuary. Biologists at the Karrak Lake colony estimated that 709,000 adult Ross's geese nested there in 2010, 2% fewer than in 2009 (Figure 18). These estimates increased an average of 7% per year during 2001–2010 ($P < 0.001$). At Karrak Lake Ross's geese now outnumber lesser snow geese. In 2011 conditions near the Queen Maud Gulf were approximately 2 days later than the long-term average (1991–2010). Due to the number of late nest initiation dates since 2007, the population has appeared to stabilize at around 700,000 adult geese. Biologists expect Ross's goose production in 2011 to be slightly below average there, the fifth consecutive year of below-average production. Biologists surveying Baffin Island reported that the Great Plain of the Koukdjouak was largely snow free by 26 June, and that considerable numbers of Ross's geese were nesting there. Ross' goose production in 2011 is again expected to be slightly below average.

Mid-continent Population Light Geese (MCP)

This population includes lesser snow geese and increasing numbers of Ross's 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 2011 MWS, biologists counted 3,175,200 light geese, 19% more than in 2010 (Figure 19.1). Winter indices during 2002–2011 increased an average of 2% per year ($P = 0.095$). Biologists on Southampton and Baffin Islands reported numerous nests and average goose nesting phenology, and expect good production from MCP geese there in 2011. Biologists reported that the late ice breakup, slow runoff and localized flooding near Cape Churchill reduced nest site availability, which caused some birds to redistribute south to La Perouse Bay and perhaps forego nesting altogether. In 2011, nest initiation on Akimiski Island was similar to the long-term average, and clutch size during late incubation was slightly higher than average, so average production was expected there. Cape Henrietta Maria experienced a normal spring, with a spring thaw slightly earlier than in 2010, and the area occupied by the colony was typical of the sizes observed over the past decade. Overall, information suggests an average fall flight of MCP snow geese containing an average proportion of young.



19.1: Mid-continent Population Light Geese



19.2: Western Central Flyway Light Geese

Figure 19: Estimated numbers of Mid-continent Population and Western Central Flyway Population snow and Ross's geese (winter geese).

Western Central Flyway Population (WCFP)

Historically, this population included predominantly snow geese, but Ross's 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 usually surveyed once every three years. Surveys in Mexico were not conducted in 2009 due to sociopolitical unrest in that country. During the 2011 surveys in the U.S. portion of WCFP range, 196,100 geese were counted, 18% fewer than in 2010 (Figure 19.2). These population indices have increased 10% per year during 2002–2011 ($P < 0.001$). In 2011, areas near the Queen Maud Gulf experienced spring phenology that was average to slightly below average, a marked improvement over last year's very late snowmelt. Nesting activities at the Karrak Lake colony were delayed 2 days compared to the long-term average (1991–2010). Approximately 1.16 million light geese nested at the Karrak Lake colony in 2010, of which 452,000 were lesser snow geese, up from 346,000 in 2008. Biologist there expect snow and Ross's goose production in 2011 to be below average again for the fifth consecutive year. Snow goose production from this population will be slightly below average, but very likely better than 2010.

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.

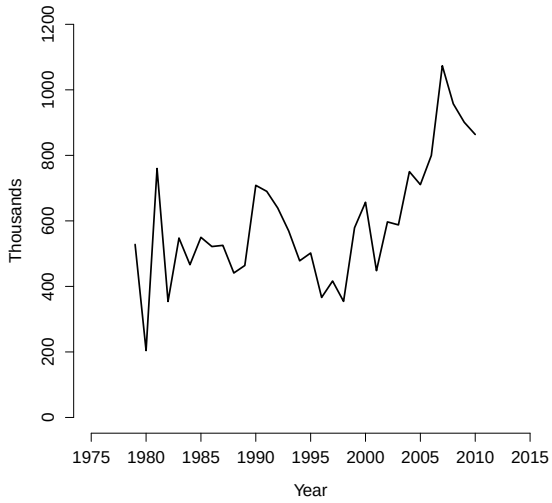


Figure 20: Estimated numbers of Western Arctic/Wrangel Island Population snow geese (fall geese).

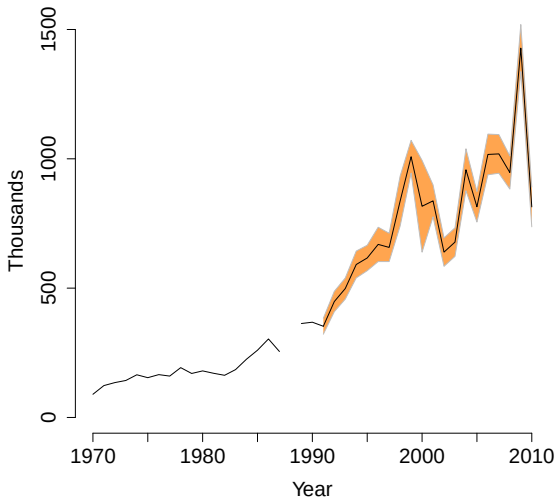


Figure 21: Estimated numbers of greater snow geese (spring staging geese, with 95% confidence intervals), 1970–2010.

The fall 2010 estimate of WAWI snow geese was 863,800, 4% lower than in 2009 (Figure 20). Fall estimates increased 8% per year during 2001–2010 ($P = 0.001$). Biologists report that snowmelt and nesting phenology were average to slightly later than average. Preliminary estimates from Wrangel Island's Tundra River colony included a spring population of approximately 140,000 adults, down slightly relative to last year. However good weather conditions and a very large colony size were reported, so improved production is expected compared to last year's very poor production. Increased fox activity was noted, but well below historic levels. Estimates of the Wrangel Island spring population have increased an average of 3% per year since 2002 ($P < 0.001$). A near-average fall flight is expected in 2011.

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 Valley in Quebec. The preliminary estimate from spring surveys was not available at the time of publication, so we present the time series though 2010 (Figure 21). The number of snow geese counted during the 2011 MWS in the Atlantic Flyway was 271,100, similar to numbers from the 2010 survey. The largest known greater snow goose nesting colony is on Bylot Island, where conditions were good this year. Snow cover was slightly below average this spring and melted rapidly in June. Late June and early July was very warm and sunny. Nest density was high, mean nest initiation date (13 June) and mean clutch size (3.8) were both near average, and nesting success to late incubation was high at 90%. In addition, lemming numbers remained high which likely reduced nest predation. Biologists who conducted an aerial survey of Baffin Island reported numerous nesting snow geese and an average phenology. Overall, good production and an above-average fall flight is 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 since 1999 has been a predicted fall population estimate derived

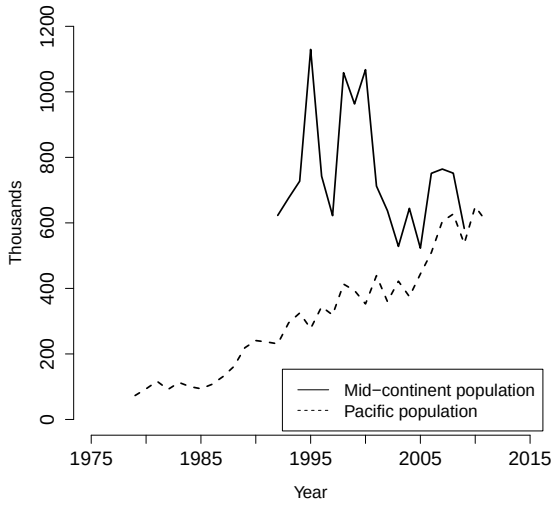


Figure 22: Estimated numbers of mid-continent population and Pacific population white-fronted geese (fall geese).

from spring surveys of adults on the YKD and Bristol Bay. The 2011 predicted fall estimate is 604,300, 7% lower than the 2010 estimate (Figure 22). These estimates have increased an average of 6% per year since 2002 ($P < 0.001$). Conditions were good and nests in surveyed areas were up 10% relative to last year on the YKD. The median hatch date of white-fronted geese was two days later than the long-term average. Nest success to late incubation appeared high. Good production and another large fall flight are expected.

Mid-continent Population White-fronted Geese (MCP)

These white-fronted geese (*Anser albifrons*) 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 2010 survey in Saskatchewan and Alberta, biologists counted 709,800 MCP geese, 22% more than during the previous survey (Figure 22). During 2001–2010, these estimates increased by an average of 1% per year ($P = 0.480$). In eastern portions (e.g., Queen Maud Gulf) of MCP white-fronted goose range, spring phenology was slightly later than normal. Nesting phenology near Karrak Lake was delayed 2 days compared to the long-term average, and white-fronted goose production there is expected to be slightly below average. Nesting near the Mackenzie River Delta may have been affected by flooding. In the interior of Alaska, the timing of spring break-up appeared to be near average with little flooding observed, and large numbers of adult geese and goslings were reported. Overall, production of MCP white-fronted geese in 2011 is expected to be above average.

Status of Brant

Atlantic Brant (ATLB)

Most of this population nests on islands of the eastern Canadian Arctic. These brant (*Branta Bernicula*) winter along the Atlantic Coast from Massachusetts to North Carolina (Figure 17). The 2011 MWS index for brant in the Atlantic Flyway was 148,900, 7% higher than the 2010 estimate (Figure 23). These estimates have shown no trend during 2002–2011 ($P = 0.555$). Winter snowfall and spring temperatures were both average, as was the timing of snowmelt, near James Bay staging areas. Biologists on Southampton and Baffin Islands reported average goose nesting phenology and expect average brant production in 2011.

Pacific Brant (PACB)

These brant nest across Alaska's Yukon-Kuskokwim Delta (YKD) and North Slope, on Banks Island and other islands of the western and central Arctic, the Queen Maud Gulf, and Wrangel Island. They winter as far south as Baja California and the west coast of Mexico (Figure 17). The 2011 MWS estimate of brant in the Pacific Flyway was 147,900. The 2011 estimate is 3% higher than the estimate from 2010 (Figure 23). Estimates increased an average of 4% per year from 2002 to 2011 ($P = 0.023$). Spring phenology was normal in 2011 on the YKD, and the median hatch date of brant was similar to the long-term average. The total number of brant nests at five primary colonies on the YKD increased by 26% from 2010 to 2011 but

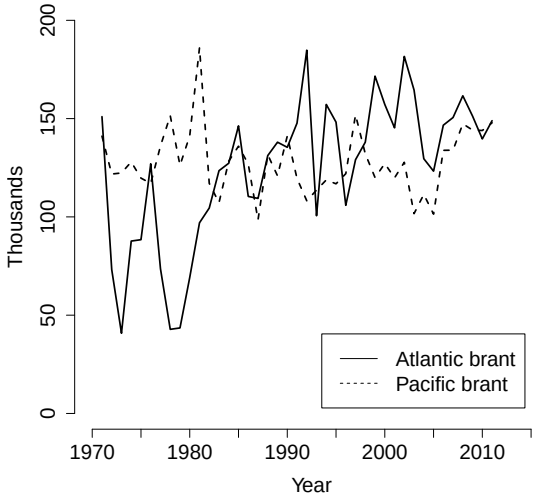


Figure 23: Numbers of Atlantic and Pacific brant estimated during winter surveys.

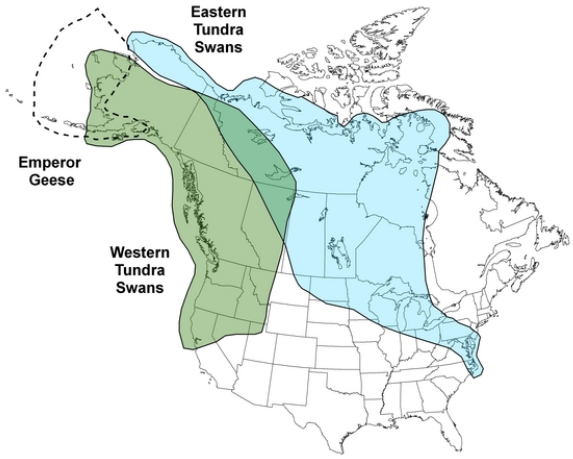


Figure 24: Approximate ranges of emperor geese, and Eastern and Western Populations of tundra swans in North America.

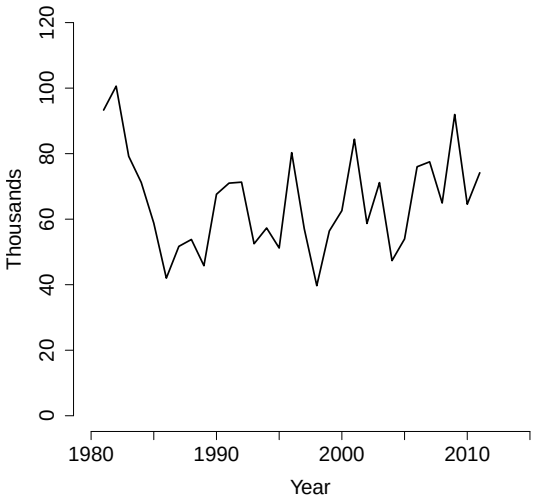
the 2011 estimate remained 25% below the long-term average. This continued a long-term (1992–2011) decline of approximately 3% per year at these colonies. However, overall, aerial surveys and ground truthing suggested a better nesting year for brant on the YKD than the previous 3-year average. Spring phenology was expected to be normal on the North Slope and slightly delayed on Banks Island, and near the Queen Maud Gulf. Overall, Pacific brant production is expected to be average.

Western High Arctic Brant (WHA)

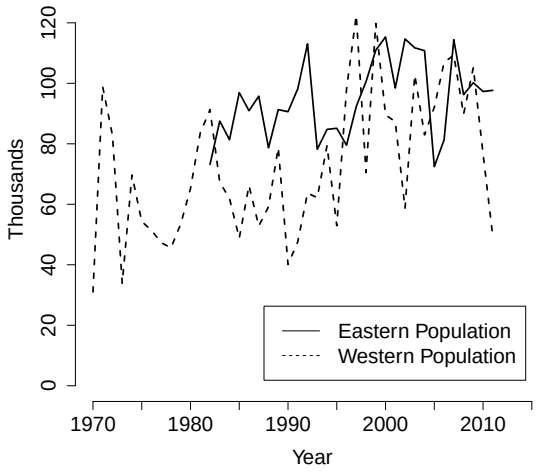
This population of brant nests on the Parry Islands of the Northwest Territories (Figure 17). The population stages in fall at Izembek Lagoon, Alaska. They predominantly winter in the Padilla, Samish, and Fidalgo Bays of Washington and near Boundary Bay, British Columbia, although some individuals have been observed as far south as Mexico. This population is monitored during the MWS in three Washington state counties. During the 2011 MWS, 8,500 brant were counted, 42% more than in 2010. These estimates have increased an average of 2% per year during 2002–2011 ($P = 0.538$). As in 2010, satellite imagery indicated very little snow cover on the Parry Islands during spring of 2011 which is consistent with an expectation for excellent brant production.

Status of Emperor Geese

The breeding range of emperor geese (*C. canagica*) 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 24). Since 1981, emperor geese have been surveyed annually on spring staging areas along southwestern coastal Alaska. The 2011 emperor goose estimate from this survey estimate was 74,200, 15% higher than in 2010 (Figure 25.1). These estimates have increased an average of 3% per year during 2002–2011 ($P = 0.138$). Emperor geese are also surveyed separately along they YKD coast. Aerial surveys of the YKD coast in 2011 indicated slight increases in the number of indicated pairs, and the number of indicated total birds compared to 2010 levels. A long-term increasing trend in both indices seen in the YKD coastal survey data. Spring phenology on the YKD ranged from normal to slightly earlier than normal, and good conditions were reported there. Emperor goose nest numbers on the YKD were approximately 10% higher in 2011 than in 2010. Good



25.1: Emperor geese



25.2: Tundra swans

Figure 25: Estimated numbers of emperor geese (spring staging geese), and Eastern and Western populations of tundra swans (winter swans).

production and a fall flight similar to that of recent years are expected.

Status of Tundra Swans

Western Population Tundra Swans

These swans (*Cygnus columbianus*) 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 24). The 2011 MWS estimate of Western Population swans was 49,300, 36% lower than last year's estimate of 76,700 (Figure 25.2). For the second year in a row, major swan areas in California could not be covered, which likely accounts for the low counts of the past few years. Despite variation in survey coverage, MWS estimates have shown no trend over the last 10 years ($P = 0.640$). On the breeding grounds the numbers of swan nests and the single plus paired swan index from the 2011 coastal Yukon-Kuskokwim Delta survey both increased (28% and 6%, respectively) over 2010 levels. The nest index was 40% greater than the 10-year average. However, the total bird index was 28% lower than in 2010. Spring phenology on the Yukon Delta ranged from normal to slightly later than normal, and good conditions were reported. Good swan production is expected in 2011. The fall flight should be average or slightly above average this 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 24). The primary index for EP tundra swans includes swans counted during winter in Ontario and the Atlantic and Mississippi Flyways. During the 2011 MWS, 97,700 EP tundra swans were observed, similar to the 2010 count (Figure 25.2). These estimates decreased by an average of 1% per year during 2002–2011 ($P = 0.563$). Spring phenology was average in the central Arctic and North Slope portions of EP tundra swan range in 2011. Flooding may have hampered nesting on the Mackenzie River Delta. Swan production in 2011 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. Spiegel

Northern Saskatchewan and Northern Manitoba (Strata 21–25)

Air W. Rhodes and M. Rabe[b]

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

Air J. Bredy and K. Doherty

Ground S. Leach[d], J. Caswell[b], M. Gillespie[c], J. Ingram[a], A. Sorensen[a], M. Watmough[a], S. Molenkamp[a], G. Raven[a], R. Wiacek[a], and E. Ewald[a]

Southern Saskatchewan (Strata 30–33, 36)

Air P. Thorpe and P. Devers

Ground J.-M. DeVink[a], K. Dufour[a], K. Warner[a], N. Tchir[a], C. Holderness[a], D. Routhier[c], P. Bergen[c], N. Wiebe[c], and N. Astleford[c]

Southern Manitoba (Strata 34-35, 37-40)

Air K. Bollinger and R. Spangler

Ground M. Schuster[a], J. Leafloor[a], G. Ball[a], J. Asmundson[a], J. Black[a], R. Buss[a], and D. Walker[a]

Montana and Western Dakotas (Strata 41–44)

Air S. Bayless and J. Klimstra

Ground K. Kruse and G. Suleiman

Eastern Dakotas (Strata 45–49)

Air T. Liddick and D. Fronczak

Ground P. Garrettson, C. Nicolai, D. Collins, M. Rheude, and J. White[d]

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

Air J. Wortham and G. Boomer

Helicopter G. Zimmerman and S. Gibbs

Central and Eastern Ontario (Strata 51-52, 54, 57)

Air S. Earsom and C. Ferguson[e]

Southern Ontario and Southern Quebec (Strata 53, 56, and 68)

Air	J. Rayfield and T. Lewis

Maine and Maritimes (Strata 62–67)

Air	M. Koneff and J. Bidwell[e]

Canadian Wildlife Service helicopter plot survey

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Ontario	S. Meyer[a], C. Sharp[a], R. Russell[a], and R. Coe[d]
New Brunswick & Nova Scotia	R. Hicks[a], B. Pollard[a], A. Hicks[a]
Labrador & Newfoundland	S. Gilliland[a], P. Ryan[a], R. Wells[a], and P. MacDonald[a]

California

Air	M. Weaver[b], S. Oldenburger[b]

Michigan

Air	B. Barlow[b], B. Berger[b], S. Chadwick[b], N. Kalejs[b], T. Maples[b], M. Mills[b], J. Niewoonder[b], J. Robison[b], and B. Sova[b]

Minnesota

Air	T. Pfingsten[b] and S. Cordts[b]
Ground	S. Kelly, W. Brininger, D. Hertel, T. Cooper, J. Kelley, B. Russell, P. Richert, K. Bousquet, L. Berkley, P. Soler, J. Govan, L. Deede, G. Kemper, R. Beam, G. Dehmer, R. Drum, S. Fisher

Nebraska

M. Vrtiska

Northeastern U.S.

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Delaware	M. Dibona[b]
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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. Kilborn[b]
New Jersey	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], R. Somes[b], P. Winkler[b], K. Tinnes[b], T. Watts[b], T. Clifford[b], P. Woerner[b], and P. Castelli
New York	Staff of New York Department of Environmental Conservation and cooperators

Pennslyvania	D. Brauning[b], M. Casalena[b], J. Dunn[b], J. Gilbert[b], I. Gregg[b], D. Gross[b], T. Hardisky[b], T. Hoppe[b], K. Jacobs[b], M. Lovallo[b], J. Morgan[b], D. Sittler[b], J. Stempka[b], M. Ternent[b], S. Trusso[b], M. Weaver[b], and D. Zellner[b]
Rhode Island	P. Ricard[b], C. Brown[b], J. Beuth[b], J. Veale[b], and J. Brooks[b]
Vermont	B. Crenshaw[b], J. Gobeille[b], D. Sausville[b], J. Austin[b] J. Mlcuch[b], J. Buck[b], A. Alfieri[b], F. Hammond[b], D. Blodgett[b], T. Appleton[b], J. Flewelling[b], and R. Smith[b]
Virginia	G. Costanzo[b], M. DeLeeuw[b], M. Giles[b], A. Proctor[b], M. Gallahan[b], M. Dye[b], T. Engelmeyer[b], P. West[b], C. Dobyns[b], J. Rohm[b], D. Ellinghausen[b], G. Sours[b], A. Bourgeois[b], T. Willingham[b], J. Ferdinansen[b], J. Cooper[b], M. Frank[b], M. Gautier[b], T. Moss[b], D. Johnson[b], D. Lovelace[b], J. Bowman[b], B. Stinson[b], F. Frenzel[b], B. Bassinger[b], and J. Watson[b]

Nevada

Air	R. Keller[b], K. Neill[b], and M. Dobel[d]

Oregon

Air	B. Bales[b], B. Reishus[b], N. Leonetti[b], T. Collom[b],M. St. Louis[b], J. Journey[b], M. Kirsch[b], N. Myatt[b], J. Thompson[b], C. Sponseller[b], R. Klus[b], K. Martin[b], K. Roth[b], and Brim Aviation[d]

Washington

Air	M. Moore[b], J. Evenson[b], D. Base[b], J. Shepherd[b], D. Volsen[b], J. Gallie[b], H. Ferguson[b], M. Atamian[b], P. Wik[b], R. Finger[b], B. Hoenes[b], S. Fitkin[b], J. Heinlen[b], M. Livingston[b], J. Bernatowicz[b], W. Moore[b], E. Krausz[b], D. Antoine[b], T. Hames[b], and D. Blodgett[b]

Wisconsin

Air	L. Waskow[b], P. Berringer[b], C. Cold[b], C. Kopacek[b], and R. Lichtie[b]
Ground	R. Anderson[b], J. Carstens[b], N. Christel[b], J. Christian[b], J. Christopoulos[b], G. Dunsmoor[b], B. Glenzinski[b], E. Grossman[b], H. Halverson[b], J. Huff[b], B. Kelly[b], S. Klock[b], D. Matheys[b], R. McDonough[b], C. Mogen[b], K. Morgan[b], J. Pritzl[b], J. Robaidek[b], K. Rosenthal[b], M. Schmidt[b], M. Soergel[b], J. Spiegel[b], J. Wanner[b], R. Weide[b], D. Weidert[b], D. Wyman[b], P. Charland, A. Kitchen, J. Lutes, S. Otto, M. Pfost, R. Samerdyke, G. Van Vreede, K. Waterstradt, 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 & Wildlife Service Retired
All others—U.S. Fish & Wildlife Service

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

Flyway-wide and Regional Survey Reports

R. Bergeron[a], K. Bollinger, D. Collins, L. Denlinger, J. Fischer, D. Fronczak, J. Kelley, J. Klimstra, K. Kruse, J. Leafloor[a], P. Padding, J. Dubovsky, E. Taylor, and R. Trost

Information from the Breeding Population and Habitat Survey

See Appendix A.1

North Atlantic Population of Canada Geese

J. Bidwell, S. Gilliland[a], M. Koneff, B. Pollard[a], and G. Zimmerman

Atlantic Population of Canada Geese

R. Cotter[a], W. Harvey[b], L. Hindman[b], M. Koneff, E. Reed[a], and J. Rodrigue[a]

Atlantic Flyway Resident Population of Canada Geese

G. Balkcom[b], G. Costanzo[b], W. Crenshaw[b], J. Fuller, I. Gregg[b], D. Harrigal[b], H. Heusmann[b], L. Hindman[b], R. Hossler[b], M. Huang[b], J Hughes[a] K. Jacobs[b], T. Nichols[b], J. Osenkowski[b], B. Pollard[a], E. Robinson[b], B. Swift[b], K. Sullivan[b], and S. Wilson[b]

Southern James Bay Population of Canada Geese

K. Abraham[b], R. Brook[b], J. Hughes[a]

Mississippi Valley Population of Canada Geese

K. Abraham[b], R. Brook[b], J. Hughes[a]

Mississippi Flyway Population Giant Canada Geese

K. Abraham[b], F. Baldwin[b], J. Hughes[a], D. Luukkonen[b], R. Marshalla[b], L. Naylor[b], A. Phelps[b], R. Pritchert[b], A. Radeke[b], D. Rave[b], L. Reynolds[b], D. Scott[b], K. Van Horn[b], T. White[b], and G. Zenner[b]

Eastern Prairie Population of Canada Geese

F. Baldwin[b], B. Lubinski, A. Raedeke[b], and J. Wollenberg[b]

Western Prairie and Great Plains Populations of Canada Geese

P. Devers, D. Fonczak, T Liddick, M. Johnson[b], F. McNew[b], M. Rabe[b], W. Rhodes, J. Richardson[b], P. Thorpe, and M. Vrtiska[b]

Tall Grass Prairie Population of Canada Geese

K. Abraham[b], R. Alisauskas[a], G. Gilchrist[a], J. Leafloor[a], and F. Roetker

Short Grass Prairie Population of Canada Geese

R. Alisauskas[a], and W. Rhodes

Hi-Line Population of Canada Geese

S. Bayless, J. Bredy, L. Roberts[b], E. Silverman, and P. Thorpe

Rocky Mountain Population of Canada Geese

S. Bayless[b], J. Bredy, J. Bohne[b], K. Doherty, J. Dolling, J. Gammonley[b], R. Woolstenhulme[b], D. Kraege[b], R. Northrup[b], L. Roberts[b], E. Silverman, and D. Yparraguirre[b]

Pacific Population of Canada Geese

B. Bales[b], A. Breault[a], J. Bredy, K. Doherty, T. Hemker[b], D. Kraege[b], R. Northrup[b], B. Reishus[b], F. Roetker, M. Weaver[b], R. Woolstenhulme[b], and D. Yparraguirre[b]

Dusky Canada Geese

B. Eldridge, B. Larned, and R. Stehn

Lesser and Taverner's Canada Geese

K. Bollinger, C. Dau, D. Groves, B. Larned, E. Mallek, M. Spindler, R. Platte, and R. Stehn

Cackling Canada Geese

K. Bollinger, R. Platte, and R. Stehn

Aleutian Canada Geese

V. Byrd, D. Collins, T. Sanders, and L. Spitler

Greater Snow Geese

J. Lefebvre[a], G. Gauthier[c], J. Leafloor[a], A. Reed[c], and F. Roetker

Mid-continent Population Light Geese

K. Abraham[b], R. Brook[b], G. Gilchrist[a], J. Leafloor[a], R. Rockwell[c], and F. Roetker

Western Central Flyway Population Light Geese

R. Alisauskas[a], D. Groves, E. Mallek, and W. Rhodes

Western Arctic/Wrangel Island Population of Lesser Snow Geese

V. Baranuk[c], S. Boyd[a] D. Groves, D. Kraege[b], and E. Mallek

Ross's Geese

R. Alisauskas[a], J. Leafloor[a], F. Roetker, and W. Rhodes

Pacific Population White-fronted Geese

K. Bollinger, C. Dau, D. Groves, and R. Platte

Mid-continent Population White-fronted Geese

R. Alisauskas[a], S. Durham[b], D. Groves, K. Kraii[b], B. Larned, E. Mallek, F. Roetker, M. Spindler, and K. Warner[a]

Pacific Brant

K. Bollinger, D. Collins, R. Platte, H. Wilson

Atlantic Brant

K. Abraham[a], G. Gilchrist[a], and J. Klimstra

Western High Arctic Brant

D. Kraege[b]

Emperor Geese

K. Bollinger, C. Dau, E. Mallek, and R. Platte

Western Population of Tundra Swans

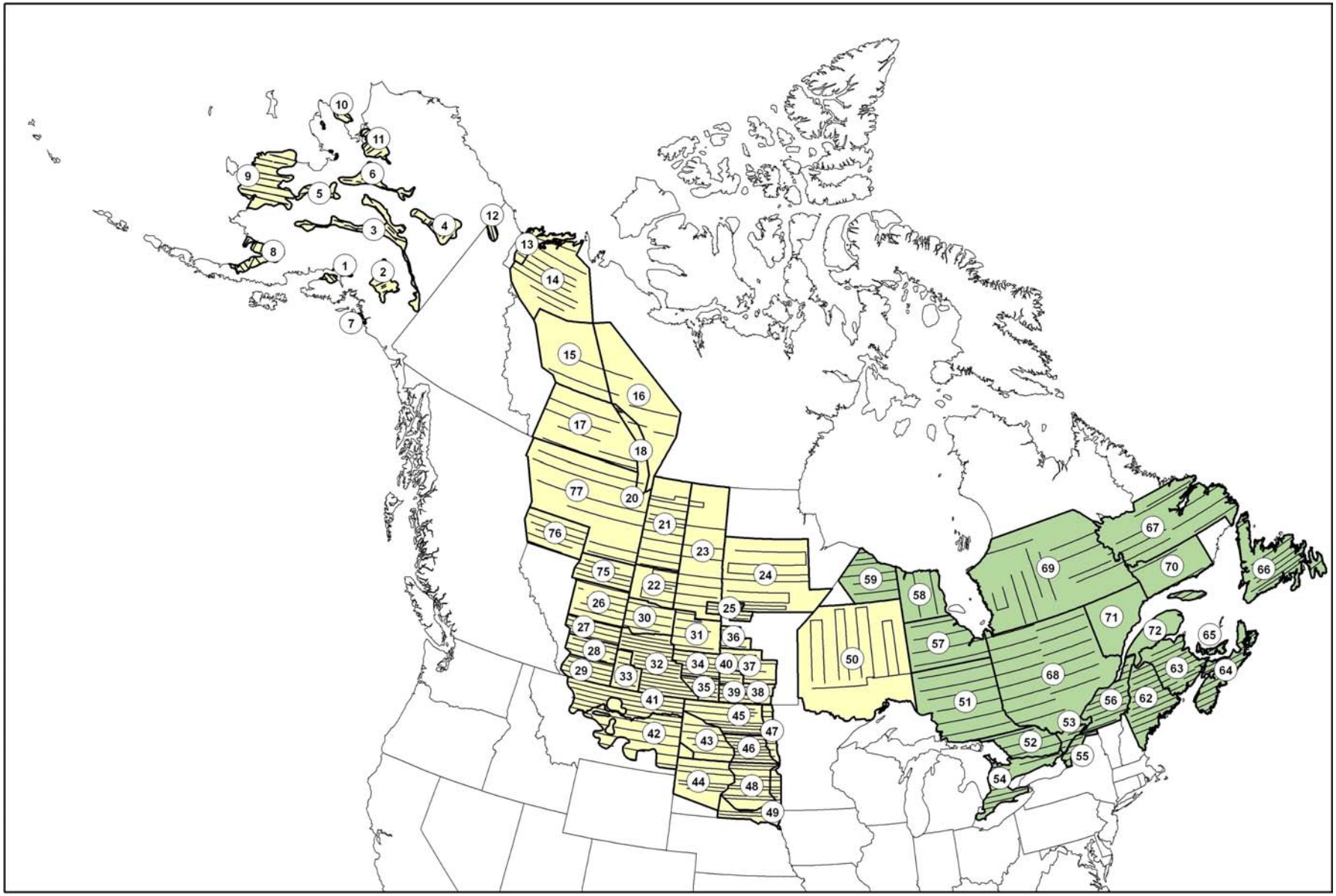
K. Bollinger, C. Dau, D. Groves, R. Platte, and R. Stehn

Eastern Population of Tundra Swans

K. Abraham[a], C. Dau, D. Fronzcak, D. Groves, J. Klimstra, B. Larned, and E. Mallek

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

B Waterfowl Breeding Population and Habitat Survey map



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

C Historical estimates of May ponds and regional waterfowl populations

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

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

Table C.1: Continued.

Year	Prairie Canada		North-central U.S.[a]		Total	
	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$
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
2010	3,728.70	203.40	2,936.30	142.30	6,665.00	248.20
2011	4,892.70	197.50	3,239.50	127.40	8,132.20	235.00

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

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

	British Columbia		California		Michigan		Minnesota		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							614.9	192.3	120.5	41.7
1988							752.8	271.7	126.5	27.8
1989							1,021.6	273.0	136.7	18.7
1990							886.8	232.1	81.4	14.7
1991							868.2	225.0	126.3	26.0
1992			497.4	375.8	665.8	384.0	1,127.3	360.9	63.4	24.4
1993			666.7	359.0	813.5	454.3	875.9	305.8	92.8	23.8
1994			483.2	311.7	848.3	440.6	1,320.1	426.5	118.9	17.5
1995			589.7	368.5	812.6	559.8	912.2	319.4	142.9	42.0
1996			843.7	536.7	790.2	395.8	1,062.4	314.8	132.3	38.9
1997			824.3	511.3	886.3	489.3	953.0	407.4	128.3	26.1
1998			706.8	353.9	1,305.2	567.1	739.6	368.5	155.7	43.4
1999			851.0	560.1	824.8	494.3	716.5	316.4	251.2	81.1

Table C.2: Continued.

	British Columbia		California		Michigan		Minnesota		Nebraska	
Year	Total ducks	Mallards	Total ducks	Mallards	Total ducks	Mallards	Total ducks	Mallards	Total ducks	Mallards
2000			562.4	347.6	1,121.7	462.8	815.3	318.1	178.8	54.3
2001			413.5	302.2	673.5	358.2	761.3	320.6	225.3	69.2
2002			392.0	265.3	997.3	336.8	1,224.1	366.6	141.8	50.6
2003			533.7	337.1	587.2	294.1	748.9	280.5	96.7	32.9
2004			412.8	262.4	701.9	328.8	1,099.3	375.3	69.9	23.2
2005			615.2	317.9	442.6	238.5	684.7	238.5	117.1	29.3
2006	394.4	102.1	649.4	399.4	353.5	207.8	529.8	160.7		
2007	369.0	98.5	627.6	388.3	723.0	315.0	495.6	242.5		
2008	345.6	73.7	554.3	297.1	457.0	189.0	782.8	297.6		
2009	314.6	67.0	510.8	302.0	530.5	258.9	575.2	236.4		
2010	300.1	72.4	541.3	367.9	596.5	339.9	540.1	241.9		
2011	253.2	68.3	558.6	314.7	424.3	224.6	709.7	283.3		

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

Table C.2: Continued.

	Nevada[c]		Northeast U.S.[b]		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
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

Table C.2: Continued.

	Nevada[c]		Northeast U.S.[b]		Oregon		Washington		Wisconsin	
Year	Total ducks	Mallards	Total ducks	Mallards	Total ducks	Mallards	Total ducks	Mallards	Total ducks	Mallards
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	1,500.1	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	12.7	1,271.1	666.8	198.3	79.5	116.5	47.5	502.4	200.5
2010	68.9	8.9	1,302.0	651.7	219.8	75.1	105.0	49.2	386.5	199.1
2011	11.7	2.3	1,265.0	586.1	168.9	67.9	122.3	54.9	513.7	187.9

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

[c] 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
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

Table C.3: Continued.

	Mallard		Gadwall		American wigeon		Green-winged teal		Blue-winged teal	
Year	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$
1998	9,640.4	301.6	3,742.2	205.6	2,857.7	145.3	2,087.3	138.9	6,398.8	332.3
1999	10,805.7	344.5	3,235.5	163.8	2,920.1	185.5	2,631.0	174.6	7,149.5	364.5
2000	9,470.2	290.2	3,158.4	200.7	2,733.1	138.8	3,193.5	200.1	7,431.4	425.0
2001	7,904.0	226.9	2,679.2	136.1	2,493.5	149.6	2,508.7	156.4	5,757.0	288.8
2002	7,503.7	246.5	2,235.4	135.4	2,334.4	137.9	2,333.5	143.8	4,206.5	227.9
2003	7,949.7	267.3	2,549.0	169.9	2,551.4	156.9	2,678.5	199.7	5,518.2	312.7
2004	7,425.3	282.0	2,589.6	165.6	1,981.3	114.9	2,460.8	145.2	4,073.0	238.0
2005	6,755.3	280.8	2,179.1	131.0	2,225.1	139.2	2,156.9	125.8	4,585.5	236.3
2006	7,276.5	223.7	2,824.7	174.2	2,171.2	115.7	2,587.2	155.3	5,859.6	303.5
2007	8,307.3	285.8	3,355.9	206.2	2,806.8	152.0	2,890.3	196.1	6,707.6	362.2
2008	7,723.8	256.8	2,727.7	158.9	2,486.6	151.3	2,979.7	194.4	6,640.1	337.3
2009	8,512.4	248.3	3,053.5	166.3	2,468.6	135.4	3,443.6	219.9	7,383.8	396.8
2010	8,430.1	284.9	2,976.7	161.6	2,424.6	131.5	3,475.9	207.2	6,328.5	382.6
2011	9,182.6	267.8	3,256.9	196.9	2,084.0	110.1	2,900.1	170.7	8,948.5	418.2

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
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

Table C.3: Continued.

	Northern shoveler		Northern pintail		Redhead		Canvasback		Scaup	
Year	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$
1999	3,889.5	202.1	3,057.9	230.5	973.4	69.5	716.0	79.1	4,411.7	227.9
2000	3,520.7	197.9	2,907.6	170.5	926.3	78.1	706.8	81.0	4,026.3	205.3
2001	3,313.5	166.8	3,296.0	266.6	712.0	70.2	579.8	52.7	3,694.0	214.9
2002	2,318.2	125.6	1,789.7	125.2	564.8	69.0	486.6	43.8	3,524.1	210.3
2003	3,619.6	221.4	2,558.2	174.8	636.8	56.6	557.6	48.0	3,734.4	225.5
2004	2,810.4	163.9	2,184.6	155.2	605.3	51.5	617.2	64.6	3,807.2	202.3
2005	3,591.5	178.6	2,560.5	146.8	592.3	51.7	520.6	52.9	3,386.9	196.4
2006	3,680.2	236.5	3,386.4	198.7	916.3	86.1	691.0	69.6	3,246.7	166.9
2007	4,552.8	247.5	3,335.3	160.4	1,009.0	84.7	864.9	86.2	3,452.2	195.3
2008	3,507.8	168.4	2,612.8	143.0	1,056.0	120.4	488.7	45.4	3,738.3	220.1
2009	4,376.3	224.1	3,225.0	166.9	1,044.1	106.3	662.1	57.4	4,172.1	232.3
2010	4,057.4	198.4	3,508.6	216.4	1,064.2	99.5	585.2	50.8	4,244.4	247.9
2011	4,641.0	232.8	4,428.6	267.9	1,356.1	128.3	691.6	46.0	4,319.3	261.1

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
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

Table C.4: Continued.

	Traditional Survey Area[a]	
Year	$\widehat{N}$	$\widehat{SE}$
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
2010	40,893.8	718.4
2011	45,554.3	766.5

[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% credibility intervals (in thousands) for the 6 most abundant species of ducks in the eastern survey area, 1990–2011[a].

	Mallard		American black duck		Green-winged teal		Ring-necked duck		Goldeneyes[b]		Mergansers[c]	
Year	$\hat{N}$	90% CI	$\hat{N}$	90% CI	$\hat{N}$	90% CI	$\hat{N}$	90% CI	$\hat{N}$	90% CI	$\hat{N}$	90% CI
1990	321.0	(209.2, 534.3)	599.0	(533.8, 678.2)	251.9	(196.9, 331.8)	496.9	(396.9, 639.1)	365.2	(286.0, 477.0)	380.2	(321.3, 455.0)
1991	371.0	(241.5, 608.9)	600.8	(529.0, 691.0)	244.2	(189.9, 324.0)	438.7	(353.3, 558.2)	382.0	(298.7, 499.1)	452.8	(380.6, 549.4)
1992	368.0	(238.6, 610.0)	569.8	(505.0, 648.5)	230.9	(179.1, 308.5)	448.1	(359.4, 575.8)	396.0	(309.7, 518.7)	451.3	(373.2, 562.8)
1993	375.2	(243.3, 616.7)	550.9	(483.3, 630.1)	211.4	(161.5, 283.2)	417.2	(333.4, 537.5)	382.4	(298.0, 503.2)	427.0	(354.3, 526.4)
1994	388.9	(253.3, 645.2)	509.7	(447.8, 582.9)	222.5	(170.5, 299.8)	420.4	(333.9, 542.7)	392.4	(305.3, 515.7)	430.0	(350.5, 555.6)
1995	317.0	(203.9, 535.5)	591.1	(519.1, 676.0)	226.9	(173.8, 304.1)	429.5	(343.0, 550.8)	342.0	(265.0, 450.3)	462.8	(381.9, 577.6)
1996	350.2	(227.3, 582.0)	714.9	(637.7, 807.6)	297.5	(235.3, 389.1)	544.4	(438.0, 698.7)	417.0	(325.6, 547.9)	414.8	(351.5, 496.6)
1997	374.1	(242.1, 623.4)	597.0	(535.0, 669.5)	231.9	(181.4, 304.0)	482.9	(388.5, 615.3)	420.5	(327.6, 549.6)	425.8	(360.0, 510.9)
1998	416.5	(272.4, 682.8)	633.0	(568.0, 708.0)	220.8	(173.6, 287.9)	423.4	(340.8, 541.4)	366.1	(286.5, 480.2)	346.8	(294.0, 414.4)
1999	424.3	(279.5, 689.7)	720.8	(645.9, 808.0)	254.3	(198.9, 334.5)	501.8	(404.6, 640.2)	453.5	(349.0, 604.2)	410.1	(346.3, 493.3)
2000	378.2	(251.0, 617.6)	652.7	(586.9, 727.0)	278.6	(221.7, 357.3)	524.8	(423.7, 668.0)	434.9	(338.9, 573.4)	422.5	(358.8, 504.0)
2001	411.8	(273.1, 667.7)	612.0	(550.1, 685.0)	236.3	(186.4, 307.0)	477.8	(387.6, 607.7)	505.5	(390.3, 669.3)	400.6	(340.4, 479.1)
2002	404.4	(267.7, 656.0)	711.0	(637.8, 797.0)	280.2	(220.0, 368.2)	477.4	(383.0, 614.6)	565.3	(425.0, 781.0)	551.8	(466.0, 662.7)
2003	420.5	(277.3, 689.0)	648.6	(581.1, 728.0)	271.0	(212.8, 356.2)	490.9	(395.9, 625.0)	426.1	(332.4, 561.0)	471.9	(398.9, 568.5)
2004	445.5	(295.0, 720.4)	644.0	(576.3, 722.9)	312.8	(245.2, 411.7)	530.1	(430.2, 672.7)	418.9	(331.1, 543.3)	500.2	(424.8, 596.7)
2005	432.2	(283.6, 710.6)	619.0	(553.0, 698.0)	249.7	(196.1, 326.0)	501.4	(408.1, 633.8)	383.9	(302.3, 499.0)	467.0	(396.0, 562.8)
2006	399.8	(264.9, 648.1)	637.4	(570.9, 716.7)	252.7	(198.9, 330.5)	513.8	(414.2, 649.0)	382.8	(300.7, 498.6)	425.4	(361.5, 507.5)
2007	445.0	(294.1, 724.4)	747.0	(664.9, 846.2)	281.7	(222.4, 366.3)	627.4	(505.0, 798.9)	458.4	(356.4, 604.2)	454.0	(382.9, 546.9)
2008	441.0	(291.3, 713.6)	642.1	(575.0, 722.6)	301.4	(229.9, 420.2)	507.3	(410.4, 640.9)	431.3	(337.3, 564.8)	433.2	(368.3, 518.1)
2009	466.0	(308.5, 758.0)	596.2	(534.4, 668.4)	291.4	(227.4, 391.0)	510.0	(412.1, 647.3)	401.0	(312.5, 525.9)	456.0	(386.1, 546.0)
2010	377.9	(249.0, 620.0)	565.9	(506.7, 636.4)	272.6	(215.4, 354.7)	514.8	(416.2, 650.6)	394.7	(308.0, 518.7)	376.7	(319.0, 451.7)
2011	426.8	(279.0, 696.0)	545.0	(489.0, 611.0)	256.3	(201.4, 337.3)	483.5	(390.9, 612.0)	398.7	(313.1, 522.9)	401.2	(338.2, 481.3)

[a] Estimates from Bayesian hierarchical analysis using FWS and CWS data from strata 51, 52, 63, 64, 66–68, 70–72.

[b] Common and Barrow's.

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

D Historical estimates of goose and swan populations

Table D.1: Abundance indices (in thousands) for North American Canada goose populations, 1969–2011.

Year	North Atlantic[a,b]	Atlantic[a,b]	Atlantic Flyway Resident[a]	Southern James Bay[a]	Miss. Valley[a]	Miss. Flyway Giant[a]	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					352.5		132.1
1989/90				92.1	518.8		163.4
1990/91				72.4	254.8		167.4
1991/92				73.0	438.9		158.4
1992/93		91.3		50.7	411.2	779.4	136.2
1993/94		40.1		45.7	432.2	909.4	136.2
1994/95		29.3		74.1	348.2	941.6	139.0
1995/96	99.6	46.1		71.1	362.4	1,037.3	141.0
1996/97	64.4	63.2		87.0	426.0	957.0	130.5
1997/98	53.9	42.2		70.3	312.5	1,140.5	99.3
1998/99	96.8	77.5		108.1	465.5	1,163.3	139.5
1999/00	58.0	93.2		78.7	352.6	1,436.7	130.0
2000/01	57.8	146.7		68.4	325.4	1,296.3	122.2
2001/02	62.0	164.8		55.2	286.5	1,415.2	152.0
2002/03	60.8	156.9	1,126.7	90.2	360.1	1,416.3	122.4
2003/04	67.8	174.8	1,073.1	75.2	276.3	1,430.4	145.5
2004/05	51.3	162.4	1,167.1	42.2	344.9	1,367.0	161.6
2005/06	49.2	160.2	1,144.0	128.9	384.4	1,575.2	134.8
2006/07	69.9	195.7	1,128.0	64.8	402.6	1,454.7	153.4
2007/08	41.9	169.7	1,024.9	92.3	305.2	1,459.8	161.1
2008/09	53.7	176.1	1,006.1	69.2	239.6	1,463.7	169.2
2009/10	54.6	154.0	977.1	76.4	339.3	1,599.9	172.6
2010/11	48.5	194.9	1,015.1	86.9	269.8	1,629.8	133.1

Table D.1: Continued

Year	W. Prairie & Great Plains[b]	Tall Grass Prairie[b,c]	Short Grass Prairie[d]	Hi-line[a]	Rocky Mountain[a]	Dusky[e]	Cackling[f]	Aleutian[e]
1969/70			151.2	58.8				
1970/71		131.1	148.5	99.6	46.9			
1971/72		159.6	160.9	53.0	33.8			
1972/73		147.2	259.4	30.1	37.9			
1973/74		158.5	153.6	33.9	42.7			
1974/75		125.6	123.7	29.1	42.3			0.8
1975/76		201.5	242.5	40.5	30.2			0.9
1976/77		167.9	210.0	40.9	29.5			1.3
1977/78		211.3	134.0	39.8	43.1			1.5
1978/79		180.5	163.7	50.5	58.6		64.1	1.6
1979/80		155.2	213.0	51.2	36.3		127.4	1.7
1980/81		244.9	168.2	51.0	60.3		87.1	2.0
1981/82	175.0	268.6	156.0	54.5	65.9		54.1	2.7
1982/83	242.0	165.5	173.2	74.1	49.7		26.2	3.5
1983/84	150.0	260.7	143.5	105.8	48.3		25.8	3.8
1984/85	230.0	197.3	179.1	92.3	49.9		46.8	4.2
1985/86	115.0	189.4	181.0	101.8	68.4	17.1	45.2	4.3
1986/87	324.0	159.0	190.9	95.4	70.4	15.8	66.7	5.0
1987/88	272.1	306.1	139.1	131.3	107.0	16.0	82.0	5.4
1988/89	330.3	213.0	284.8	124.8	95.0	17.4	85.3	5.8
1989/90	271.0	146.5	378.1	185.8	91.5	16.3	106.4	6.3
1990/91	390.0	305.1	508.5	148.3	85.6	10.7	96.6	7.0
1991/92	341.9	276.3	620.2	168.0	102.1	17.8	148.6	7.7
1992/93	318.0	235.3	328.2	158.0	116.4	16.5	153.2	11.7
1993/94	272.5	224.2	434.1	160.9	138.5	16.3	217.8	15.7
1994/95	352.5	245.0	697.8	234.6	148.2	12.1	234.1	19.2
1995/96	403.3	264.0	561.2	200.5	145.7	12.0	249.8	20.6
1996/97	453.4	262.9	460.7	208.0	103.5	13.5	294.8	20.2
1997/98	482.3	331.8	440.6	257.7	146.7	14.5	216.4	32.5
1998/99	467.2	548.2	403.2	204.5	164.6	10.5	241.8	36.7
1999/00	594.7	295.7	200.0	287.7	180.8	10.3	251.2	34.3
2000/01	682.7	149.1	164.1	261.9	177.3	11.1	253.3	
2001/02	710.3	504.7	160.9	239.0	150.9	12.4	168.1	
2002/03	561.0	611.9	156.7	239.1	148.7	9.8	234.0	76.1
2003/04	622.1	458.7	203.6	208.4	165.4	11.2	172.1	110.2
2004/05	415.1	400.8	177.2	245.4	167.0	16.1	219.4	90.9
2005/06	444.4	499.8	234.7	217.6	148.4	12.1	241.1	110.4
2006/07	446.0	680.3	190.5	309.5	153.6	10.2	248.4	110.1
2007/08	669.5	402.7	212.4	348.2	221.3	9.1	283.7	110.7
2008/09	628.0	309.9	220.3	306.7	131.5	6.7	225.9	82.1
2009/10	462.8	417.0	290.7	277.6	150.1	9.5	275.3	120.5
2010/11	499.0	427.1	309.6	274.0	111.7	11.8	180.2	111.8

[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 birds).

Table D.2: Abundance indices for snow, Ross's, white-fronted, and emperor goose populations, 1969–2011.

	Snow and Ross' geese				White-fronted geese		
Year	Greater snow geese[a]	Mid-continent[b]	Western Central Flyway[c]	Western Arctic & Wrangel Isl.[d]	Mid-continent[d]	Pacific[e]	Emperor geese[a]
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	1073.5	764.3	627.0	64.9
2008/09	1,428.0	2,753.4	284.4	957.4	751.7	536.7	91.9
2009/10	814.0	2,657.5	238.1	901.0	583.2	649.8	64.6
2010/11		3,175.2	196.1	863.8	709.8	604.3	74.2

[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, 1969–2011.

	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	62.2	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[b]	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
2009/10	139.7	143.9	6.0	76.7	97.3
2010/11	148.9	147.9	8.5	49.3[b]	97.7

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

[b] Incomplete or preliminary.

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