U. S. Fish and Wildlife Service

Waterfowl

Population Status, 2010

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July 23, 2010

In North America the process of establishing hunting regulations for waterfowl is conducted annually. In the United States the process involves a number of scheduled meetings in which information regarding the status of waterfowl is presented to individuals within the agencies responsible for setting hunting regulations. In addition the proposed regulations are published in the Federal Register to allow public comment. This report includes the most current breeding population and production information available for waterfowl in North America and is a result of cooperative efforts by the U.S. Fish and Wildlife Service (FWS), the Canadian Wildlife Service (CWS), various State and Provincial conservation agencies, and private conservation organizations. This report is intended to aid the development of waterfowl harvest regulations in the United States for the 2010–2011 hunting season.

Cover: 2010–2011 Duck stamp. American wigeon by Robert Bealle, winner of the 2009 federal duck stamp design competition.

Acknowledgments

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

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

Report Preparation: The preparation of this report involved substantial efforts on the part of many individuals. Support for the processing of data and publication was provided by Emily Silverman, Guthrie Zimmerman, and John Sauer. Doug Benning, John Bidwell, Karen Bollinger, Jim Bredy, Mark Koneff, Thom Lewis, Terry Liddick, Ed Mallek, Fred Roetker, John Solberg, Walt Rhodes, Phil Thorpe, and James Wortham provided habitat narratives, reviewed portions of the report that addressed major breeding areas, and provided helpful comments. Tom Cooper, Pam Garrettson, Rebecca Rau, and Guthrie Zimmerman provided helpful comments on earlier drafts. Kathy Fleming provided the survey area map and colorized revisions to the goose and swan range maps.

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

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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 40.9 ± 0.7 [SE] million birds. This estimate was similar to last year's estimate of 42.0 ± 0.7 million birds and was 21% above the long-term average (1955–2009). Estimated mallard (*Anas platyrhynchos*) abundance 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. Estimated abundance of gadwall (*A. strepera*; 3.0 ± 0.2 million) was similar to the 2009 estimate and 67% above the long-term average. Estimated abundance of American wigeon (*A. americana*; 2.4 ± 0.1 million) was similar to 2009 and the long-term average. The estimated abundance of green-winged teal (*A. crecca*) 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. The estimate of blue-winged teal abundance (*A. discors*) 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 estimate for northern pintails (*A. acuta*; 3.5 ± 0.2 million) was similar to the 2009 estimate, and 13% below the long-term average of 4.0 ± 0.04 million. Estimates of northern shovelers (*A. clypeata*; 4.1 ± 0.2 million) and redheads (*Aythya americana*; 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 canvasback estimate (*A. valisineria*; 0.6 ± 0.05 million) was similar to the 2009 estimate and to the long-term average. The scaup estimate (*A. affinis* and *A. marila* combined; 4.2 ± 0.2 million) was similar to that of 2009 and 16% below the long-term average of 5.1 ± 0.05 million. 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 traditional 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 (1974–2009) of 5.0 ± 0.03 million ponds. The 2010 estimate of ponds in Prairie Canada was 3.7 ± 0.2 million. This was similar to last year's estimate (3.6 ± 0.1 million) and to the long-term average (1961–2009; 3.4 ± 0.03 million). The 2010 pond estimate for the northcentral U.S. was 2.9 ± 0.1 million, which was similar to last year's estimate (2.9 ± 0.1 million) and 87% above the long-term average (1974–2009; 1.6 ± 0.02 million). The projected mallard fall-flight index is 10.3 ± 0.9 million birds. The eastern survey area was restratified in 2005 and is now composed of strata 51–72. Estimates of mallards, scaup, scoters (black [*Melanitta nigra*], white-winged [*M. fusca*], and surf [*M. perspicillata*]), green-winged teal, American wigeon, bufflehead (*Bucephala albeola*), ring-necked duck (*Aythya collaris*), and goldeneyes (common [*B. clangula*] and Barrow's [*B. islandica*]) were all similar to their 2009 estimates and long-term averages. The merganser (red-breasted [*Mergus serrator*], common [*M. merganser*], and hooded [*Lophodytes cucullatus*]) estimate was 386.4 thousand, which was 15% below the 2009 estimate, and 14% below the long-term average of 450.8 thousand. The American black duck (*Anas rubripes*) estimate was similar to the 2009 estimate and 7% below the long-term average of 478.9 thousand.

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 northcentral U.S., and covers approximately 1.3 million square miles (Appendix B.1). The eastern survey area (strata 51–72) includes parts of Ontario, Quebec, Labrador, Newfoundland, Nova Scotia, Prince Edward Island, New Brunswick, New York, and Maine, covering an area of approximately 0.7 million square miles (Appendix B.1). In Prairie and Parkland Canada and the northcentral U.S., aerial waterfowl counts are corrected annually for visibility bias by conducting ground counts along a portion of survey segments. In some northern regions of the traditional survey area, visibility corrections were derived from past helicopter surveys. In the eastern survey area, duck estimates are adjusted using visibility-correction factors derived from a comparison of airplane and helicopter counts. Annual estimates of duck abundance are available since 1955 for the traditional survey area and since 1996 for all strata (except 57–59 and 69) in the eastern survey area. However, 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 northcentral U.S., since 1974. Several Provinces and States also conduct breeding waterfowl surveys using various methods; some have survey designs that allow calculation of measures of precision for their estimates. Information about habitat conditions was supplied primarily by biologists working in the survey areas. Unless otherwise noted, z-tests were used for assessing statistical significance, with alpha level set at 0.1; P-values are given in tables along with wetland and waterfowl estimates. Since 1990, the U.S. Fish and Wildlife Service (USFWS) has conducted aerial transect surveys using airplanes in eastern Canada and the northeast U.S., similar to those in the midcontinent, in order to estimate waterfowl abundance. Additionally, the Canadian Wildlife Service (CWS) has conducted a helicopter-based aerial plot survey in core American black duck breeding regions of Ontario, Quebec, and the Atlantic Provinces. Historically, data from these surveys were analyzed separately, despite overlap in geographic areas of inference. In 2004, the USFWS and CWS agreed to integrate the two surveys, produce composite estimates from both sets of survey data, and expand the geographic scope of the survey in eastern North America. Consequently, as of 2005, waterfowl population sizes for eastern North America (strata 51–72) are estimated using a hierarchical-modeling approach that combines USFWS and CWS data. For strata containing both CWS and USFWS surveys (51, 52, 63, 64, 66–68, and 70), USFWS estimates were adjusted for visibility by CWS plot estimates, and then averaged to derive stratum-level estimates. In strata with only USFWS survey estimates (53, 54, 56–59, 62, 65, and 69), traditional visibility-correction factors were used. No visibility adjustments were made for strata with only CWS plots (71 and 72). In cases where the USFWS has traditionally not recorded observations to the species level (i.e., scoters, mergansers, scaup, and goldeneyes), estimates were produced for multi-species groupings from 2007 forward. While estimates were generated for all strata in the eastern survey area, survey-wide composite estimates presented in this report currently correspond only to strata 51, 52, 63, 64, 66–68, and 70–72. These strata contain either (1) both USFWS 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 stra-

tum, 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 all years. The composite estimate was calculated as the average of the CWS estimate and adjusted USFWS estimate to provide estimated total indicated birds for each stratum and year. For two species groups, goldeneyes and mergansers, for which there are many survey units with no observations, a zero-inflated Poisson distribution (Martin et al. 2005) was used to fit the model. Using this technique, the binomial probability of encountering the species on a transect or a plot is modeled separately. Even this modified modeling approach was not adequate for species that occur at lower densities and are more patchily distributed in the eastern survey area (scaup, scoters, bufflehead, and American wigeon). Estimates for these species were the means of CWS and visibility-adjusted USFWS survey averages weighted by their precision, such that more precise estimates were given higher weights. We will continue to investigate methods that will allow us to estimate populations of these rarer species within the hierarchical-modeling framework.

To produce a consistent index for American black ducks, total indicated pairs are calculated using the CWS method of scaling observed pairs. The CWS scaling is based on sex-specific observations collected during the CWS survey in eastern Canada, which indicate that approximately 50% of black duck pair observations are actually two drakes. For this index, observed black duck pairs are scaled by 1.5 rather than the 1.0 scaling traditionally applied by the USFWS. However, in this report, estimates for American black ducks and other species are based on total indicated birds, an index estimated using the conventional scaling factor applied by the USFWS.

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

Waterfowl Production and Habitat Survey

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

Total Duck Species Composition

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

Mallard Fall-flight Index

The mallard fall-flight index is a prediction of the size of the fall abundance of mallards originating from the mid-continent region of North America. For management purposes, the mid-continent population has historically been composed of mallards originating from the traditional survey area, as well as Michigan, Minnesota, and Wisconsin. However, as of 2008, the status of western mallards 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 2010).

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 15 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

2009 in Review

Habitat conditions during the 2009 Waterfowl Breeding Population and Habitat Survey were characterized by above-average moisture across the southern portions of the traditional survey area, good habitat in the eastern survey area, and late spring conditions across northern survey areas. The total pond estimate (Prairie Canada and U.S. combined) was 6.4 ± 0.2 million. This was 45% above the 2008 estimate of 4.4 ± 0.2 million ponds and 31% above the long-term average of 4.9 ± 0.03 million ponds. Conditions across the Canadian prairies improved in 2009, with the exception of southern Alberta. The 2009 estimate of ponds in Prairie Canada was 3.6 ± 0.1 million. This was a 17% increase from the 2008 estimate (3.1 ± 0.1 million) and was similar to the 1961–2008 average (3.4 ± 0.03 million). The prairie parklands received below-normal precipitation but waterfowl habitat in this area continued to benefit from above-normal precipitation received in 2007 and was classified as fair to good.

Significant improvements in wetland numbers occurred in the U.S. prairies during 2009. The 2009 pond estimate for the north-central U.S. of 2.9 ± 0.1 million was 108% above the 2008 estimate (1.4 ± 0.07 million) and 87% above the long-term average (1974–2008; 1.5 ± 0.02 million). Considerable precipitation in late spring 2008 and above-normal precipitation over the fall and winter recharged wetlands across the Dakotas and eastern Montana. Drier conditions were noted in western Montana and southeastern South Dakota. In the bush regions of the traditional survey area (Alaska, Yukon, Northwest Territories, northern Manitoba, northern Saskatchewan, and western Ontario), spring break up in 2009 was delayed as much as three weeks relative to normal. Most of the large lakes across the region remained frozen in early June, whereas smaller habitats, such as beaver ponds, were open. Overall habitat conditions in northern Alberta and the Northwest Territories, and most of Alaska, were rated as good. Below-average precipitation through northern Saskatchewan and portions of northern Manitoba negatively affected smaller ponds.

The boreal forest of the eastern survey area was generally in good condition in the spring of 2009, although northern survey areas in Ontario, Quebec, and Labrador experienced a very late spring. Above-average snowfall was recorded from Maine to the Maritimes, but average spring

temperatures prevented the flooding that occurred in 2008, resulting in good-to-excellent waterfowl habitat in 2009. Good-to-excellent waterfowl habitat existed throughout New York and much of Quebec and Ontario. Although overall habitat conditions were good in the eastern survey area, flooding from a series of major storms in southwestern Ontario during mid-May and persistent winter conditions in the James and Hudson Bay Lowlands may have reduced habitat quality in those areas.

In the traditional survey area, the 2009 total duck population estimate (excluding scoters, eiders, long-tailed ducks, mergansers, and wood ducks) was 42.0 ± 0.7 million birds. This estimate represented a 13% increase over the 2008 estimate of 37.3 ± 0.6 million birds and was 25% above the long-term average (1955–2008). In the eastern Dakotas, total duck numbers were 79% above the 2008 estimate and 171% above the long-term average. The total duck estimate in southern Alberta was 22% below that of 2008, and 23% below the long-term average. The total duck estimate was 10% below 2008 in southern Saskatchewan, but was similar to the long-term average. In southern Manitoba, the total duck population estimate was similar to the 2008 estimate, but was 11% below the long-term average. The total duck estimate in central and northern Alberta, northeastern British Columbia, and the Northwest Territories was unchanged from 2008 and the long-term average. The 2009 estimate in the northern Saskatchewan–northern Manitoba–western Ontario survey area was 21% higher than the 2008 estimate but similar to the long-term average. The total duck estimate in the western Dakotas–eastern Montana area was 117% above the 2008 estimate and 53% above the long-term average. In the Alaska–Yukon Territory–Old Crow Flats region the total duck estimate was 15% lower than 2008, but 19% above the long-term average.

Several States and Provinces conduct breeding waterfowl surveys in areas outside the geographic extent of the Waterfowl Breeding Population and Habitat Survey of the USFWS and CWS. In California, the northeastern U.S., Oregon, and Wisconsin, measures of precision for survey estimates are available. In Oregon, the 2009 total duck estimate was 17% lower than in 2008, and 32% below the long-term average. The total duck estimate in California was similar to the 2008 estimate and the long-term average. Wisconsin's total duck estimate was 20% lower than in 2008, but 15% above its long-term average. The total breeding duck estimate in the northeastern U.S. was similar to 2008, and was 9% below the long-term average. Of the States without measures of precision for total duck numbers, the 2009 estimate in Michigan increased by 16%, and in Minnesota, fell by more than 31% compared to those in 2008. Estimates fell slightly in Washington relative to 2008.

In the traditional survey area the 2009 estimated mallard abundance was 8.5 ± 0.2 million birds, 10% higher than the 2008 estimate of 7.7 ± 0.3 million birds and 13% higher than the long-term average. The abundance of blue-winged teal (7.4 ± 0.4 million) was similar to 2008 and 60% above the long-term average. Gadwall abundance (3.1 ± 0.2 million) was similar to the 2008 estimate and 73% above the long-term average. Estimated American wigeon abundance (2.5 ± 0.1 million) was similar to 2008 and the long-term average. Estimated abundance of green-winged teal (3.4 ± 0.2 million) was similar to the 2008 estimate and well above the long-term average (+79%). Northern shovelers (4.4 ± 0.2 million) were 25% above the 2008 estimate of 3.5 ± 0.2 million and remained well above their long-term average (+92%). The estimate for northern pintails was 3.2 ± 0.2 million, which was 23% above the 2008 estimate of 2.6 ± 0.1 million, and 20% below the long-term average. Estimated abundance of redheads (1.0 ± 0.1 million) was similar to 2008 and 62% above the long-term average. The canvasback estimate (0.7 ± 0.06 million) was 35% above the 2008 estimate (0.5 ± 0.05 million) and similar to the long-term average. The combined scaup estimate (4.2 ± 0.2 million) was similar to that of 2008, and 18% below the long-term average. Population estimates for the 10 most abundant species in the eastern survey area were all similar to their 2008 estimates and to long-term averages.

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

			Change from 2009			Change from LTA	
Region	2010	2009	%	*P*	LTA[a]	%	*P*
Prairie Canada							
S. Alberta	678	687	-1	0.901	740	-8	0.110
S. Saskatchewan	2,668	2,210	+21	0.056	1,998	+34	0.001
S. Manitoba	382	671	-43	<0.001	676	-43	<0.001
Subtotal	3,729	3,568	+5	0.523	3,413	+9	0.124
Northcentral U.S.							
Montana & western Dakotas	595	1,034	-42	<0.001	550	+8	0.370
Eastern Dakotas	2,341	1,832	+28	0.002	1,020	+129	<0.001
Subtotal	2,936	2,866	+2	0.708	1,571	+87	<0.001
Total	6,665	6,434	+4	0.462	4,959	+34	<0.001

[a] Long-term average. Prairie and Parkland Canada, 1961–2009; northcentral U.S. and Grand Total, 1974–2009.

2010 Breeding Populations and Habitat Conditions

Overall Habitat and Population Status

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 (Table 1, Figure 1). 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 last year. The 2010 estimate of ponds in Prairie Canada was 3.7 ± 0.2 million. This was similar to last year's 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 northcentral U.S. was 2.9 ± 0.1 million, which was similar to last year's 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, wetlands in the western Dakotas and Montana were not recharged, resulting in a deterioration of conditions from 2009, at the time the survey was conducted.

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

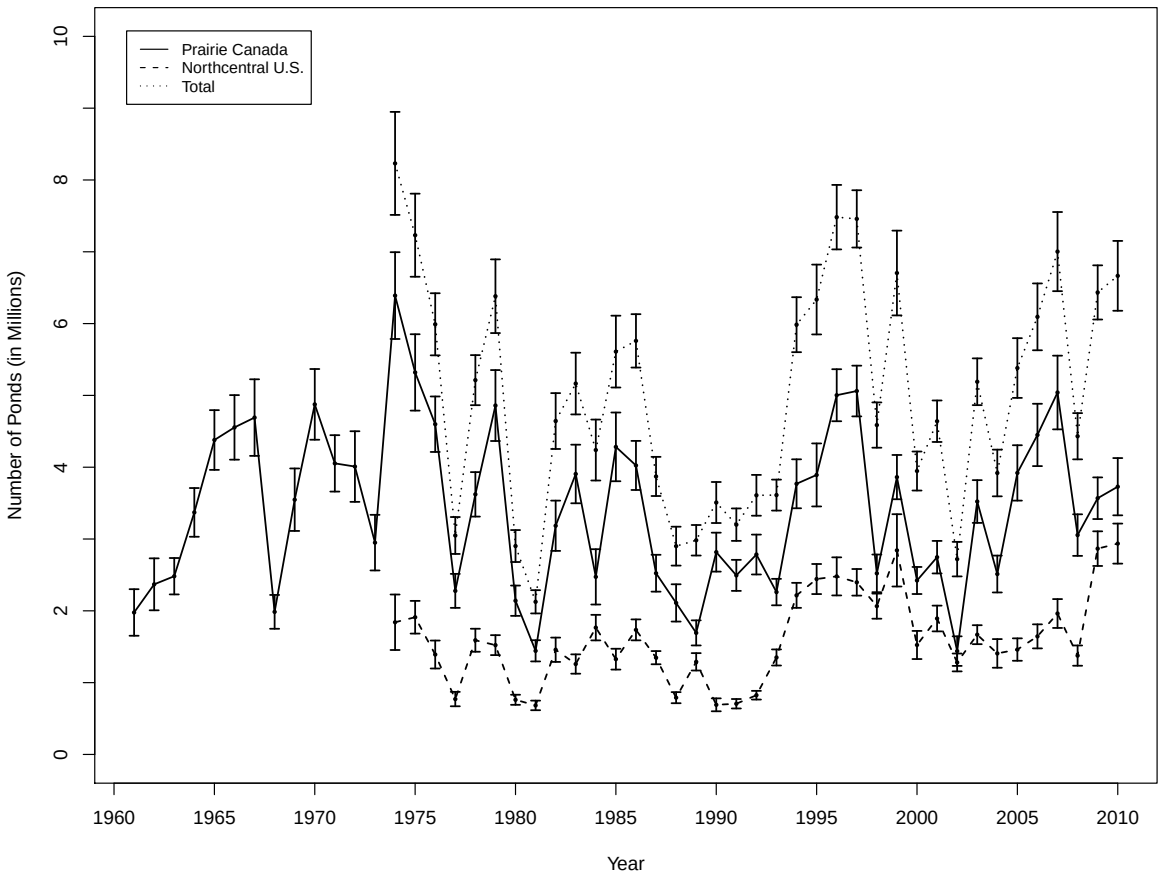

Figure 1: Number of ponds in May and 90% confidence intervals in Prairie Canada and the north-central U.S.

of the eastern survey area experienced an early spring 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 westcentral 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 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 last year's estimate of 42.0 ± 0.7 million birds and was 21% above the long-term average (1955–2009; Table 2, Appendix C.4). 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 last year's 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 last year's, 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 last year and 23% above the long-term average. The estimate in northern

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 2009			Change from LTA	
Region	2010	2009	%	*P*	LTA[b]	%	*P*
Alaska, Yukon Territory, and Old Crow Flats	5,556	4,345	+28	<0.001	3,654	+52	<0.001
C. & N. Alberta, N.E. British Columbia, and NWT	8,717	6,934	+26	<0.001	7,090	+23	<0.001
N. Saskatchewan, N. Manitoba and W. Ontario	2,149	3,813	-44	<0.001	3,533	-39	<0.001
S. Alberta	2,641	3,288	-20	<0.001	4,269	-38	<0.001
S. Saskatchewan	6,839	8,053	-15	0.004	7,507	-9	0.010
S. Manitoba	1,104	1,371	-20	0.007	1,536	-28	<0.001
Montana & Western Dakotas	1,977	2,468	-20	0.008	1,626	+22	0.004
Eastern Dakotas	11,910	11,733	+2	0.777	4,465	+167	<0.001
Total	40,893	42,005	-3	0.268	33,680	+21	<0.001
Other regions							
California	541	511	+6	0.744	593	−9	0.402
Northeast U.S.[c]	1,302	1,271	+2	0.811	1,408	−8	0.299
Oregon	220	198	+11	0.797	286	−23	0.002
Wisconsin	387	502	−23	0.054	440	−12	0.183

[a] Includes 10 species in Appendix C.3 plus American black duck, ring-necked duck, goldeneyes, bufflehead, and ruddy duck; excludes eiders, long-tailed duck, scoters, mergansers, and wood duck.
[b] Long-term average, 1955–2009.
[c] Includes all or portions of CT, DE, MD, MA, NH, NJ, NY, PA, RI, VT, and VA.

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 last year, 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 (Table 2). In Oregon, the total duck estimate 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 estimates of total ducks 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 (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 round-

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

			Change from 2009			Change from LTA	
Region	2010	2009	%	*P*	LTA[a]	%	*P*
Alaska, Yukon Territory, and Old Crow Flats	606	503	+20	0.140	370	+64	<0.001
C. & N. Alberta, N.E. British Columbia, and NWT	1,423	1,080	+32	0.032	1,072	+33	0.007
N. Saskatchewan, N. Manitoba and W. Ontario	801	930	-14	0.388	1,138	-30	0.004
S. Alberta	598	754	-21	0.013	1,080	-45	<0.001
S. Saskatchewan	1,699	1,867	-9	0.292	2,062	-18	0.001
S. Manitoba	351	417	-16	0.124	382	-8	0.339
Montana & Western Dakotas	533	444	+20	0.172	500	+7	0.525
Eastern Dakotas	2,420	2,517	-4	0.678	925	+162	<0.001
Total	8,430	8,512	-1	0.827	7,529	+12	0.002
Eastern survey area	403	488	−17	[b]	424	−5	[b]
Other regions							
California	368	302	+22	0.435	367	0	0.981
Michigan	340	259	+31	0.130	376	−10	0.471
Minnesota	242	236	+2	0.913	224	+8	0.611
Northeast U.S.[c]	653	667	−2	0.833	770	−15	0.020
Oregon	75	80	−6	0.588	105	−28	<0.001
Wisconsin	198	200	−1	0.950	182	+9	0.492

[a] Long-term average. Traditional survey area 1955–2009; eastern survey area 1990–2009; years for other regions vary (see Appendix C.2).

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

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

ing 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 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 (Table 3). The mallard estimate in southern Alberta was 21% below last year's and was 45% below the long-term average. In the eastern Dakotas, the mallard estimate was similar to last year's count, and 162% above the long-term average. In the eastern Montana–western Dakotas survey area, mallard counts were similar to the 2009 estimate and long-term average. In the central and northern Alberta–northeastern British Columbia–Northwest Territories region the mallard estimate was 32% higher than 2009 and 33% higher than the long-term average. In the northern Saskatchewan–northern Manitoba–western Ontario survey area, the mallard estimate was similar to that of 2009, but 30% below the long-term average. Mallard numbers were similar to the 2009 estimate and 64% above their long-term average in the Alaska–Yukon Territory–Old Crow Flats region. In the southern Manitoba survey area, the mallard estimate was similar to last year's and to the long-term aver-

age. In southern Saskatchewan, mallards were similar to last year but 18% below the long-term average. Mallard abundance with estimates of precision are also available for other areas where surveys are conducted (California, Oregon, Nevada, Wisconsin, the northeast U.S., as well as Michigan and Minnesota). In California, mallard numbers were similar to last year and the long-term average. In Wisconsin, mallards were similar to last year and the long-term average. Mallards were similar in Oregon to last year, and 28% lower than the long-term average. In Nevada, the mallard estimate was lower than in 2009 (changes in Nevada's survey design in 2009 preclude comparison of these estimates to the long-term average). The mallard estimate was similar to the 2009 estimate in the northeast U.S., but was 15% below the long-term average. In Michigan and Minnesota, mallard estimates were similar to the 2009 estimates and the long-term averages. In Washington, where precision estimates were not available, 2010 mallard numbers were slightly higher than those in 2009.

In the traditional survey area 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) 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 (Table 13, Figures 3–4, Appendix C.5).

The longest time series of data available to assess the status of the American black duck is provided by the midwinter surveys conducted in January in States of the Atlantic and Mississippi flyways. Measures of precision are not available for the midwinter surveys. In 2010, the total midwinter count of American black ducks in both flyways combined was 223,500, which was 7% below the most recent 10-year average (2000–2009) of 241,100. In the Atlantic Flyway, the black duck midwinter index was 203,000, which was 5% below the flyway's 10-year average of 214,000. In the Mississippi Flyway, the black duck midwinter index in 2010 was 20,400, which was 25% below the 10-year flyway average of 27,100. 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 444,200, similar to the 2009 estimate and 7% below the 1990–2009 average of 478,900. 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 2010 survey ($38,200 \pm 8,500$) was not significantly different from the 2009 estimate ($39,500 \pm 6,200$) but was 43% below the 1993–2009 average.

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

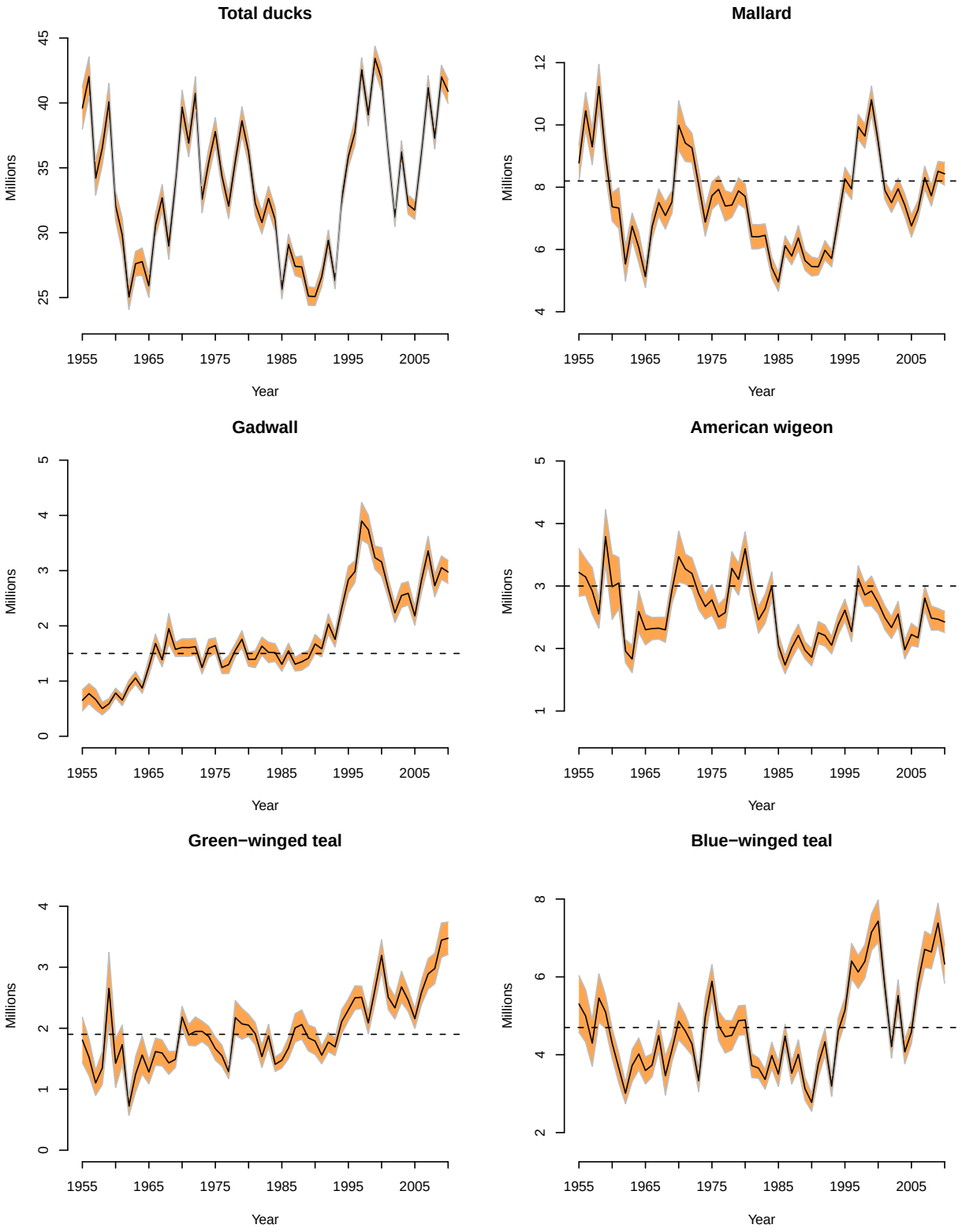

Figure 2: Breeding population estimates, 95% confidence intervals, and North American Waterfowl Management Plan population goal (dashed line) for selected species in the traditional survey area (strata 1–18, 20–50, 75–77).

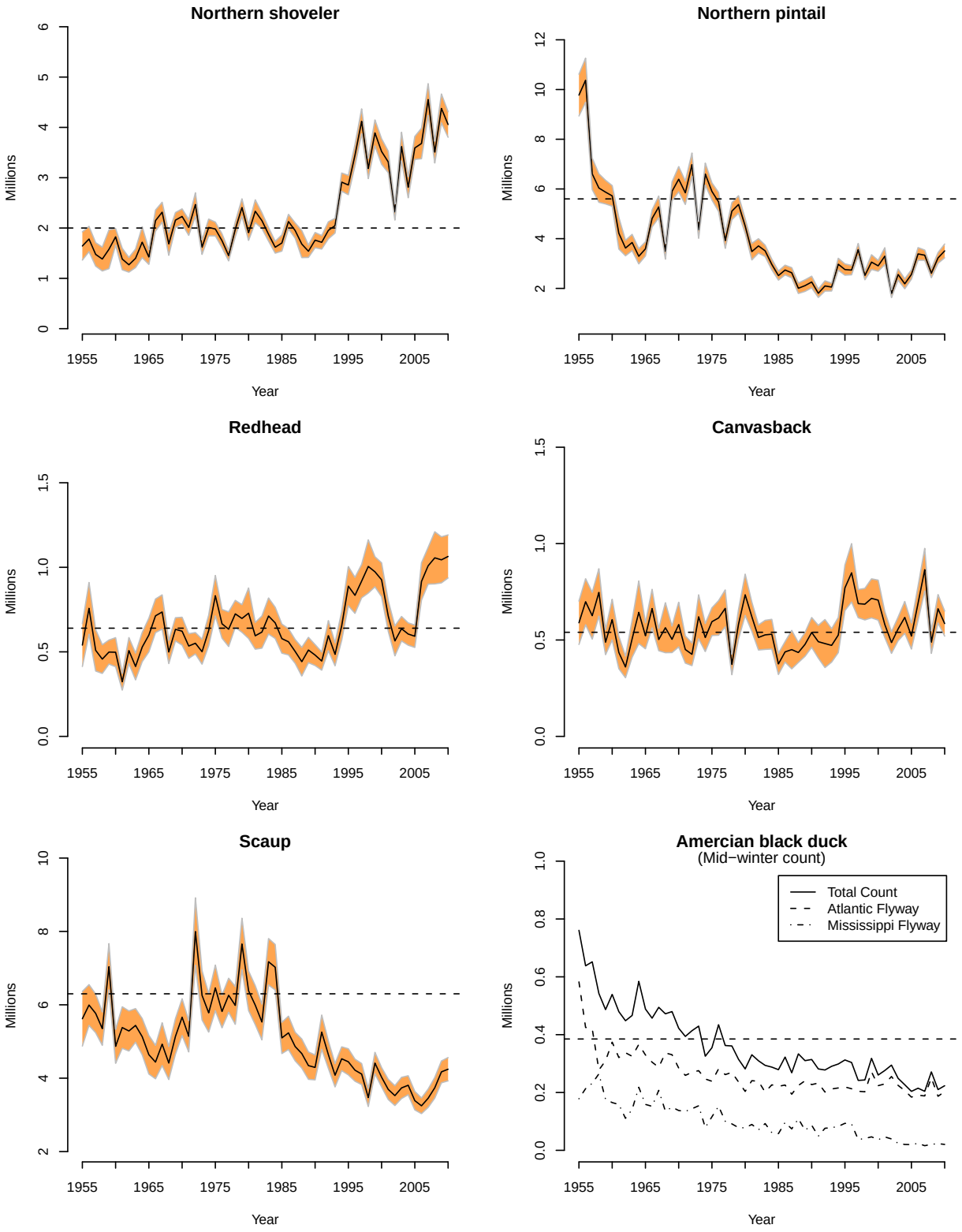

Figure 2: Continued.

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

			Change from 2009			Change from LTA	
Region	2010	2009	%	*P*	LTA[a]	%	*P*
Alaska, Yukon Territory, and Old Crow Flats	3	2	+45	0.679	2	+49	0.554
C. & N. Alberta, N.E. British Columbia, and NWT	51	67	-24	0.547	51	+0	0.991
N. Saskatchewan, N. Manitoba and W. Ontario	14	9	+63	0.307	26	-46	0.003
S. Alberta	323	401	-19	0.322	316	+2	0.845
S. Saskatchewan	913	1,044	-13	0.403	599	+53	0.001
S. Manitoba	102	118	-14	0.532	70	+45	0.061
Montana & Western Dakotas	392	319	+23	0.383	198	+98	0.007
Eastern Dakotas	1,178	1,094	+8	0.490	525	+125	<0.001
Total	2,977	3,054	-3	0.740	1,787	+67	<0.001

[a] Long-term average, 1955–2009.

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

			Change from 2009			Change from LTA	
Region	2010	2009	%	*P*	LTA[a]	%	*P*
Alaska, Yukon Territory, and Old Crow Flats	1,053	805	+31	0.034	540	+95	<0.001
C. & N. Alberta, N.E. British Columbia, and NWT	597	793	-25	0.110	901	-34	<0.001
N. Saskatchewan, N. Manitoba and W. Ontario	73	147	-50	0.030	243	-70	<0.001
S. Alberta	124	133	-6	0.740	287	-57	<0.001
S. Saskatchewan	193	237	-19	0.264	416	-54	<0.001
S. Manitoba	11	9	+26	0.565	58	-81	<0.001
Montana & Western Dakotas	166	216	-23	0.226	110	+51	0.034
Eastern Dakotas	206	128	+61	0.073	51	+308	<0.001
Total	2,425	2,469	-2	0.816	2,607	-7	0.174

[a] Long-term average, 1955–2009.

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

			Change from 2009			Change from LTA	
Region	2010	2009	%	*P*	LTA[a]	%	*P*
Alaska, Yukon Territory, and Old Crow Flats	954	658	+45	0.009	385	+148	<0.001
C. & N. Alberta, N.E. British Columbia, and NWT	1,464	1,225	+19	0.290	769	+90	<0.001
N. Saskatchewan, N. Manitoba and W. Ontario	105	399	-74	<0.001	206	-49	<0.001
S. Alberta	130	175	-26	0.248	197	-34	0.022
S. Saskatchewan	398	648	-39	0.050	251	+59	0.016
S. Manitoba	48	48	+1	0.975	51	-6	0.721
Montana & Western Dakotas	39	175	-78	<0.001	42	-8	0.703
Eastern Dakotas	337	115	+193	0.009	46	+625	<0.001
Total	3,476	3,444	+1	0.915	1,948	+78	<0.001

[a] Long-term average, 1955–2009.

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

			Change from 2009			Change from LTA	
Region	2010	2009	%	*P*	LTA[a]	%	*P*
Alaska, Yukon Territory, and Old Crow Flats	4	0	– –	– –	1	+169	0.544
C. & N. Alberta, N.E. British Columbia, and NWT	279	248	+12	0.713	275	+2	0.933
N. Saskatchewan, N. Manitoba and W. Ontario	5	116	-96	0.001	253	-98	<0.001
S. Alberta	294	480	-39	0.005	616	-52	<0.001
S. Saskatchewan	1,363	1,740	-22	0.157	1,287	+6	0.616
S. Manitoba	212	303	-30	0.114	377	-44	<0.001
Montana & Western Dakotas	308	345	-11	0.671	266	+16	0.482
Eastern Dakotas	3,865	4,152	-7	0.531	1,582	+144	<0.001
Total	6,329	7,384	-14	0.056	4,657	+36	<0.001

[a] Long-term average, 1955–2009.

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

			Change from 2009			Change from LTA	
Region	2010	2009	%	*P*	LTA[a]	%	*P*
Alaska, Yukon Territory, and Old Crow Flats	626	464	+35	0.106	282	+122	<0.001
C. & N. Alberta, N.E. British Columbia, and NWT	297	293	+1	0.950	219	+36	0.111
N. Saskatchewan, N. Manitoba and W. Ontario	4	16	-77	0.030	42	-91	<0.001
S. Alberta	475	527	-10	0.509	385	+23	0.025
S. Saskatchewan	795	894	-11	0.401	698	+14	0.165
S. Manitoba	87	137	-36	0.027	109	-20	0.097
Montana & Western Dakotas	221	408	-46	0.011	154	+43	0.077
Eastern Dakotas	1,553	1,639	-5	0.699	423	+267	<0.001
Total	4,057	4,376	-7	0.287	2,312	+76	<0.001

[a] Long-term average, 1955–2009.

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

			Change from 2009			Change from LTA	
Region	2010	2009	%	*P*	LTA[a]	%	*P*
Alaska, Yukon Territory, and Old Crow Flats	1,164	930	+25	0.122	926	+26	0.044
C. & N. Alberta, N.E. British Columbia, and NWT	338	243	+39	0.220	368	-8	0.672
N. Saskatchewan, N. Manitoba and W. Ontario	6	21	-74	0.015	39	-85	<0.001
S. Alberta	242	172	+41	0.133	693	-65	<0.001
S. Saskatchewan	332	444	-25	0.118	1,181	-72	<0.001
S. Manitoba	18	48	-61	0.003	107	-83	<0.001
Montana & Western Dakotas	177	383	-54	0.007	264	-33	0.006
Eastern Dakotas	1,233	984	+25	0.168	463	+166	<0.001
Total	3,509	3,225	+9	0.299	4,041	-13	0.015

[a] Long-term average, 1955–2009.

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

			Change from 2009			Change from LTA	
Region	2010	2009	%	*P*	LTA[a]	%	*P*
Alaska, Yukon Territory, and Old Crow Flats	1	1	+66	0.679	2	-10	0.885
C. & N. Alberta, N.E. British Columbia, and NWT	51	29	+79	0.201	40	+27	0.495
N. Saskatchewan, N. Manitoba and W. Ontario	3	6	-46	0.278	27	-87	<0.001
S. Alberta	90	135	-33	0.257	122	-26	0.052
S. Saskatchewan	316	285	+11	0.644	204	+55	0.031
S. Manitoba	107	69	+56	0.422	72	+49	0.407
Montana & Western Dakotas	50	33	+54	0.423	10	+416	0.018
Eastern Dakotas	444	487	-9	0.697	175	+153	<0.001
Total	1,064	1,044	+2	0.890	652	+63	<0.001

[a] Long-term average, 1955–2009.

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

			Change from 2009			Change from LTA	
Region	2010	2009	%	*P*	LTA[a]	%	*P*
Alaska, Yukon Territory, and Old Crow Flats	57	41	+38	0.407	90	-37	0.037
C. & N. Alberta, N.E. British Columbia, and NWT	72	88	-19	0.523	75	-5	0.841
N. Saskatchewan, N. Manitoba and W. Ontario	18	49	-63	0.059	54	-66	<0.001
S. Alberta	39	52	-25	0.394	65	-40	<0.001
S. Saskatchewan	192	280	-31	0.105	188	+2	0.897
S. Manitoba	35	48	-28	0.179	56	-38	<0.001
Montana & Western Dakotas	41	26	+58	0.190	8	+391	0.001
Eastern Dakotas	131	77	+69	0.120	34	+287	0.001
Total	585	662	-12	0.316	570	+3	0.775

[a] Long-term average, 1955–2009.

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

			Change from 2009			Change from LTA	
Region	2010	2009	%	*P*	LTA[a]	%	*P*
Alaska, Yukon Territory, and Old Crow Flats	947	821	+15	0.269	920	+3	0.769
C. & N. Alberta, N.E. British Columbia, and NWT	2,378	1,685	+41	0.012	2,541	-6	0.462
N. Saskatchewan, N. Manitoba and W. Ontario	208	684	-70	<0.001	575	-64	<0.001
S. Alberta	127	287	-56	0.021	343	-63	<0.001
S. Saskatchewan	246	324	-24	0.362	409	-40	0.001
S. Manitoba	53	70	-25	0.373	130	-60	<0.001
Montana & Western Dakotas	14	34	-58	0.017	51	-72	<0.001
Eastern Dakotas	271	266	+2	0.949	103	+163	0.001
Total	4,244	4,172	+2	0.831	5,073	-16	0.001

[a] Long-term average, 1955–2009.

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

Species	2010	2009	% Change from 2009	Average[b]	% Change from average
Mergansers (common, red-breasted, and hooded)	386	457	-15[c]	451	-14[c]
Mallard	403	488	-17	424	-5
American black duck	444	466	-5	479	-7[c]
American wigeon	7	12	-39	19	-61
Green-winged teal	256	274	-6	241	+6
Scaup (greater and lesser)	51	54	-5	44	+17
Ring-necked duck	567	542	+5	515	+10
Goldeneyes (common and Barrow's)	395	400	-1	417	-5
Bufflehead	25	27	-6	25	+2
Scoters (black, white-winged, and surf)	75	101	-26	83	-10

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

[b] Average for 1990–2009.

[c] Indicates significant change. Significance determined by non-overlap of Bayesian credibility intervals or confidence intervals.

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 interval limits 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 1.5%) per year over the entire survey period (1966–2009), 2.5% (UCL 3.3%, LCL 1.9%) over the past 20 years (1990–2009), and 3.0% (UCL 4.3%, LCL 1.8%) over the most recent (2000–2009) 10-year period. The Atlantic Flyway wood duck index increased by an average of 1.5% (UCL 2.2%, LCL 0.7%) annually over the entire time series (1966–2009), by 2.2% (UCL 3.2%, LCL 1.0%) over the past 20 years (1990–2009), and by 3.0% (UCL 4.7%, LCL 1.3%) from 2000–2009. In the Mississippi Flyway, the corresponding BBS wood duck indices increased by 2.3% (UCL 3.1%, LCL 1.5%, 1966–2009), 2.7% (UCL 3.7%, LCL 1.8%, 1990–2009), and 3.0% (UCL 4.6%, LCL 1.5%, 2000–2009). In the Central Flyway, the BBS wood duck population index increased by an average of 5.5% annually over 1966–2009 (UCL 7.0%, LCL 2.2%), 6.3% from 1990 to 2009 (UCL 8.4%, LCL 4.0%), and 5.1% from 2000 to 2009 (UCL, 9.0%, LCL 0.9%; J. Sauer, U.S. Geological Survey/Biological Resources Division, unpublished data). An independent wood duck population estimate is available for the northeast States from New Hampshire south to Virginia, from the Atlantic Flyway Breeding Waterfowl Survey. The estimate from the 2010 survey (388,300) was similar to the 2009 estimate (386,000) and to the 1993–2009 average (376,000).

Regional Habitat and Population Status

A description of habitat conditions and duck populations for each of the major breeding areas follows. In the past this information was taken from more detailed reports of specific regions available under Waterfowl Breeding Population Surveys, Field Crew Reports located on the Division of Migratory Bird Management's Web site on the Publications page (http://www.fws.gov/migratorybirds/NewReportsPublications/WPS.html). Although these reports will no longer be produced, habitat and population status for each region will continue to be summarized here. More detailed information on regional waterfowl and habitat conditions during the May waterfowl survey is also available on the flyways.us website (http://www.flyways.us/status-of-waterfowl).

Southern Alberta (strata 26–29, 75–76)

A large part of Alberta experienced drought conditions throughout the winter of 2009–2010 (Agriculture and Agri-Food Canada 2010). Bird migration appeared to be well underway by mid-April and phenology also appeared to be ahead of last year. However, toward the end of April a series of cold, wet winter storms moved through the Province, providing much needed relief to the wetlands. The Peace Region, located between Slave Lake, Grande Prairie, Fort St. John and Peace River, received additional moisture in the form of rain and snow during the middle of May. Another significant storm brought more moisture to the southern strata the last week of May. In the southeast corner of Alberta, wetlands appeared to have benefited the most from the late-April storms, resulting in excellent habitat conditions. However, in this region many wetlands were unoccupied by ducks, presumably due to the late-arriving precipitation and better conditions in the Dakotas. To the north, the effects of the drought were more evident, but there were a few isolated pockets of good habitat in the eastern portion of this region. The eastern Alberta parklands remain in a drought and only the more permanent wetlands contain water. The dry conditions are allowing farmers to drain and clear wetland areas that were previously inaccessible due to the higher water levels. Habitat conditions in the Peace Region appeared drier than last year, with most of the

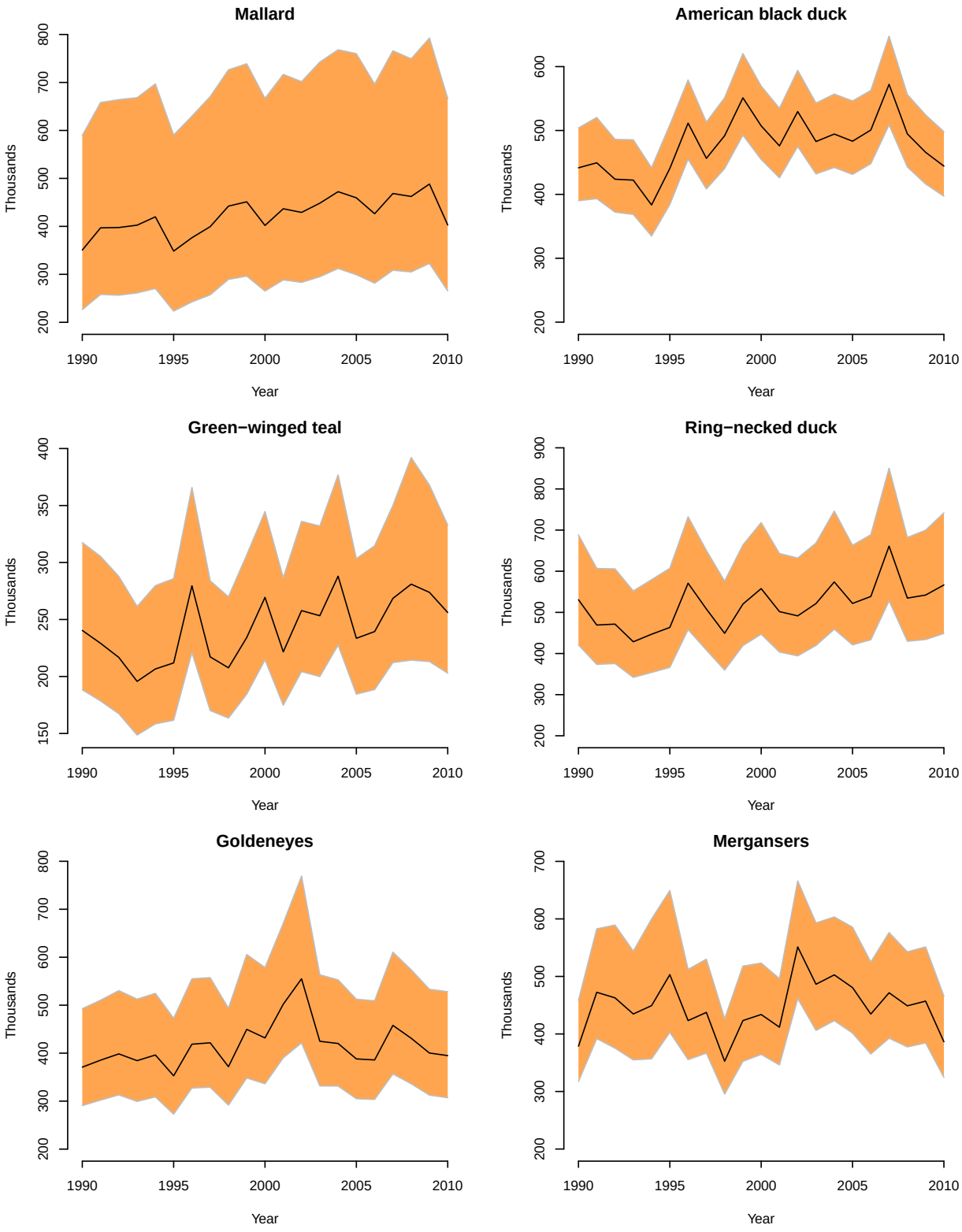

Figure 3: Breeding population estimates and 90% credible intervals from Bayesian hierarchical models for selected species in the eastern survey area (strata 51, 52, 63, 64, 66–68, 70–72).

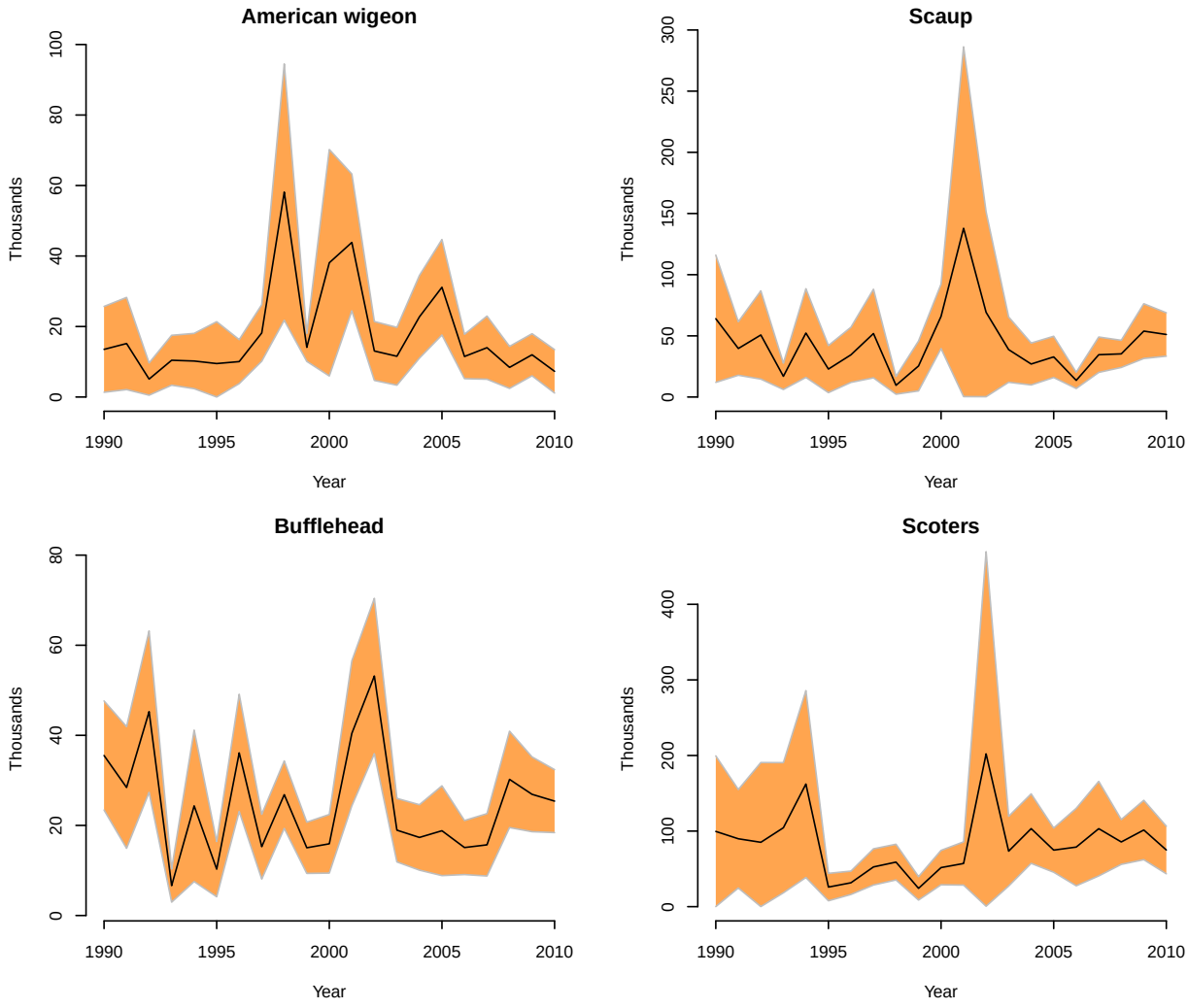

Figure 4: Breeding population estimates (precision-weighted means) and 90% confidence intervals for selected species in the eastern survey area (strata 51, 52, 63, 64, 66–68, 70–72).

water in permanent, semi-permanent, and artificial wetland basins. Overall, with the exception of the southeast portion of the Province, habitat conditions did not appreciably improve from last year. However, spring storms most likely enhanced the quality of the remaining wetlands as brood-rearing habitat.

Overall, May ponds were similar to the 2009 estimate and the long-term average. The total duck estimate was 20% below 2009, and 38% below the long-term average. The mallard estimate in this survey area was 21% lower than 2009, and 45% lower than the long-term average. Blue-winged teal were 39% below the 2009 estimate, and 52% below the long-term average. The gadwall estimate was similar to 2009 and the long-term average. American wigeon and green-winged teal were both similar to last year, but were 57% and 34% below their long-term averages, respectively. The northern shoveler estimate was similar to 2009 but was 23% above the long-term average. Northern pintails were similar to 2009 but 65% below the long-term average. Both redheads and canvasbacks were similar to 2009, but 26% and 40% below their long-term averages, respectively. The scaup estimate was 56% below the 2009 estimate and 63% below the long-term average.

Southern Saskatchewan (strata 30–33)

Habitat conditions for nesting and brood rearing improved considerably across the Province during the month of May. Good-to-excellent wetland conditions were observed throughout the central parklands and grasslands and into the southwestern grasslands. The western grasslands and parklands remained very dry and poor production and recruitment potential was expected from these areas. The eastern parklands continued to have good-to-excellent habitat conditions for nesting and brood-rearing waterfowl.

Fall precipitation was below average in the western parklands and grasslands, while the central portion of the survey area received precipitation that was above or well-above normal. The eastern border with Manitoba received below-average precipitation during the fall. Winter precipitation was well-below average across the survey area. The western third of the Province had some of the driest winter conditions, with areas receiving less than 40% of normal precipitation. The winter precipitation trend continued for most of the month of April but changed during the last week of the month. Precipitation from late April into June was well-above average. Record high precipitation occurred across southern Saskatchewan, breaking records back to 1892. Monthly-average temperatures were well-above average through much of the fall and winter and continued into spring.

Most of southern Saskatchewan entered spring with dry conditions. The late rains improved habitat across much of the Province and likely improved brood rearing for waterfowl in the Province. The precipitation arrived too late to attract or stop migrating waterfowl in the prairie region of the Province. The northern grasslands and western parklands have continued to dry and were considered poor for waterfowl production. The late rains have helped recharge wetlands in this area but more above-average precipitation is required to overcome the long-term dry spell. The wetlands in the eastern grasslands southeast of Saskatoon remain in good-to-excellent condition. Residual water in the northeast parklands has been supplemented with additional precipitation, and excellent conditions for brood rearing were present during the survey.

The excellent water conditions in the Province could negatively affect waterfowl by flooding nests. Some of the highest nesting densities of canvasbacks and redheads are in the northeastern parklands of the Province. The continued above-average precipitation could flood many overwater nests and result in poor recruitment this year. Given the propensity of many dabbling ducks to nest in the vegetation between cropland and wetland (i.e., wetland margins), any rise in water levels during the nesting season has a high likelihood of flooding these nests. If wetland margins were flooded and ducks forced into other habitats, renesting attempts could have had poor results.

The May pond estimate in this survey area was 21% higher than in 2009, and 34% higher

than the long-term average. Total duck numbers were 15% lower than 2009, and 9% below the long-term average. Mallards were similar to 2009 but 18% below the long-term average. Blue-winged teal, northern shovelers, and canvasbacks were all similar to 2009 and their long-term averages. The green-winged teal estimate was 39% lower than in 2009, but still 59% above its long-term average. Gadwall numbers were similar to 2009 and 53% above their long-term average. American wigeon and northern pintail were both similar to the 2009 estimates, but 54% and 72% below their respective long-term averages. Redheads were similar to 2009 and 55% above their long-term average. The scaup estimate was also similar to 2009, but was 40% below the long-term average.

Southern Manitoba (strata 34–40)

Good-to-excellent habitat conditions were observed in five of the seven strata, while habitat in the north and northeast of the survey area was dry to very dry. However, heavy rains followed the survey throughout most of the region and as a result, overall production expectations were revised downward.

Fall precipitation was normal to well-above normal (85–150% of normal) for most of the southern grasslands and parklands, but below normal (40–85%) in the northern two strata. Winter was unusually mild with precipitation ranging from below normal (40–85%) to well-below normal (<40%). Spring remained mild and precipitation was below normal through late April, when general rain brought some much needed relief. There was very little precipitation during the survey. However, from late May to mid-June, when the survey was completed, rainfall that was well-above normal (>200%) fell throughout the region (not the typical patchwork pattern of thunderstorms), much of which fell at the end of May.

The mild conditions in March and April facilitated early spring migration into the area. Spring green up was more advanced than the very late start in 2009 and was still earlier than normal. Pond levels appeared similar to last year in the southern and westcentral part of Manitoba, while southeastern Saskatchewan was generally much improved overall. However, the northern and northeastern areas of southern Manitoba were considerably drier. Ponds were abundant and fairly well distributed in much of the region and these areas were originally expected to provide for good-to-excellent production for those birds present. During the survey, some wetland areas in good condition were observed that were nearly devoid of waterfowl, which was attributed to much better conditions farther south that very likely attracted some of the birds that would normally nest in this region. Though late rains after the survey probably did not attract additional nesting birds, they may have improved production and overall recruitment. The increase in upland nesting cover likely provided improved protection from both avian and terrestrial nest predators. Also, semi-permanent wetlands may maintain water longer, providing lasting brood-rearing habitat through the critical pre-fledge period. However, excessive late rains during nesting may have resulted in subsequent flooding of overwater and margin-cover nests. Overall, waterfowl production in this region was expected be similar or slightly better than last year. On the positive side, the late rains will lessen the summer drawdown, and hopefully lead to improved wetland conditions next spring.

The May pond estimate was 43% lower than both the 2009 estimate and the long-term average. The total duck estimate was 20% lower than in 2009, and 28% lower than the long-term average. Mallard numbers were similar to 2009 and the long-term average. The gadwall estimate was similar to last years, but 45% above the long-term average. Green-winged teal and redheads were both similar to 2009 and their long-term averages. American wigeon and blue-winged teal were both similar to 2009, but 81% and 44% below their long-term averages, respectively. The northern shoveler estimate was 36% below the 2009 estimate, and 20% below the long-term average. Northern pintails were 61% lower than 2009, and 83% lower than the long-term average. Canvasback and scaup estimates were both similar to 2009, but 38% and 60% below their long-term averages in this survey area.

Montana and Western Dakotas (strata 41–44)

May 2010 habitat conditions in the survey area were significantly drier compared to conditions in 2009 in Montana, and comparable to 2009 conditions in the western Dakotas. At the beginning of the survey, upland vegetation had already begun to green up and trees had begun to leaf out. Spring phenology appeared to be earlier this year compared to last year. In strata 43 and 44, conditions were judged to be fair to good with some excellent areas, probably due to early May rain. Conditions in strata 41 and 42 were poor to fair for the prairie strata. A significant amount of rain fell in the northern areas of stratum 41 just prior to when they were flown, so that conditions may have improved only one or two days earlier. All of strata 41 and 42 were much drier than in 2009. Strata 43 and 44 are located to the west of the Missouri River in the western Dakotas and were similar to 2009, although slightly drier.

The 2010 May pond count in this survey area decreased by 42% from last year, but was similar to the long-term average. Total duck numbers decreased by 20% from 2009, but were 22% above the long-term average. The mallard estimate was similar to 2009 and the long-term average. Both gadwall and American wigeon estimates were similar to 2009, but were 98% and 51% above their respective long-term averages. Green-winged teal were 78% lower than in 2009, but similar to their long-term average, while blue-winged teal were similar to both the 2009 estimate and the long-term average. The northern shoveler estimate was 46% below the 2009 estimate but 43% above the long-term average. Northern pintails were 54% lower than in 2009, and 33% lower than the long-term average. Redhead and canvasback numbers were similar to 2009, but were still much higher than their long-term averages in this survey area (416% and 391%, respectively). The scaup estimate was 58% lower than in 2009 and 72% lower than the long-term average.

Eastern Dakotas (strata 45–49)

In the Eastern Dakotas, precipitation during the fall of 2009 and winter of 2009–2010 generally improved the good habitat conditions already present in the region. Although wetland counts increased in all strata relative to 2009 (except for stratum 47, the Red River Valley), the most significant increases occurred in South Dakota. Warm April temperatures encouraged the early and rapid development of both aquatic and terrestrial vegetation. Despite significant recent losses in Conservation Reserve Program (CRP) acres, adequate cover for nesting waterfowl in overwater and upland locations was probably present. These conditions attracted an above-average breeding population to the area, which appeared to be highly synchronized and well along in their efforts.

In the eastern Dakotas, the 2010 May pond estimate was 28% higher than in 2009, and 129% higher than the long-term average. The total duck estimate was similar to last year and 167% above the long-term average. Mallard numbers were similar to 2009 and 162% higher than the long-term average. The gadwall estimate was similar to 2009 and 125% above the long-term average. The American wigeon estimate increased 61% from 2009, and was 308% above the long-term average. Green-winged teal increased 193% from 2009, and were much higher (625%) than the long-term average. Blue-winged teal were similar to last year and 144% higher than their long-term average. Northern shoveler and northern pintail estimates were both similar to their 2009 estimates, and were 267% and 166% higher than their long-term averages, respectively. The redhead and canvasback estimates were both similar to 2009 and were 153% and 287% above their respective long-term averages. Scaup numbers were similar to last year and 163% above their long-term average in this survey area.

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

This survey area generally received average to below-average precipitation, with temperatures that ranged from slightly below average to well-above average since May 2009. Precipitation was fairly consistent across the region, and ranged from 40% to as much as 150% of average. Early-summer precipitation through July

2009 was generally average to above average in the survey area, with the exception of the western edge from Uranium City to south of Fort McMurray and an area between Cluff Lake and Key Lake where precipitation was 0–70% of average. By late summer into early fall, a drying trend developed that continued into the spring of 2010. The entire survey area received below (<80%) to well-below (<40%) average precipitation from November 2009 to March 2010. A small south-to-north wetter pocket remained, however, between Prince Albert and La Ronge and west toward Meadow Lake.

The below-average temperatures experienced during the 2009 survey continued through August 2009 across the entire survey area. Freeze up across the area was late in 2009 due to generally above average temperatures. October and December 2009 experienced near normal temperatures but September and November 2009 had temperatures exceeding 5° C above normal over both Saskatchewan and Manitoba. The winter of 2009–2010 also was above normal. Monthly winter temperatures routinely averaged 3–5° C or greater above normal across the entire survey area. Temperatures were only slightly below normal when the survey began in May 2010.

All wetlands and lakes were ice-free during the survey, in sharp contrast to the 2009 survey. Overall, most waterfowl habitat was classified as fair, primarily due to the early spring. More moisture is needed to recharge habitats that have been precipitation deficient in recent years. Good-to-excellent waterfowl habitat was found in the region from Prince Albert north to La Ronge, Saskatchewan. Habitat also was classified as good between Thompson and Gillam, Manitoba. Both areas were regions that had received slightly more summer and fall precipitation than the rest of survey area. Major river drainages had average flows but several large lakes in the region associated with hydropower were drawn down.

The 2010 total duck estimate in this survey area was 44% lower than last year and 39% lower than the long-term average. The mallard estimate was similar to last year and 30% lower than the long-term average. Gadwall numbers were similar to 2009 but 46% lower than the long-term average. The American wigeon estimate was 50% lower than 2009, and 70% lower than the long-term average. Green-winged teal and blue-winged teal estimates were both lower than 2009 (−74% and −96% respectively) and lower than their long-term averages (−49% and −98%, respectively). Northern shovelers decreased by 77% from 2009, and were 91% below their long-term average. Northern pintails were 74% lower than 2009, and 85% lower than their long-term average. The redhead estimate was similar to 2009 and 87% below the long-term average. Canvasbacks were 63% lower than 2009 and 66% lower than the long-term average. The scaup estimate was 70% lower than in 2009 and 64% lower than the long-term average.

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

Winter snowfall and early spring precipitation across northern Alberta and northeastern British Columbia was below normal. As a result, many wetlands were recessional and stream flows were diminished. Beaver ponds appeared normal, and the lower water on bigger lakes offered miles of grassy shorelines with more cover available to nesting waterfowl than in high-water years. Conditions appeared to be more normal across most of the Northwest Territories. The entire survey area experienced an earlier-than-normal break up and early spring in sharp contrast to the 2009 late spring. Good waterfowl production was predicted across most of this region.

The total duck estimate for 2010 was 26% higher than in 2009 and 23% higher than the long-term average. Mallard numbers were 32% higher than 2009 and 33% higher than the long-term average. The American wigeon estimate was similar to 2009 and 34% lower than the long-term average. Green-winged teal were similar to 2009 and 90% above the long-term average. Gadwall, blue-winged teal, northern shoveler, northern pintail, redhead, and canvasback estimates were all similar to 2009 and their long-term averages. The scaup estimate was 41%

higher than 2009 but similar to its long-term average.

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

Habitat conditions in Alaska this spring were normal along the coastal sections of the survey area and rather dry in the interior. Little winter snowfall in the interior, and below-normal spring rainfall, resulted in dry conditions throughout this region. All of the annual water bodies in the interior held significant water, but were at late-summer levels during the survey. Many of the seasonal ponds and sloughs were low or dry during mid-May to early June. However, waterfowl production may not have been affected by the dry spring conditions because the low water levels provided excellent nesting areas, and annual water bodies still held significant (although reduced) water. The coastal regions of the survey area were normal with typical water levels and a relatively normal spring breakup. Waterfowl production was expected to be good this year in coastal areas.

The total duck estimate in this survey area was 28% higher than in 2009, and 52% higher than the long-term average. Mallard numbers were similar to last year and 64% higher than the long-term average. Gadwall, blue-winged teal, redheads, and scaup were all similar to their 2009 estimates and long-term averages. The American wigeon estimate was 31% higher than 2009, and 95% higher than the long-term average. Green-winged teal were 45% higher than 2009 and 148% higher than the long-term average. Northern shoveler and northern pintail estimates were both similar to 2009 and were 122% and 26% above their respective long-term averages. The canvasback estimate was similar to 2009 but was 37% lower than the long-term average.

Eastern survey area (strata 51–72)

In Ontario, record low winter (Nov 2009–Mar 2010) precipitation continued into the spring (April–May 2010) over much of the survey area (Agriculture and Agri-Food Canada 2010). Many rivers, lakes and other wetlands were receding and were well-below normal levels for spring. Boreal marsh and bog areas appeared to have minimal water levels. Habitat conditions were fair to poor across most of the boreal forest habitats in stratum 51. Lake levels in stratum 68 were low, especially in the northern half of the stratum. Many wetland habitats in western Ontario were visibly drier than in past years and reservoir water levels were much lower, exposing large shoreline margins. In addition, many drainages normally dammed by beavers were abandoned and dry, resulting in even less available habitat for waterfowl. Degraded habitat conditions due to lower water levels were somewhat offset by the above-average spring temperatures and early ice melt, which made virtually all water bodies ice-free and available to arriving birds. Habitat conditions in southeast Ontario were fair to poor. Below-normal winter precipitation (November through March) continued during April and May. Cultivated fields appeared dry and dusty, and water levels in drainages and sloughs were low. However, agricultural areas along the Great Lakes received more precipitation and conditions were good to fair in stratum 54. Growing-season precipitation maps reported high (60–80 percentile of historical distribution) to extremely high (80–100 percentile) precipitation in portions of stratum 54 (Agriculture and Agri-Food Canada 2010). Overall, rivers, lakes and wetlands were full and sheet water was standing in many fields in the southern area of the stratum. Precipitation decreased from mid-range (40–60 percentile) to low (20–40 percentile) to the east and north (Agriculture and Agri-Food Canada 2010) and habitat conditions transitioned to fair. These observations were corroborated by fire danger reports at the end of the survey period (Ontario Ministry of Natural Resources 2010). Overall, spring was early across most of Ontario with tree leaf out and green up of wetland vegetation well advanced at survey start. The early spring was expected to help waterfowl production, especially in the southern portions where habitat conditions were good. Spring phenology was closer to normal in the northern parts of this region. Production is expected to be fair to poor in habitats in the

northern part of the survey area.

The winter of 2009–2010 in Quebec was characterized by warmer-than-average temperatures which persisted throughout the spring. Snow fall was average to below average and spring conditions came early to northwestern Quebec, where wetlands were ice-free by the start of the second week of May. Winter persisted in northeastern Quebec, where higher-elevation areas (>600 m) remained frozen until late May. In general, habitat conditions for breeding waterfowl were considered good to excellent throughout this survey area. Eastern Quebec and the north shore areas of the St. Lawrence experienced record low snowfall over the winter; however, spring rains were near average and helped to offset any moisture deficit. Warm spring temperatures ushered in an early spring, resulting in excellent conditions for breeding waterfowl.

Snowfall for the winter of 2009–2010 in Maine was below average and temperatures were above average. Spring break up and snow melt were extremely early and precipitation was normal through April, resulting in a very early phenology. There was minimal flooding and all wetlands and beaver flowages were fully charged. Habitat conditions were excellent and waterfowl production should be above average. In the Maritimes (including strata 63, 64 and 65), the winter of 2009–2010 had above-normal temperatures with near-normal precipitation. Spring arrived very early, and by mid-March, there was essentially no ice in the Gulf of St. Lawrence, something that has not been observed since the 1960s. Canada geese and even late-nesting ring-necked ducks arrived early in the Maritimes. Flooding along the St. John River was about normal in early April, and during the survey nothing was observed which would adversely affect waterfowl production. Habitat conditions were excellent, and average to above-average waterfowl production is expected in 2010. During the winter of 2009–2010 Newfoundland and Labrador experienced well-below-average snowpack, particularly in the interior parts of the Province. The above-normal temperatures through March had melted much of the lower-elevation ice and snow in Newfoundland. Cooler temperatures in April and early May delayed phenology; however, adequate precipitation provided abundant waterfowl habitat. Along with low temperatures, Labrador also experienced significant snowfall in April and early May which delayed spring phenology and waterfowl dispersion. In Newfoundland, nesting waterfowl were evenly dispersed; however, in Labrador, they were only concentrated in open wetlands and ponds below 450 m in elevation. Above this elevation, most ponds and wetlands were completely ice covered and significant snowpack was observed. The survey area in Newfoundland exhibited excellent habitat conditions. Labrador habitat conditions were good and timing appeared normal for concentrated waterfowl. In both Newfoundland and Labrador above-average waterfowl production was expected.

The eastern survey area estimates (excluding strata 57–59, which were not flown in 2010) of mallards, scaup, scoters, green-winged teal, American wigeon, bufflehead, ring-necked ducks, and goldeneyes were all similar to their 2009 estimates and long-term averages. The merganser estimate was 386.4 thousand, which was 15% below the 2009 estimate, and 14% below the long-term average of 450.8 thousand. The American black duck estimate was similar to the 2009 estimate and 7% below the long-term average of 478.9 thousand.

Other areas

Overall, habitat conditions showed a slight improvement in the Pacific Flyway relative to last year. In California, late-spring precipitation in the Central Valley increased the quality of nesting conditions throughout this region. Precipitation from February through April delayed wheat harvest in many areas, but enhanced the upland vegetation and quantity of wetlands. In northeastern California, habitat conditions were highly variable, dependent on winter snow pack and spring precipitation events. In California, the total duck estimate in 2010 was 541,300, which was similar to last year's estimate and their long-term average of 593,500. The mallard estimate in 2010 was 367,900, also similar to the 2009 estimate and their long-term average (366,500). The 2010 total duck estimate

in Nevada was 68,900, which was lower than the 2009 estimate of 105,500 (due to changes in Nevada's waterfowl survey design, estimates prior to 2009 are not comparable). The mallard estimate was 8,900 which was lower than last year's estimate of 12,700.

In western Oregon, spring precipitation contributed to fair-to-good wetland conditions. Southeast Oregon was generally dry during the survey period but habitat conditions were slightly improved from last spring due to increased precipitation in April and May. Wetland areas in other areas of eastern Oregon were generally below average but benefited from late spring precipitation; however, flooding during early June in some areas of northeast Oregon may have impacted nesting success for late nesting waterfowl. In Oregon, the total duck estimate in 2010 was 219,900, which was similar to 2009, but 23% below the long-term average. The 2010 mallard count was 75,100, which was similar to last year, and 28% lower than the long-term average. In Washington, the estimate for total ducks (105,000) was down 9% from 2009, and 31% from the long-term average. In this estimate, gadwall, blue-winged and cinnamon teal, redheads, and northern shovelers showed the most significant reductions. Total mallards in the breeding population were estimated at 49,200, a small increase (2%) from last years count, and 7% below the long-term average. Total duck numbers were up 9% in the wetland habitats associated the irrigation projects of the Yakima Valley and the Columbia Basin largely due to beneficial flooding conditions associated with Toppenish Creek in the Yakima Valley. A relatively dry winter in eastern Washington failed to recharge potholes in the Channeled Scablands. Total duck numbers were reduced in the potholes from 2009, and were 50% below the long-term average. Pond counts were down 36% from 2009, 42% below the long-term average. In British Columbia, weather during the 2009–2010 winter was dominated by the effects of a moderate El Niño. Most of the Province experienced above-normal temperatures in January, February, and March that resulted in significant winter snow melt. Winter snowfall and snowpacks were also below average for the interior of British Columbia over the winter. Water levels were very low overall and habitat conditions were poor in the lower-elevation portions of the interior in May 2010. This was the fourth consecutive year with dry and poor habitat conditions for the low-elevation wetlands. The total duck estimate in British Columbia was 300,100, which was similar to the 2009 estimate of 314,600. The mallard estimate in British Columbia was 72,400, which was higher than the 2009 estimate of 67,000.

In the midwest U.S., habitat conditions were influenced by an early spring and higher than normal temperatures. Habitat conditions in the Sandhills region of Nebraska were average to above average. Water conditions in the western Sandhills were better than average, but the eastern Sandhills were average. Precipitation after the primary nesting season greatly improved conditions across the Sandhills, and should have aided renesting and brood rearing. A higher fall flight from the Sandhills is predicted this year compared to last, and slightly above average. In Michigan, the 2010 statewide estimate of ponds was 200,423, which was 7% below the 2009 estimate and 22% below the long-term average. Habitat conditions were variable across the State; the 2010 pond estimates for the northern forested region declined 26%, while the number of ponds increased 3% in southern Michigan compared to 2009. The 2010 estimate of total ducks was 596,500 birds, similar to the 2009 estimate of 530,500. The 2010 estimate of mallards was 339,900, similar to the 2009 estimate and the long-term average. In southern Wisconsin, spring phenology was 10–14 days ahead of normal. Despite above-average winter precipitation, spring (March–May) precipitation was 42–46% below normal across the north, producing drought conditions throughout the northern and central areas of Wisconsin. Precipitation in the southcentral and southeast regions was only average during this important spring period. When migrating ducks arrived in Wisconsin this spring they found dry-to-average conditions in the southcentral portions of Wisconsin and dry conditions throughout much of the rest of the State. Much needed rains came after the survey and probably improved brood-

rearing conditions. The 2010 total Wisconsin breeding duck population estimate was 386,500, down 23% from 2009 but similar to the long-term average. The mallard population estimate was 198,200, which was similar to the 2009 estimate of 200,500 and the long term (37-year) average. In Minnesota, spring wetland habitat conditions were near average. Wetland conditions were fairly dry across much of the survey area in late April and early May but improved considerably with rain events in mid-May. Ice-out on most lakes across the State was 2–3 weeks earlier than average. This was the first April since modern records began in 1891 that no measurable snow was recorded in the State and was the 2^{nd} warmest April on record. The 2010 breeding population estimate of mallards was 241,900, which was similar to 2009 and the long-term average of 224,000. The total duck population index, excluding scaup, was 531,000, which was close to last year's index of 541,000 ducks but below the 10-year and long-term averages.

Habitat conditions in the northeast U.S. this spring were characterized by above-average precipitation, with extensive flooding in Rhode Island and Massachusetts, and warm temperatures resulting in early nesting and hatching dates observed in some States. Record winter snowfalls in some areas of the mid-Atlantic region, and heavy March storms, resulted in wetter habitats and substantial nest flooding. However, late nesters and renesting birds may not have been affected by the early spring storms, and probably benefited from the lush nesting and brood-rearing cover resulting from the combination of the early spring and increased rainfall. Some areas reported slightly drier conditions than average, but overall, waterfowl production for the region was expected to be slightly above average. The exception was Rhode Island, where nest flooding likely reduced the success of early nesters. Total duck numbers from the Atlantic Flyway Breeding Waterfowl Survey (1.3 million) were similar to the 2009 estimate of 1.3 million and their 1993–2009 average (1.4 million). Mallard numbers (652,600) were similar to the 2009 estimate of 666,800 and 15% below their long-term average of 770,500.

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 10.3 ± 0.9 million birds in 2010 (Figure 5). This is similar to the 2009 estimate of 10.3 ± 0.9 million.

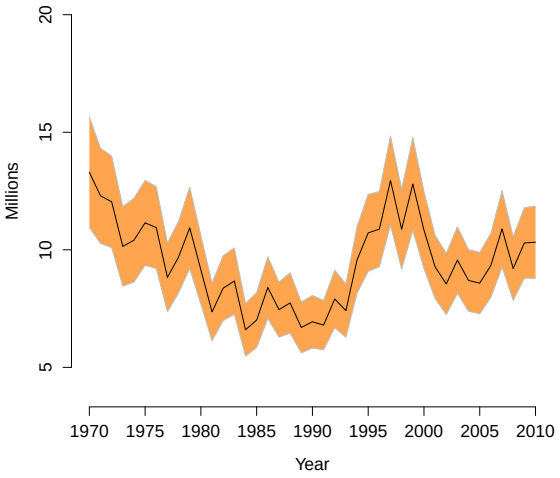

Figure 5: Estimates and 90% confidence intervals for the size of the mallard population in the fall.

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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' geese (*C. rossii*), emperor geese (*C. canagica*), white-fronted geese (*Anser albifrons*), and tundra swans (*Cygnus columbianus*). Temperatures in much of central and northern Canada from January through April were in excess of 5° C warmer than average. Substantially above-average temperatures continued into May and June in important goose habitats within eastern Canada. The resulting accelerated snowmelt contributed to favorable nesting conditions for many mid-latitude and Arctic nesting goose populations in 2010. Persistent snow cover significantly delayed goose nesting activities only in the Queen Maud Gulf, Victoria Island, and Wrangel Island regions. 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 for 15 goose populations and increased for 12 goose populations in 2010 compared to 2009. Primary abundance indices for both populations of tundra swans decreased in 2010 from 2009 levels. The following populations displayed significant positive trends during the most recent 10-year period ($P < 0.05$); Mississippi Flyway Giant, Short Grass Prairie, Aleutian, and Eastern Prairie Canada geese; Western Arctic/Wrangel Island, and Western Central Flyway light geese; and Pacific white-fronted geese. No population showed a significant negative 10-year trend. The forecast for the production of geese and swans in North America for 2010 is regionally variable, but production for many populations will be much improved this year compared to the poor production widely experienced in 2009.

This section summarizes information regarding the status, annual production of young, and expected fall flights of goose and tundra swan populations in North America. Information was compiled from a broad geographic area and is provided to assist managers in regulating harvest. Most populations of geese and swans in North America nest in the Arctic and subarctic regions of Alaska and northern Canada (Figure 6), but several Canada goose populations nest in temperate regions of the United States and southern Canada ("temperate-nesting" populations). The annual production of young by northern-nesting geese is influenced greatly by weather conditions on the breeding grounds, especially the timing of spring snowmelt and its impact on the initiation of nesting activity (i.e., phenology). Persistent snow cover reduces nest site availability, delays nesting activity, and often results in depressed reproductive effort and productivity. In general, goose productivity will be better than average if nesting begins by late May in western and central portions of the Arctic, and by early June in the eastern Arctic. Production usually is poor if nest initiations are delayed much beyond 15 June. For temperate-nesting Canada goose populations, recruitment rates are less variable, but productivity is influenced by localized drought and flood events.

Methods

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

Population estimates for geese (Appendices D.1, D.2, and D.3) are derived from a variety of surveys conducted by biologists from federal, State, and provincial agencies, or from universities (Appendices A.2). Surveys include the Midwinter Survey (MWS, conducted each January in wintering areas), the Waterfowl Breeding Population and Habitat Survey (WBPHS,

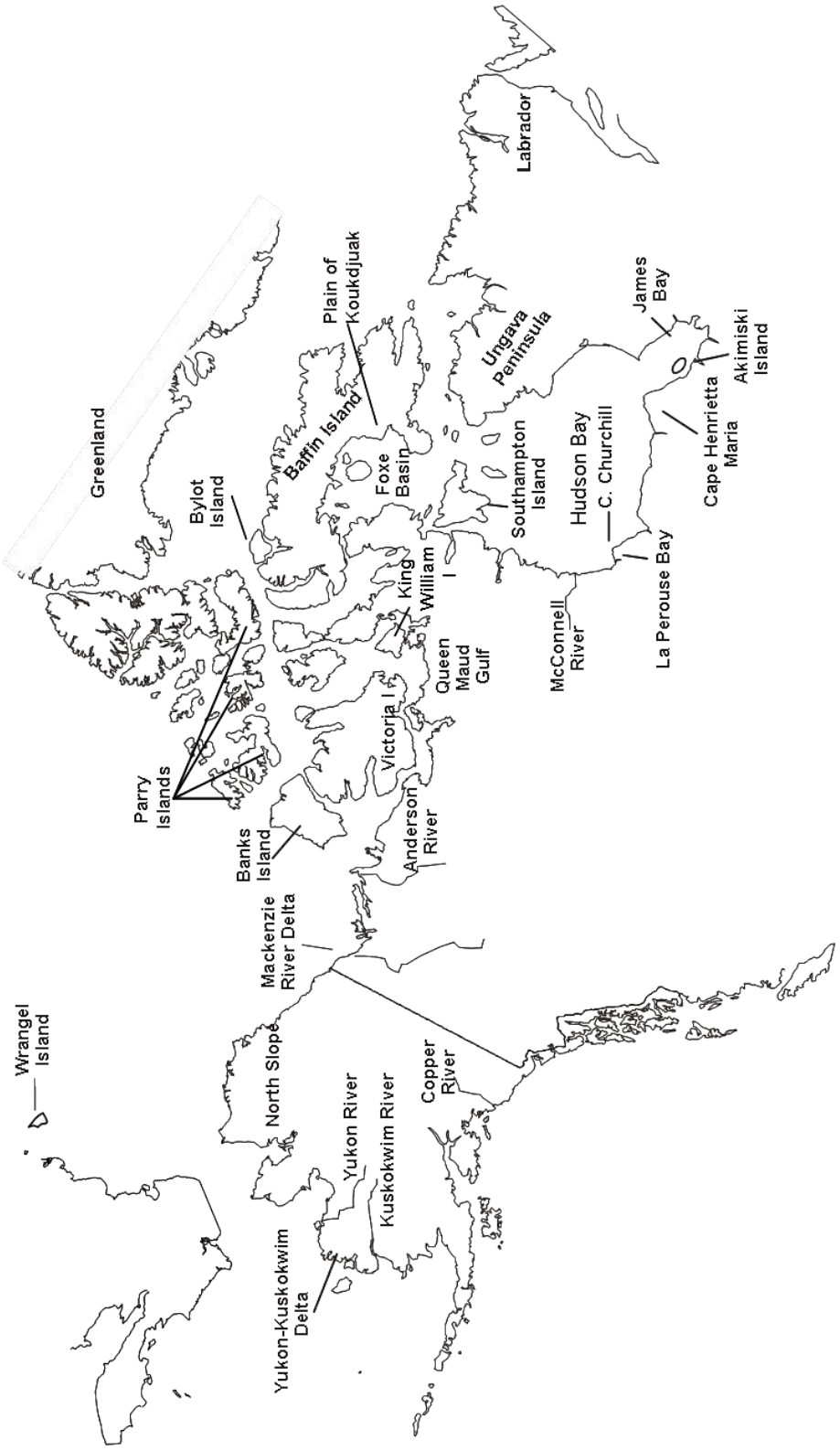


Figure 6: Important goose and swan nesting areas in Arctic and subarctic North America.

Figure 7: The extent of snow and ice cover in North America on 2 June 2010 and 2 June 2009 (data from National Oceanic and Atmospheric Administration).

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 with population estimates. The 10-year trends of population estimates were calculated by regressing the natural logarithm of survey results on year, and slope coefficients were presented and tested for equality to zero (t-statistic). Changes in population indices between the current and previous years were calculated and, where possible, assessed with a z-test using the sum of sampling variances for the two estimates. Primary abundance indices, those related to management plan population objectives, are described first in population-specific sections and graphed when data are available.

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

Results and Discussion

Conditions in the Arctic and Subarctic

Temperatures in much of central and northern Canada from January through April in 2010 were in excess of 5° C warmer than average. Well-above-average temperatures continued into May and June in eastern Canada and the resulting accelerated snowmelt contributed to favorable nesting conditions for many mid-latitude and Arctic nesting goose populations in 2010. Persistent snow cover significantly delayed goose nesting activities only in the Queen Maud Gulf, Victoria Island, and Wrangel Island regions. The gosling production of most goose populations that inhabit the Atlantic and Mississippi Flyways will likely be improved from last year's poor production. Gosling production of Ross' and white-fronted geese that migrate predominantly through the Central Flyway will be reduced for a fourth consecutive year due to harsh conditions in portions of the central Arctic. The snow and ice cover graphics (Figure 7, National Oceanic and Atmospheric Administration, http://www.natice.noaa.gov/ims/) illustrate the advanced snowmelt on 2 June 2010 relative to the same date in 2009, especially in eastern Canada.

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 2010 generally were improved from 2009 and contributed to increased nesting and brood rearing success this year. Generally favorable nest-

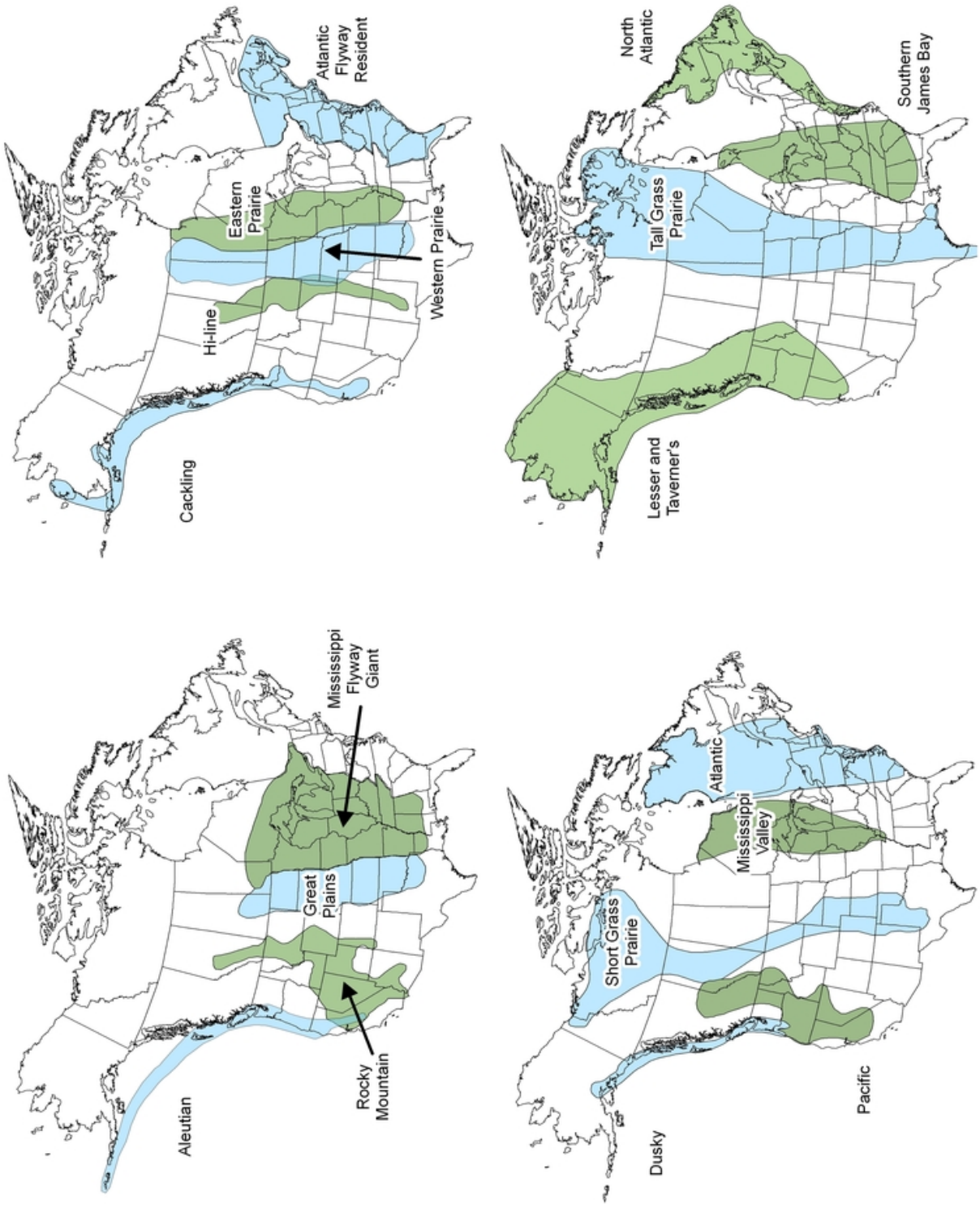


Figure 8: Approximate ranges of Canada goose populations in North America.

ing conditions were reported in most areas inhabited by temperate-nesting geese in southern Canada and the eastern United States. In several western States and other regions (e.g., RI, MA, MO, KY, and NE) drought or flooding reduced production potential. Production of temperate-nesting Canada geese from most of their North American range is expected to be above-average in 2010, with the exception of those in the western United States.

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 8). 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 2010 WBPHS, biologists estimated 54,600 ($\pm 29,100$) indicated pairs (singles plus pairs) within the NAP range (strata 66 and 67), 2% more than in 2009 ($P = 0.962$, Figure 9). Indicated pair estimates declined an average of 2% per year during 2001–2010 ($P = 0.258$). The 2010 estimate of 156,600 ($\pm 86,100$) total NAP Canada geese was 13% lower than last year's estimate ($P = 0.715$). Well-below average winter snowfall, and above average spring temperatures contributed to an early snowmelt in Newfoundland in 2010. Spring conditions in Labrador were somewhat cooler and snowier. Overall, conditions in Newfoundland and lowland portions of Labrador were favorable for NAP geese. A fall flight similar to that of 2009 is expected.

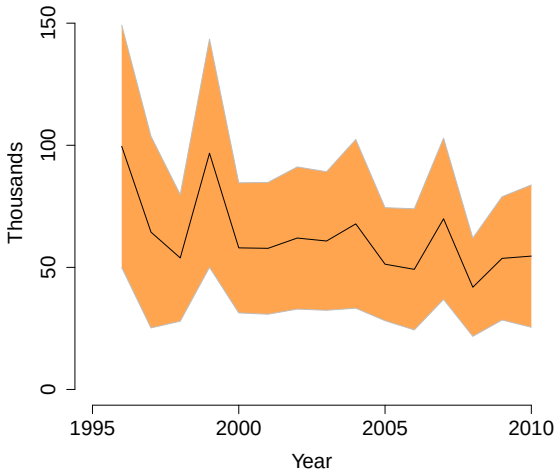


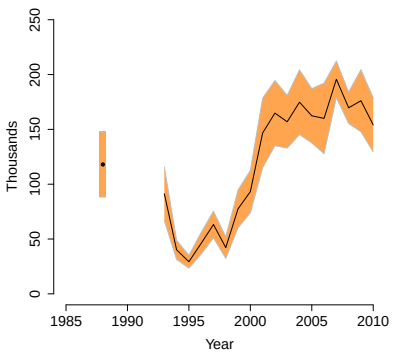
Figure 9: Estimated numbers (and 95% confidence intervals) of North Atlantic Population Canada geese (breeding pairs).

Atlantic Population (AP)

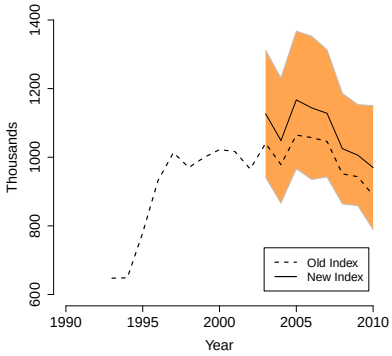
AP Canada geese nest throughout much of Quebec, especially along Ungava Bay, the eastern shore of Hudson Bay, and on the Ungava Peninsula. The AP winters from New England to South Carolina, but the largest concentrations occur on the Delmarva Peninsula (Figure 8). Spring surveys in 2010 yielded an estimate of 154,000 ($\pm 24,600$) breeding pairs, 13% fewer than in 2009 ($P = 0.248$, Figure 10.1). Breeding pair estimates indicate no trend during 2001–2010 ($P = 0.299$). In 2010, 57% of indicated pairs were observed as singles, slightly higher than the 18-year average, and indicated a near average nesting effort in 2010. The estimated total spring population of 776,200 ($\pm 108,200$) in 2010 was 29% lower than in 2009 ($P = 0.002$). In Quebec, below average winter snowfall and warmer than average temperatures in March and April were followed by near-average temperatures in May. Nesting studies along Ungava Bay estimated a mean nest initiation date two days earlier than the long-term average and eight days earlier than last year. Average clutch size in 2010 was 3.8 eggs, slightly below the long-term average. Gosling production and the fall flight of AP geese in 2010 are expected to be similar to the average of recent years.

Atlantic Flyway Resident Population (AFRP)

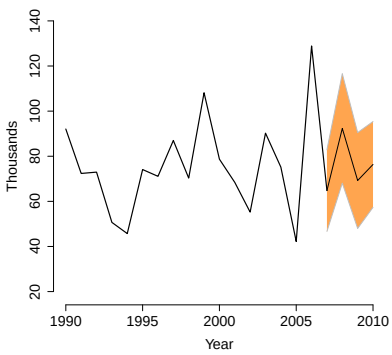
This population of large Canada geese inhabits southern Quebec, the southern Maritime



10.1: Atlantic Population



10.2: Atlantic Flyway Resident Population



10.3: Southern James Bay Population

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

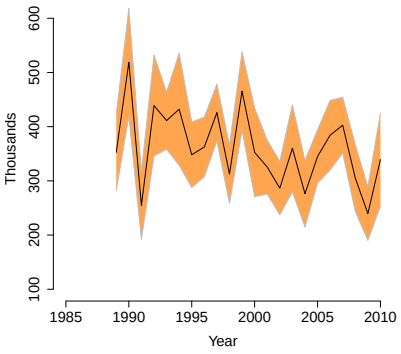
Provinces, and all States of the Atlantic Flyway (Figure 8). Surveys conducted during spring 2010 yielded an estimate of 969,900 ($\pm 180,600$) AFRP Canada geese, 4% fewer than in 2009 ($P = 0.760$, Figure 10.2). The new indices have decreased an average of 2% per year since 2003 ($P = 0.051$). The spring of 2010 was generally characterized as warmer and wetter than average throughout most of AFRP range. Some flooding occurred in Rhode Island, Massachusetts and coastal Virginia but in general, biologists expect AFRP production to be above average. The 2010 fall flight was expected to be similar to the recent average.

Southern James Bay Population (SJBP)

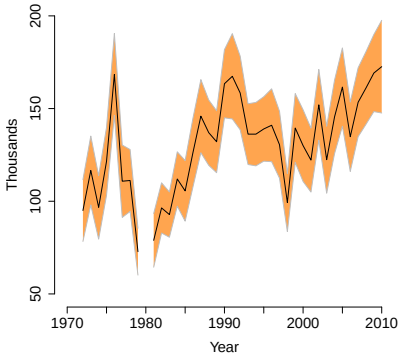
This population nests on Akimiski Island and in the Hudson Bay Lowlands to the west and south of James Bay. The SJBP winters from southern Ontario and Michigan to Mississippi, Alabama, Georgia, and South Carolina (Figure 8). The estimated number of breeding SJBP geese in spring 2010 was 76,400 ($\pm 19,000$), 10% higher than last year's index ($P = 0.626$, Figure 10.3). These indices of SJBP geese have increased an average of 2% per year since 2001 ($P = 0.574$). 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 2010 survey indicated a total spring population of 87,300 ($\pm 20,400$) Canada geese, 13% more than in 2009 ($P = 0.544$). Surveys in 2010 were conducted with the traditionally used aircraft and within the target survey period. Below-average winter snow fall and above-average spring temperatures contributed to a record-early snowmelt. Nesting phenology on Akimiski Island was also the earliest recorded (since monitoring began in 1992), which generally favors strong production. However, nesting density was only average and nest predation rates were very high. Although predation rates on the mainland portion of SJBP range are unknown, biologists expect gosling production in 2010 to be average or below average, but still anticipate a fall flight improved from the very poor production year of 2009.

Mississippi Valley Population (MVP)

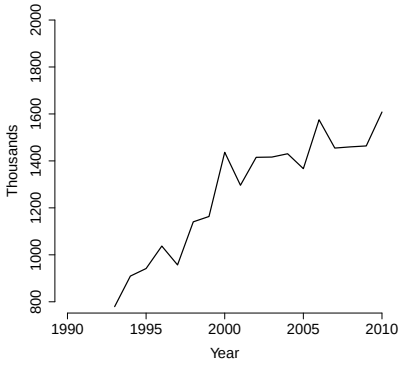
The nesting range of this population is in northern Ontario, principally in the Hudson Bay Lowlands, west of Hudson and James Bays. MVP Canada geese primarily concentrate during fall and winter in Wisconsin, Illinois, and Michigan (Figure 8). Breeding ground surveys conducted in 2010 indicated the presence of 339,300 ($\pm 86,000$) MVP breeding adults, 42% more than in 2009 ($P = 0.049$, Figure 11.1). Estimates of breeding adults show little evidence



11.1: Mississippi Valley Population



11.2: Eastern Prairie Population



11.3: Mississippi Flyway Giant Population

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

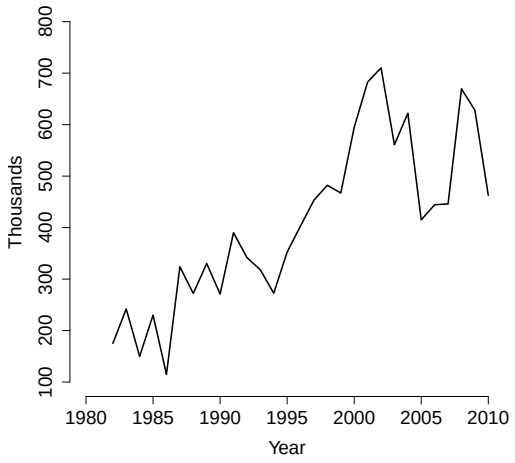
of trend during 2001–2010 ($P = 0.883$). Transect level analyses of MVP breeding pairs indicated the 2010 estimates were lower ($P = 0.031$) than the previous five-year mean. Surveys indicated a total population of 359,700 ($\pm 88,000$) Canada geese, a 31% decrease from the 2009 estimate ($P = 0.141$). In 2010 the MVP range experienced a dry spring, above average spring temperatures, and a record-early snowmelt. Despite the earliest nesting phenology yet recorded there, ground studies near Peawanuck, Ontario indicated only average nest densities. Biologists also encountered very high nest predation rates, predominantly by gull species. Biologists expect the fall flight in 2010 to be improved from that of 2009, but productivity to be below average.

Eastern Prairie Population (EPP)

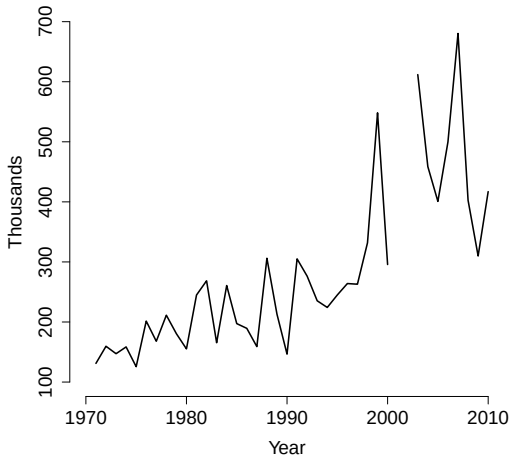
These geese nest in the Hudson Bay Lowlands of Manitoba and concentrate primarily in Manitoba, Minnesota, and Missouri during winter (Figure 8). The 2010 survey estimate of single and paired EPP geese was 172,600 ($\pm 25,000$), 2% higher than last year ($P = 0.835$, Figure 11.2). Estimates of these population components have increased an average of 3% per year during 2001–2010 ($P = 0.010$). The 2010 spring estimate of total geese was 251,300 ($\pm 73,600$), 10% lower than the 2009 estimate ($P = 0.482$). The estimated number of productive geese (nesting pairs and singles) was 80,000 in 2010, 48% higher than the poor production year of 2009. Spring phenology varied drastically in EPP range in 2010, from very early in the south to near average or later north of Churchill. Biologists at the Nestor One field station near Cape Churchill observed a median hatch date (20 June) about 4 days earlier than average, a nest density approximately 13% above average, and a clutch size about 8% larger than the average for that study area during 1976–2009. A fall flight similar to or exceeding that of the last few years 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 8). Biologists estimated the presence of 1,608,100 MFGP geese during the spring of 2010 (new indices incorporate new estimation procedures for ON and MB), 10% more than the revised 2009 estimate, and the highest estimate on record (Figure 11.3). These estimates have increased an average of 2% per year since 2001 ($P = 0.014$). Ontario, Manitoba, and most northern States reported good to excellent



12.1: Western Prairie/Great Plains Population



12.2: Tall Grass Prairie Population

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

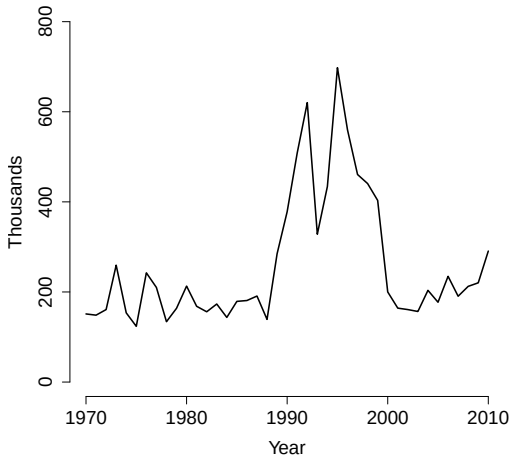
nesting conditions in 2010. However, extensive flooding reduced nest success in Missouri and Kentucky and other mid-latitude areas. Biologists expect a strong fall flight this year especially in northern portions of the range.

Western Prairie and Great Plains Populations (WPP/GPP)

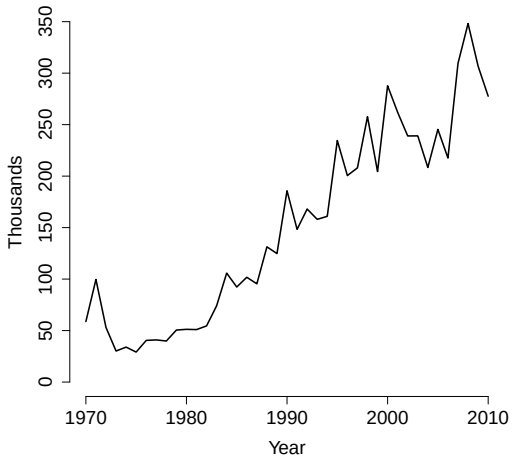
The WPP is composed of mid-sized and large Canada geese that nest in eastern Saskatchewan and western Manitoba. The GPP is composed of large Canada geese resulting from restoration efforts in Saskatchewan, North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, and Texas. Geese from these breeding populations commingle during migration with other Canada geese along the Missouri River in the Dakotas and on reservoirs from southwestern Kansas to Texas (Figure 8). These two populations are managed jointly and surveyed during winter. During the 2010 MWS, 462,800 WPP/GPP geese were counted, 26% fewer than in 2009 (Figure 12.1). These indices decreased an average of 3% per year since 2001 ($P = 0.262$). In 2010, the estimated spring population in the portion of WPP/GPP range included in the WBPHS was 998,900 ($\pm 150,354$) geese, 8% more than last year ($P = 0.451$). The WBPHS estimates have increased an average of 1% per year since 2010 ($P < 0.001$). The northern WPP range experienced near average spring phenology in 2010. Wetland abundance was variable across southern Manitoba and Saskatchewan, but remained high in most GPP range. Goose production is expected to be excellent in South and North Dakota, and near average in Oklahoma. Nebraska reported a later than average spring and that flooding reduced gosling production to slightly below average. An improved fall flight from that of 2009 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 8). These geese mix with other Canada geese on wintering areas, making it difficult to estimate the size of the winter population. During the 2010 MWS in the Central Flyway, 417,000 TGPP geese were counted, 35% more than in 2009 (Figure 12.2). These estimates increased an average of 3% per year



13.1: Short Grass Prairie Population



13.2: Hi-line Population

Figure 13: Estimated numbers of Short Grass Prairie Population (winter geese) and Hi-line Population (breeding adults) Canada geese.

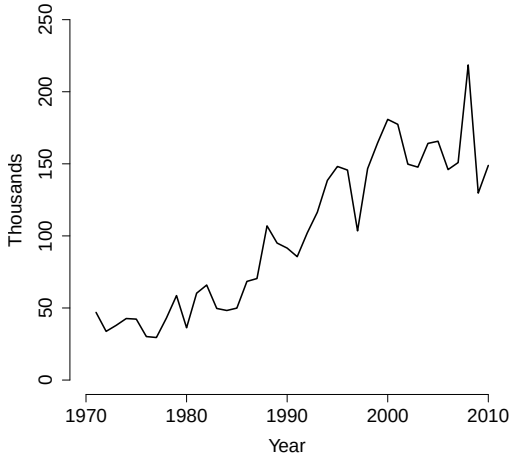
during 2001–2010 ($P = 0.535$). Biologists on Southampton Island reported early goose nesting phenology and expect good production from TGP geese there in 2010. Temperatures during May and June on Baffin Island were up to 5° C warmer than average, and satellite imagery suggests an early snowmelt there. In contrast, nesting was delayed near the Queen Maud Gulf and the McConnell River by persistent snow cover. Biologists working in the Queen Maud Gulf Sanctuary reported goose nesting phenology was 4–5 days later than average. Available information suggests that the production of TGPP Canada geese will be improved from 2009.

Short Grass Prairie Population (SGPP)

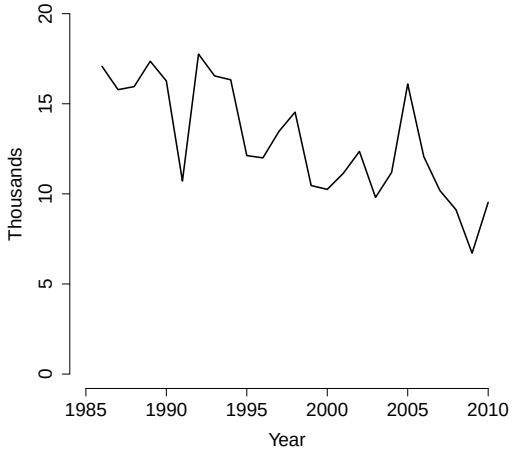
These small Canada geese nest on Victoria and Jenny Lind Islands and on the mainland from the Queen Maud Gulf west and south to the Mackenzie River and northern Alberta. These geese winter in southeastern Colorado, northeastern New Mexico, and the Oklahoma and Texas panhandles (Figure 8). The MWS index of SGPP Canada geese in 2010 was 290,700, 32% higher than in 2009 (Figure 13.1). These indices have increased an average of 5% per year since 2001 ($P = 0.002$). In 2010, the estimated spring population of SGPP geese in the Northwest Territories (WBPHS strata 13–18) was 247,300 ($\pm 111,900$), an 84% increase from 2009 ($P = 0.068$). WBPHS estimates have increased an average of 6% per year since 2001 ($P = 0.107$). Nesting phenology in the Queen Maud Gulf Sanctuary was 4–5 days later than average. In western SGPP range (i.e., West Victoria Island and near Inuvik), snow cover was less persistent and nesting likely occurred without substantial delay. Wetland conditions in boreal forest SGPP nesting areas were assessed as good. Production of SGPP geese in 2010 is expected to be below average.

Hi-line Population (HLP)

These large Canada geese nest in southeastern Alberta, southwestern Saskatchewan, eastern Montana and Wyoming, and in Colorado. They winter in these States and central New Mexico (Figure 8). A newly adopted primary index of this population is based on WBPHS surveys in Alberta, Saskatchewan, and Montana, and State surveys in Wyoming. In 2010, these surveys yielded an estimate of 277,600 geese, 9% lower than the value in 2009 (Figure 13.2). The breeding population survey estimates have increased an average of 3% per year



14.1: Rocky Mountain Population



14.2: Dusky Canada Geese

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

during 2001–2010 ($P = 0.078$). Wetland conditions in HLP range were generally improved from last year but in portions of Montana and Alberta they were poorer than in 2009. Weather patterns during nesting were likely not a major negative factor in 2010. The fall flight of HLP geese is expected to be similar to that of 2009.

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 8).

Spring population estimates from RMP States and Provinces in 2010 totaled 148,900 geese, 15% more than the revised estimate from 2009 (Figure 14.1). These estimates indicate no trend during 2001–2010 ($P = 0.720$). Population indices in 2010 have increased in Alberta, Montana, Wyoming, and Colorado, while decreasing in Idaho, Utah, Nevada, and Arizona. Several States reported that cold we spring conditions and flooding reduced gosling production in 2010. The fall flight of RMP geese is expected to be near average.

Pacific Population (PP)

These large Canada geese nest and winter west of the Rocky Mountains from northern Alberta and British Columbia south through the Pacific Northwest to California (Figure 8).

The total of PP goose indices in 2010 was 145,000, 3% lower than last year. Most PP geese are surveyed in Alberta (WBPHS strata 76–77) where 91,300 ($\pm 51,000$) were estimated in 2010, 34% more than the estimate in 2009 ($P = 0.436$). Indices of nesting effort increased in Alberta and Idaho from 2009 levels but decreased in all other areas. Several States reported that cold and wet spring conditions, and flooding reduced gosling production in 2010. Although gosling production in 2010 may be reduced from that of 2009 a fall flight similar to 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 8). Dusky Canada geese are surveyed near the Copper River Delta and Middleton Island, Alaska. The

2010 spring population estimate was 9,500 DCG, 42% above last years count which was the lowest recorded since 1986 (Figure 14.2). These estimates have decreased an average of 4% during 2001–2010 ($P = 0.115$). April and May temperatures on the Copper River Delta were near average in 2010 and nesting phenology appeared to be earlier than average. An above-average run of spawning eulachon (a common prey fish of eagles) likely contributed to the observed high rate of nest success (75%) and likely will reduce eagle predation on dusky geese this year. Gosling production is expected to be near average in 2010.

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 8). The primary index of this population is an estimated fall population derived from the spring surveys of adults on the YKD. The fall estimate for 2010 is 188,600 geese, 17% higher than last years estimate. These estimates have increased an average of 2% per year since 2001 ($P = 0.123$, Figure 15). Indices of total cackling geese and indicated pairs in the YKD coastal zone in 2010 were only slightly lower than the record-high level of 2008. Spring snowpack was sparse in 2010 and despite cool spring temperatures and later-than-average break-up of the Yukon River, nesting on the YKD began earlier than average. The median hatch date of cackling geese was three days earlier than the long-term average. Yukon Delta nesting surveys conducted during 2010 indicated clutch sizes were slightly below average, fox predation was reduced from the levels of recent years, and nest success appeared to be good throughout most of the incubation period. However, a prolonged storm with high winds and precipitation occurred at the end of the nesting period, and several field camps reported moderate flooding of nests. Overall, above-average production and a fall flight similar to that of last year are expected.

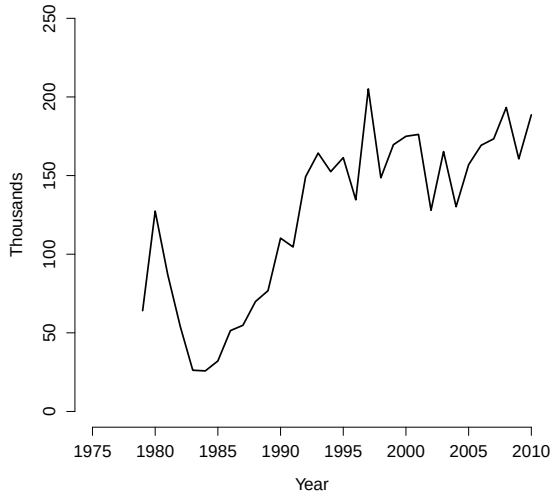


Figure 15: Estimated numbers of cackling Canada geese (fall geese).

Lesser and Taverner's Canada Geese

These populations nest throughout Alaska and winter in Washington, Oregon, and California (Figure 8). 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 2010 estimate of Canada geese within WBPHS strata predominantly occupied by these subspecies (strata 1–6, 8, 10–12) was 78,200, 15% higher than the 2009 estimate ($P = 0.635$). These estimates have declined an average of 1% per year since 2001 ($P = 0.564$). Spring conditions were warm and dry in Alaska's interior in 2010. The timing of spring break-up appeared to be near average and little flooding was observed. In general, above-average production of lesser Canada geese was expected in interior areas. Spring phenology on the Yukon Delta was slightly early and above average production of Taverner's geese is expected there. Goose nesting phenology appeared to be somewhat delayed on the North Slope and some flooding was reported there. Taverner's production on the North Slope is expected to be below average.

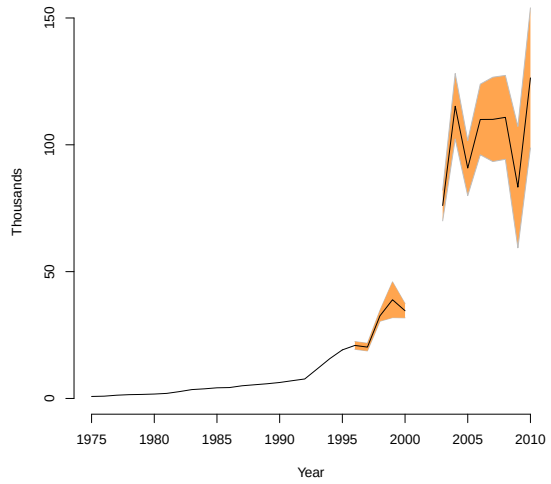


Figure 16: Estimated numbers of Aleutian Canada geese (winter geese, with 95% confidence intervals).

Overall, near-average production is expected for 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 delisted 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 8). Aleutian goose population estimates since 1996 are based on analysis of observations of neck-banded geese in California. The preliminary population estimate during the winter of 2009–2010 was 126,400 ($\pm 27,600$), 52% higher than the revised previous estimate ($P = 0.021$, Figure 16). These estimates have increased an average of 3% per year during the last 10 winters ($P = 0.305$). Biologists working on Buldir Island reported goslings were present by 15 June (suggesting early nesting phenology), a mean clutch size of 4.8 eggs (equaling the long-term average), and a strong nesting effort. A fall flight similar to that of last year is expected.

Status of Light Geese

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

Ross' Geese

Most Ross' geese nest in the Queen Maud Gulf region, but increasing numbers nest on Southhampton, Baffin, and Banks Islands, and along the western coast of Hudson Bay. Ross' geese are present in the range of three different populations of light geese and primarily winter in California, New Mexico, Texas, and Mexico, with increasing numbers in Louisiana and Arkansas (Figure 17). Ross' geese are annually surveyed at only one of their numerous nesting colonies. More comprehensive aerial photography inventories and groundwork (to identify proportions of snow and Ross' geese within colonies) are conducted periodically. The largest Ross' goose colonies are in the Queen Maud Gulf Sanctuary. Biologists at the Karrak Lake colony estimated that 720,000 adult Ross' geese nested there in 2009, 1% fewer than in 2008 (Figure 18.1). These estimates increased an average of 8% per year during 2000–2009 ($P < 0.001$). Colony 10, about 60 miles to the east of Karrak Lake, includes similar or higher numbers of Ross' geese. In 2010, areas near the Queen Maud Gulf experienced persistent snow cover compared to Arctic areas to the west and east. Nesting activities at the Karrak Lake colony were delayed 4–5 days compared to the long-term average (1991–2009). Biologists expect Ross' goose production in 2010 to be below average here, the fourth consecutive year of below-average production. The McConnell River area also appeared to have persistent snow cover this spring. Ross' goose production in 2010 is again expected to be well below average.

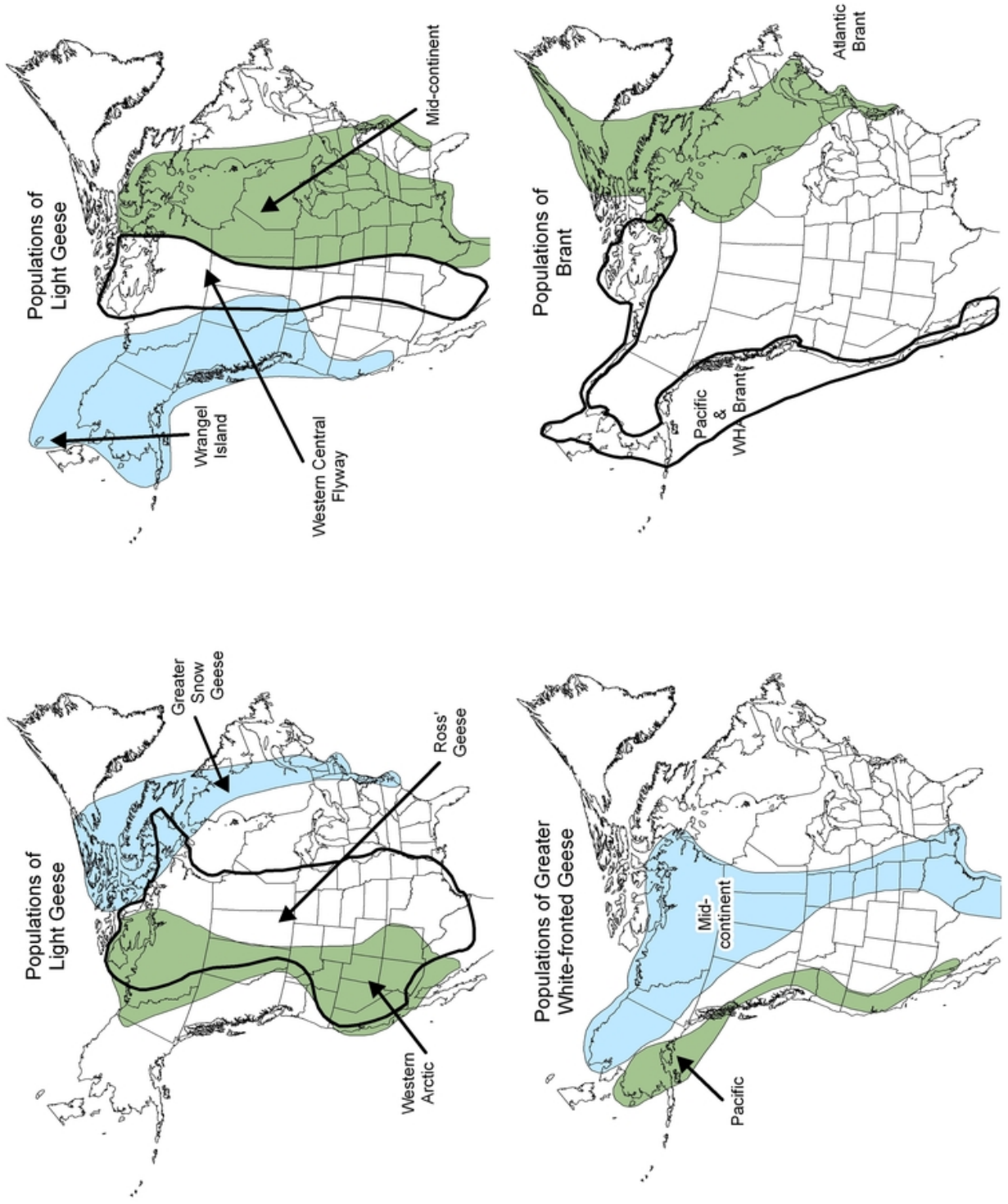
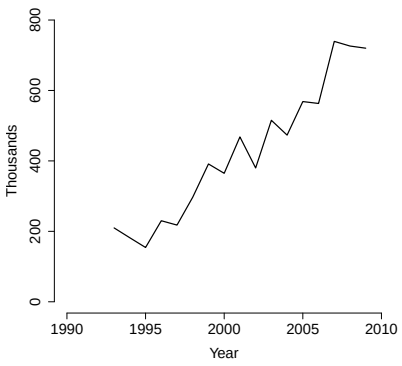
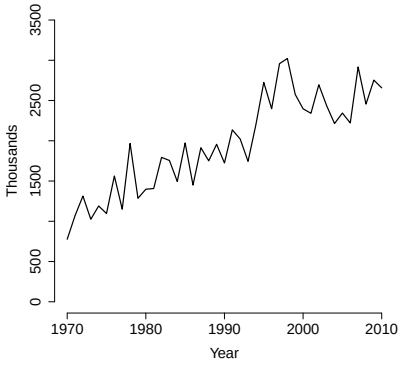


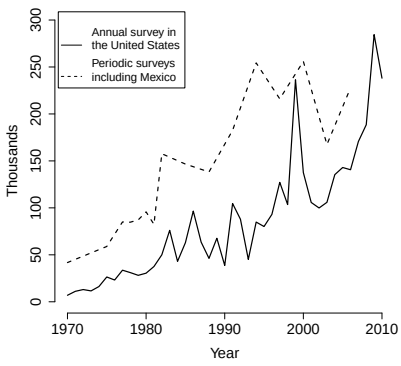
Figure 17: Approximate ranges of brant, snow, Ross', and white-fronted goose populations in North America.



18.1: Ross' Geese



18.2: Mid-continent Population Light Geese



18.3: Western Central Flyway

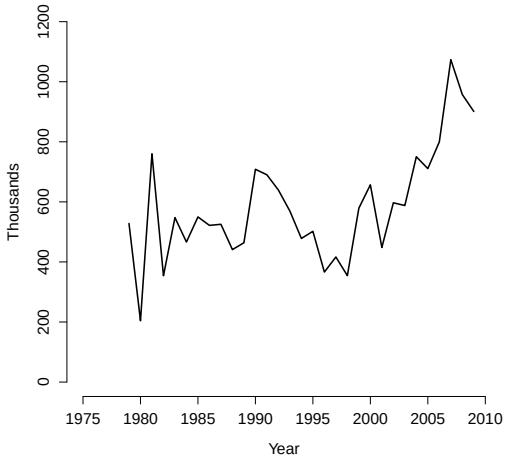
Figure 18: Estimated numbers of Ross' geese (nesting adults at the Karrak Lake colony, Nunavut) and Mid-continent Population snow and Ross' geese (winter geese).

Mid-continent Population Light Geese (MCP)

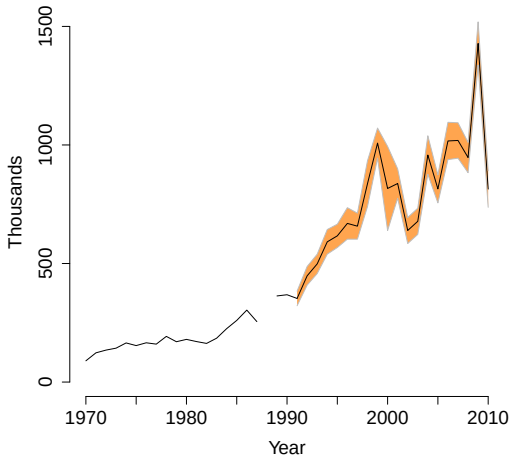
This population includes lesser snow geese and increasing numbers of Ross' geese. Geese of the MCP nest on Baffin and Southampton Islands, with smaller numbers nesting along the west coast of Hudson Bay (Figure 17). These geese winter primarily in eastern Texas, Louisiana, and Arkansas. During the 2010 MWS, biologists counted 2,657,500 light geese, 4% fewer than in 2009 (Figure 18.2). Winter indices during 2001–2010 have increased an average of 1% per year ($P = 0.243$). Biologists on Southampton Island reported early goose nesting phenology and expect good production in 2010. Baffin Island experienced temperatures up to 5° C warmer than average each month from January through May, and a June slightly warmer than average. Satellite imagery from Baffin Island suggested a snowmelt progression similar to that observed on Southampton Island. Spring break-up near the McConnell River appeared to be delayed somewhat from areas to its north and south. Biologists at La Perouse Bay, Manitoba reported a nesting phenology substantially earlier than the long-term average and a strong, but dispersed nesting effort. In 2010, Cape Henrietta Maria and Akimiski Island experienced a dry spring with above average temperatures and a record-early snowmelt. Early information suggests an abundant fall flight of MCP snow geese containing an above average proportion of young for 2010.

Western Central Flyway Population (WCFP)

Historically, this population included predominantly snow geese, but Ross' geese continue to increase and now represent nearly one third of all WCFP geese. Geese of the WCFP nest in the central and western Canadian Arctic, with large nesting colonies near the Queen Maud Gulf and on Banks Island. These geese stage during fall in eastern Alberta and western Saskatchewan and concentrate during winter in southeastern Colorado, New Mexico, the Texas Panhandle, and the northern highlands of Mexico (Figure 17). WCFP geese wintering in the U.S. portion of their range are surveyed annually, but the entire range including Mexico is usually surveyed once every three years. Surveys in Mexico were not conducted in 2009 due to sociopolitical unrest in that country. During the 2010 surveys in the U.S. portion of WCFP range, 238,100 geese were counted, 16% fewer than in 2009 (Figure 18.3). These population indices have increased 11% per year during 2001–2010 ($P < 0.001$). In 2010, areas near the Queen Maud Gulf experienced persistent snow cover compared to Arctic areas to the west and east. Nesting activities at the Karrak Lake colony were delayed 4–5 days compared to the long-term average (1991–2010). Biologists there expect snow and Ross' goose pro-



19.1: Western Arctic/Wrangel Island Population



19.2: Greater Snow Goose Population

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

duction in 2010 to be below average again for the fourth consecutive year. On Banks Island, survey crews reported a strong snow goose nesting effort and expected good gosling production. Snow goose production from this population will be below average, but likely better than 2009.

Western Arctic/Wrangel Island Population (WAWI)

Most of the snow geese in the Pacific Flyway originate from nesting colonies in the western and central Arctic (WA: Banks Island, the Anderson and Mackenzie River Deltas, and the western Queen Maud Gulf region) or Wrangel Island (WI), located off the northern coast of Russia. The WA segment of the population winters in central and southern California, New Mexico, and Mexico; the WI segment winters in the Puget Sound area of Washington and in northern and central California (Figure 17). In winter, WA and WI segments commingle with light geese from other populations in California, complicating surveys. The fall 2009 estimate of WAWI snow geese was 901,000, 6% lower than in 2008 (Figure 19.1). Fall estimates increased 7% per year during 2000–2009 ($P = 0.002$). Biologists report that snowmelt and nesting phenology were early on Banks Island. Kendall Island and the Anderson River colonies were not visited in 2010 but satellite imagery suggested snowmelt occurred early there. Preliminary estimates from Wrangel Island's Tundra River colony included a spring population of 150,000 adults, however snowmelt was very late and $< 5,000$ nests were initiated. Estimates of the Wrangel Island spring population have increased an average of 4% per year since 2001 ($P < 0.001$). Biologists expect good production from Banks Island but very poor production from Wrangel Island. A near-average fall flight is expected in 2010.

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 in 2010 was 814,000 ($\pm 77,000$) geese, 43% fewer than estimated last year ($P < 0.001$, Figure 19.2). Spring estimates of greater snow geese have increased an average of 5% per year since 2001 ($P = 0.068$). The number of snow geese counted

during the 2010 MWS in the Atlantic Flyway was 271,600, a 34% decrease from the 2009 survey. The largest known greater snow goose nesting colony is on Bylot Island. Snow cover was deep on Bylot Island this spring but temperatures were very mild and melt occurred rapidly. Nesting geese were more dispersed than in most years but nesting effort and nesting phenology were near average. The mean clutch size of 4.2 eggs was well above average (3.7), and nesting success to mid-incubation was high at 90% (average is 64%). Good production and an average or better 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 fall population estimate derived from spring surveys of adults on the YKD and Bristol Bay. The 2010 fall estimate is 649,800, 21% higher than the 2009 estimate and a new record high (Figure 20). These estimates have increased an average of 6% per year since 2001 ($P = 0.002$). Spring snowpack was sparse in 2010 and despite cool spring temperatures and later-than-average break-up of the Yukon River, nesting on the YKD began earlier than average. The median hatch date of white-fronted geese was two days earlier than the long-term average. Yukon Delta nesting surveys conducted during 2010 indicated clutch sizes were near average, fox predation was reduced from the levels of recent years, and nest success appeared to be high throughout most of the incubation period. However, a prolonged storm with high winds and precipitation occurred at the end of the nesting period, and several field camps reported moderate flooding of nests. Good production and another large fall flight are expected.

Mid-continent Population White-fronted Geese (MCP)

These white-fronted geese nest across a broad region from central and northwestern Alaska to the central Arctic and the Foxe Basin.

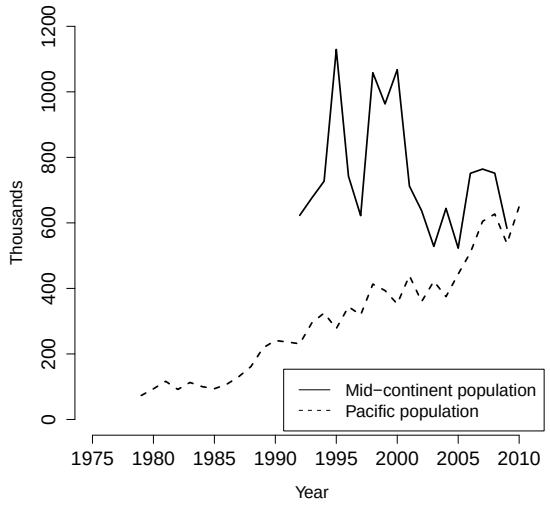


Figure 20: Estimated numbers of Mid-continent Population and Pacific Population white-fronted geese (fall geese).

They concentrate in southern Saskatchewan during the fall and in Texas, Louisiana, Arkansas, and Mexico during winter (Figure 17). During the fall 2009 survey in Saskatchewan and Alberta, biologists counted 583,200 MCP geese, 22% fewer than during the previous survey (Figure 20). During 2000–2009, these estimates declined by an average of 2% per year ($P = 0.422$). Eastern portions (e.g., Queen Maud Gulf, Rasmussen Lowlands) of MCP white-fronted goose range experienced slightly colder than average May and June temperatures and nesting activities were delayed. Nesting phenology near Karrak Lake was delayed 4–5 days compared to the long-term average, and white-fronted goose production there is expected to be below average. Spring conditions near the Mackenzie River Delta appeared to be more favorable for nesting. In Alaska's interior, the timing of spring break-up appeared to be near average with little flooding observed. Gosling production, measured during banding drives in this region, appeared to be excellent. Numbers of white-fronts observed on the surveys of the North Slope were near average but flooding may have reduced production there. Overall, production of MCP white-fronted geese in 2010 is expected to be near average.

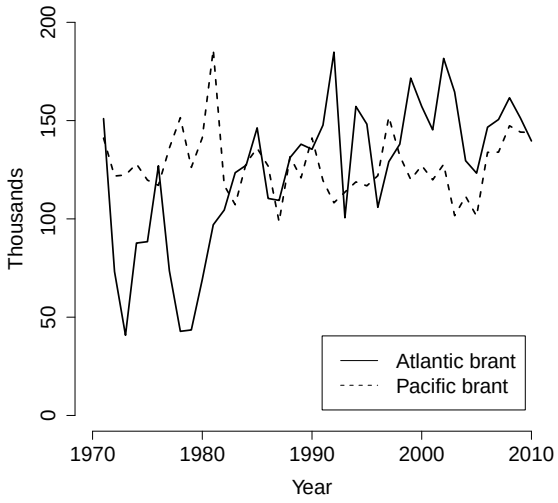


Figure 21: Numbers of Atlantic and Pacific brant estimated during winter surveys.

Status of Brant

Atlantic Brant (ATLB)

Most of this population nests on islands of the eastern Canadian Arctic. These brant winter along the Atlantic Coast from Massachusetts to North Carolina (Figure 17). The 2010 MWS estimate of brant in the Atlantic Flyway was 139,700, 8% lower than the 2009 estimate (Figure 21). These estimates have shown no trend during 2001–2010 ($P = 0.625$). Below average winter snow fall and above-average spring temperatures contributed to record-early snowmelt near the James Bay staging areas. Biologists on Southampton Island reported early goose nesting phenology and expect good brant production in 2010. Temperatures during May and June were up to 5° C warmer than average on Baffin, Prince Charles, Devon, and Ellesmere islands in 2010. Above-average temperatures and early snowmelt in brant staging and nesting areas suggest 2010 will be a productive year for Atlantic brant. Gosling production in 2010 is expected to be much better than that during 2009, which was characterized by very harsh conditions on the staging and nesting grounds.

Pacific Brant (PACB)

These brant nest across Alaska's Yukon-Kuskokwim Delta (YKD) and North Slope, Banks Island, other islands of the western and central Arctic, the Queen Maud Gulf, and Wrangel Island. They winter as far south as Baja California and the west coast of Mexico (Figure 17). The 2010 MWS estimate of brant in the Pacific Flyway and Mexico was 143,900. Winter surveys were not conducted in Mexico in 2009 due to sociopolitical unrest, so there is no comparable estimate from 2009. The 2010 estimate is 2% lower than the estimate from 2008 (Figure 21). The estimates during 2001–2010 have increased an average of 3% per year ($P = 0.074$). Spring snowpack was sparse in 2010 and despite cool spring temperatures and later than average break-up of the Yukon River, 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 decreased 21% in 2010 from 2009, and nest abundance at each colony was reduced. Yukon Delta nesting surveys, outside the main colonies, indicated nest abundance was well above the 10-year average, clutch sizes were slightly below average, fox predation was reduced from the levels of recent years, and nest success appeared to be good throughout most of the incubation period. However, a prolonged storm with high winds and precipitation occurred at the end of the nesting period, and several field camps reported moderate flooding of nests. Spring phenology was expected to be early on Banks Island, and delayed on the North Slope and near the Queen Maud Gulf. Overall, brant production is expected to be variable but similar to that of last year.

Western High Arctic Brant (WHA)

This population of brant nests on the Parry Islands of the Northwest Territories (Figure 17). The population stages in fall at Izembek Lagoon, Alaska. They predominantly winter in Padilla, Samish, and Fidalgo Bays of Washington and near Boundary Bay, British Columbia, although some individuals have been observed as far south as Mexico. This population is monitored during the MWS in three Washington State counties. During the 2010 MWS 6,000 brant were counted, 63% fewer than in 2009. These estimates have increased an average of 5% per year during 2001–2010 ($P = 0.238$). Satellite

imagery indicated very little snow cover on the Parry Islands during spring of 2010 which is consistent with an expectation for excellent brant production.

Status of Emperor Geese

The breeding range of emperor geese is restricted to coastal areas of the Bering Sea, with the largest concentration on the Yukon-Kuskokwim Delta (YKD) in Alaska. Emperor geese migrate relatively short distances and primarily winter in the Aleutian Islands (Figure 22). Since 1981, emperor geese have been surveyed annually on spring staging areas in southwestern Alaska. The 2010 emperor goose survey estimate was 64,600, 30% lower than in 2009 (Figure 23.1). These estimates have increased an average of 1% per year during 2001–2010 ($P = 0.606$). Aerial surveys during the YKD coastal survey in 2010 indicated a slight increase in the number of pairs, and a slight decrease in total birds from 2009 levels. A long-term increasing trend in both indices is still apparent in the coastal survey data. Spring break-up on the Yukon River was slightly later than average in 2010, but emperor goose nesting phenology was two days earlier than the long-term average. Nesting surveys conducted on the YKD during 2010 indicated clutch sizes were slightly below average but nest success was high throughout most of the incubation period. The impacts of a prolonged rain storm that occurred at the end of the nesting period are not known but several field camps reported moderate flooding of nests. Good production and a fall flight similar to that of recent years are expected.

Status of Tundra Swans

Western Population Tundra Swans

These swans nest along the coastal lowlands of western Alaska, particularly between the Yukon and Kuskokwim Rivers. They winter primarily in California, Utah, and the Pacific Northwest (Figure 22). The 2010 MWS estimate of western population swans was 76,700, 27% lower than last years estimate of 105,200

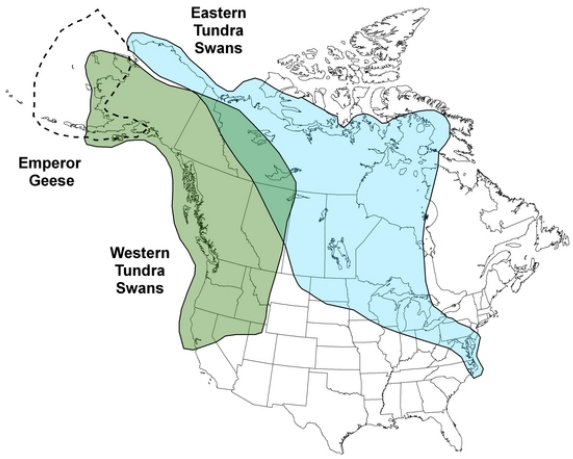
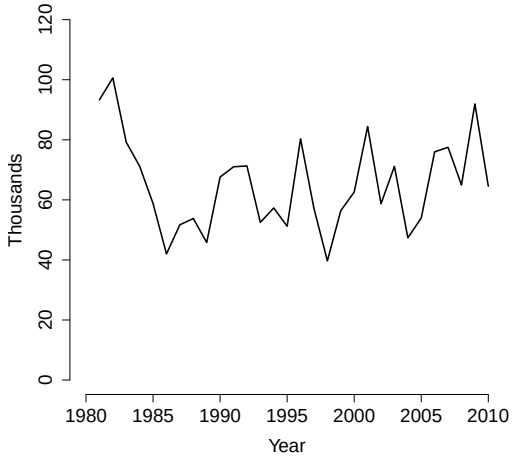


Figure 22: Approximate range of emperor geese, and Eastern and Western Populations of tundra swans in North America.

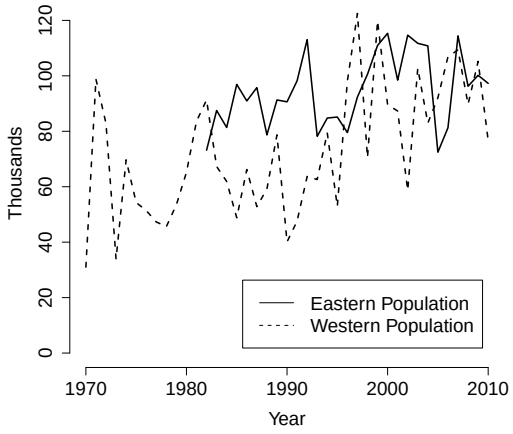
(Figure 23.2). However, several important swan wintering areas in California (where most swans are tallied during the MWS) were not surveyed in 2010. Including the 2010 estimate, MWS estimates have increased an average of 2% per year over the last 10 years ($P = 0.382$). The numbers of swan nests and the single plus paired swan index from the coastal Yukon-Kuskokwim Delta survey during spring 2010, both increased substantially (23% and 5%, respectively) from 2009 levels. Spring snowpack was sparse in 2010 and despite cool spring temperatures and later than average break-up of the Yukon River, nest-sites were available on the YKD earlier than average. Yukon Delta nesting surveys conducted during 2010 indicated median hatch date for swans was near average and nest success was slightly lower than the long-term average. Swan production is expected to be fair in 2010 and contribute to a fall flight similar to that of last year.

Eastern Population Tundra Swans

Eastern Population tundra swans (EP) nest from the Seward Peninsula of Alaska to the northeast shore of Hudson Bay and Baffin Island. The Mackenzie Delta and adjacent areas are of particular importance. These birds winter in coastal areas from Maryland to North Carolina (Figure 22). The primary index for



23.1: Emperor geese



23.2: Tundra swans

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

EP tundra swans includes swans counted during winter in Ontario and the Atlantic and Mississippi Flyways. During the 2010 MWS, 97,300 EP tundra swans were observed, 3% fewer than in 2009 (Figure 23.2). These estimates decreased by an average of 1% per year during 2001–2010 ($P = 0.596$). Spring phenology was later than average in the central Arctic portion of EP tundra swan range in 2010. Spring conditions appeared favorable near the Mackenzie River Delta and the eastern Arctic, but prodution on Alaska's North Slope was expected to be below average. Swan production in 2010 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 S. Folsom[d]

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

Air J. Bredy and D. Fronczak

Ground J. Leafloor[a], S. Leach[d], G. Raven[a], N. Clements[d], M. Watmough[a], J. Caswell[b], M. Burak[a], and A. Sorensen[a]

Southern Saskatchewan (Strata 30–33)

Air P. Thorpe and P. Devers

Ground K. Dufour[a], K. Warner[a], D. Johns[a], N. Tchir[a], D. Routhier[a], D. Nieman[c], P. Nieman[c], P. Bergen[c], and J. Traylor[c]

Southern Manitoba (Strata 34–40)

Air B. Lubinski and D. Benning[e]

Ground M. Schuster[a], G. Ball[b], F. Baldwin[b], N. Astleford[a], D. Walker[a], J. Ingram[a], J. Black[a], M. Gillespie[c], and R. Buss[a]

Montana and Western Dakotas (Strata 41–44)

Air T. Liddick and M. Rabe[b]

Ground K. Fleming and J. Klimstra

Eastern Dakotas (Strata 45–49)

Air J. Solberg and P. Fasbender

Ground P. Garrettson, K. Kruse, D. Collins, and J. White

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

Air J. Wortham and G. Boomer

Helicopter P. Padding, C. Dwyer, and S. Gibbs

Central and Eastern Ontario (Strata 51, 54)

Air K. Fox and T. Lewis

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

Air	K. Bollinger and C. Ferguson[e]

Maine and Maritimes (Strata 62–67)

Air	J. Bidwell and R. Spangler[f]

Canadian Wildlife Service helicopter plot survey

Quebec	D. Bordage[a], C. Lepage[a], C. Marcotte[a], and S. Orichefsky[a]
Ontario	S. Meyer[a], D. McNicol[a], K. Ross[d], and C. Friis[a]
New Brunswick & Nova Scotia	R. Hicks[a] and B. Pollard[a]
Labrador & Newfoundland	S. Gilliland[a], P. Ryan[a], R. Hicks[a], S. Duffy[a], and J. Foster[b]

California

Air	M. Weaver[b], S. Oldenburger[b], and D. Zezulak[b]
Ground	D. Loughman[d] and B. Huber[d]

Michigan

Air	B. Barlow[b], B. Berger[b], S. Hanna[b], E. Kafcas[b], A. Karr[b], D. Luukkonen[b], T. Maples[b], M. Mills[b], N. Kalejs[b], J. Niewoonder[b], J. Robison[b], and V. Weigold[b]

Minnesota

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

Nebraska

M. Vrtiska

Northeastern U. S.

Data Analysis	J. Klimstra
Connecticut	M. Huang[b] and K. Kubik[b]
Delaware	M. Dibona[b]
Maryland	L. Hindman[b], T. Decker[b], B. Evans[b], C. Harris[b], R. Hill[b], R. Norris[b], D. Price[b], G. Timko[b], D. Webster[b], B. Joyce[b], D. Heilmeier[b], and J. Wortham
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	P. Castelli[b], T. Nichols[b], A. Burnett[b], J. Garris[b], B. Kirkpatrick[d], K. Korth[b], S. Petzinger[b], J. Powers[b], S. Predl[b], L. Widjeskog[b], T. Watts[b], R. Somes[b], P. Winkler[b], K. Tinnes[b], A. Dinges[b], D,Duren[b], and P. Woerner[b]
New York	Staff of New York Department of Environmental Conservation

Pennslyvania	D. Brauning[b], M. Casalena[b], J. Dunn[b], J. Gilbert[b], 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], C. Thoma[b], S. Trusso[b], M. Weaver[b], and D. Zellner[b]
Rhode Island	J. Osenkowski[b], C. Brown[b], J. Beuth[b], and J. Brooks[b]
Vermont	B. Crenshaw[b], J. Gobeille[b], D. Sausville[b], J. Mlcuch[b], J. Buck[b], A. Alfieri[b], K. Royar[b], F. Hammond[b], D. Blodgett[b], T. Appleton[b], and J. Austin[b]
Virginia	G. Costanzo[b] and T. Bidrowski[b]

Nevada

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

Oregon

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

Washington

Air	D. Base[b], J. Bernatowicz[b], R. Finger[b], S. Fitkin[b], P. Fowler[b], J. Gallie[b], J. Heinlen[b], B. Hoenes[b], M. Livingston[b], M. Moore[b], W. Moore[b], D. Volsen[b], P. Wik[b], T. Hames[d], and R. Cline[d]

Wisconsin

Air	L. Waskow[b], P. Berringer[b], C. Cold[b], C. Kopacek[b], and C. Milestone[b]
Ground	M. Carlisle[b], J. Carstens[b], N. Christel[b], J. Christopoulos[b], C. Cole[b], G. Dunsmoor[b], E. Grossman[b], B. Groth[b], H. Halverson[b], B. Hogseth[b], J. Huff[b], D. Hutchison[b], B. Kelly[b], D. Matheys[b], R. McDonough[b], K. Morgan[b], J. Pritzl[b], J. Robaidek[b], M. Schmidt[b], M. Soergel[b], J. Wanner[b], R. Weide[b], P. Charland, G. Hamilton, A. Kitchen, J. Lutes, S. Otto, R. Samerdyke, J. Trick, and T. Walters[d]

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

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

Flyway-wide and Regional Survey Reports: R. Bergeron[a], K. Bollinger, D. Collins, L. Denlinger, J. Fischer, D. Fronczak, J. Kelley, J. Klimstra, K. Kruse, J. Leafloor[a], M. Otto, P. Padding, D. Sharp, E. Taylor and R. Trost

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

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

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

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

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

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

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

Tall Grass Prairie Population Canada Geese: K. Abraham[b], R. Alisauskas[a], G. Gilchrist[a], J. Leafloor[a], and F. Roetker

Short Grass Prairie Population Canada Geese: R. Alisauskas[a]

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

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

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

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

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

Cackling Canada Geese: K. Bollinger and C. Dau

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

Table A.2: Continued.

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

Mid-continent Population Light Geese: K. Abraham[b], R. Brook[b], G. Gilchrist[a], J. Leafloor[a], R. Rockwell[d], and F. Roetker

Western Central Flyway Population Light Geese: R. Alisauskas[a], D. Groves, and E. Mallek

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

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

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

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

Pacific Brant: B. Larned and H. Wilson

Atlantic Brant: K. Abraham[a], G. Gilchrist[a]

Western High Arctic Brant: D. Kraege[b]

Emperor Geese: K. Bollinger, C. Dau, and E. Mallek

Western Population Tundra Swans: K. Bollinger, C. Dau, and R. Stehn

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

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

B Waterfowl Breeding Population and Habitat Survey map

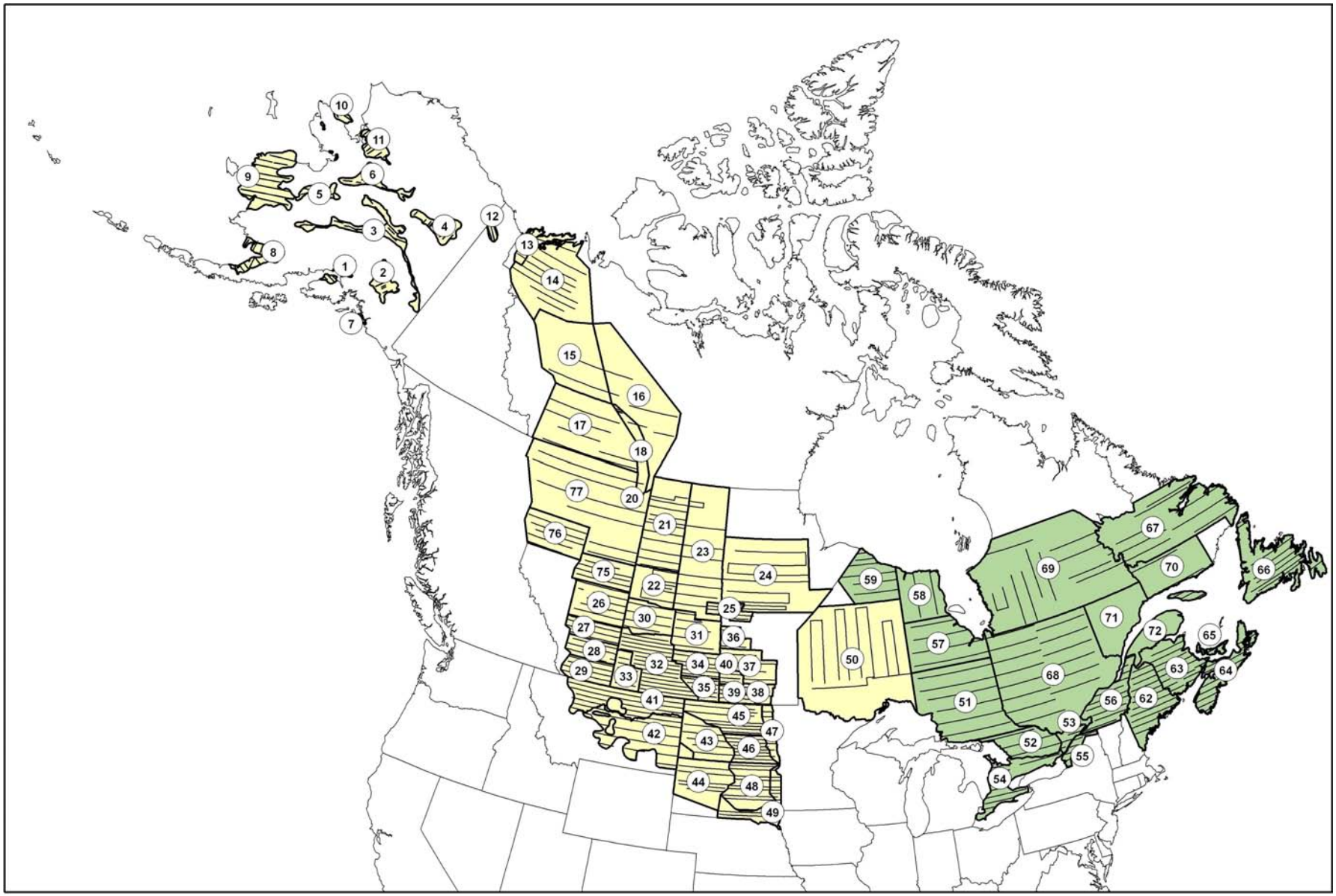


Figure B.1: Strata and transects of the Waterfowl Breeding Population and Habitat Survey (yellow = traditional survey area, green = eastern survey area).

C Historical estimates of May ponds and regional waterfowl populations

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

	Prairie Canada		Northcentral U.S.[a]		Total	
Year	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$
1961	1977.20	165.40				
1962	2369.10	184.60				
1963	2482.00	129.30				
1964	3370.70	173.00				
1965	4378.80	212.20				
1966	4554.50	229.30				
1967	4691.20	272.10				
1968	1985.70	120.20				
1969	3547.60	221.90				
1970	4875.00	251.20				
1971	4053.40	200.40				
1972	4009.20	250.90				
1973	2949.50	197.60				
1974	6390.10	308.30	1840.80	197.20	8230.90	366.00
1975	5320.10	271.30	1910.80	116.10	7230.90	295.10
1976	4598.80	197.10	1391.50	99.20	5990.30	220.70
1977	2277.90	120.70	771.10	51.10	3049.10	131.10
1978	3622.10	158.00	1590.40	81.70	5212.40	177.90
1979	4858.90	252.00	1522.20	70.90	6381.10	261.80
1980	2140.90	107.70	761.40	35.80	2902.30	113.50
1981	1443.00	75.30	682.80	34.00	2125.80	82.60
1982	3184.90	178.60	1458.00	86.40	4642.80	198.40
1983	3905.70	208.20	1259.20	68.70	5164.90	219.20
1984	2473.10	196.60	1766.20	90.80	4239.30	216.50
1985	4283.10	244.10	1326.90	74.00	5610.00	255.10
1986	4024.70	174.40	1734.80	74.40	5759.50	189.60
1987	2523.70	131.00	1347.80	46.80	3871.50	139.10
1988	2110.10	132.40	790.70	39.40	2900.80	138.10
1989	1692.70	89.10	1289.90	61.70	2982.70	108.40
1990	2817.30	138.30	691.20	45.90	3508.50	145.70

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

Table C.1: Continued.

	Prairie Canada		Northcentral U.S.		Total	
Year	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$
1991	2493.90	110.20	706.10	33.60	3200.00	115.20
1992	2783.90	141.60	825.00	30.80	3608.90	144.90
1993	2261.10	94.00	1350.60	57.10	3611.70	110.00
1994	3769.10	173.90	2215.60	88.80	5984.80	195.30
1995	3892.50	223.80	2442.90	106.80	6335.40	248.00
1996	5002.60	184.90	2479.70	135.30	7482.20	229.10
1997	5061.00	180.30	2397.20	94.40	7458.20	203.50
1998	2521.70	133.80	2065.30	89.20	4586.90	160.80
1999	3862.00	157.20	2842.20	256.80	6704.30	301.20
2000	2422.50	96.10	1524.50	99.90	3946.90	138.60
2001	2747.20	115.60	1893.20	91.50	4640.40	147.40
2002	1439.00	105.00	1281.00	63.40	2720.00	122.70
2003	3522.30	151.80	1667.80	67.40	5190.10	166.10
2004	2512.60	131.00	1407.00	101.70	3919.60	165.80
2005	3920.50	196.70	1460.70	79.70	5381.20	212.20
2006	4449.50	221.50	1644.40	85.40	6093.90	237.40
2007	5040.20	261.80	1962.50	102.50	7002.70	281.20
2008	3054.80	147.60	1376.60	71.90	4431.40	164.20
2009	3568.10	148.00	2866.00	123.10	6434.00	192.50
2010	3728.70	203.40	2936.30	142.30	6665.00	248.20

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		0.2					614.9	192.3	120.5	41.7
1988		0.6					752.8	271.7	126.5	27.8
1989		0.5					1,021.6	273.0	136.7	18.7
1990		0.5					886.8	232.1	81.4	14.7
1991		0.6					868.2	225.0	126.3	26.0
1992		0.6	497.4	375.8	665.8	384.0	1,127.3	360.9	63.4	24.4
1993		0.5	666.7	359.0	813.5	454.3	875.9	305.8	92.8	23.8
1994		0.6	483.2	311.7	848.3	440.6	1,320.1	426.5	118.9	17.5
1995		0.8	589.7	368.5	812.6	559.8	912.2	319.4	142.9	42.0

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

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
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
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	531.0	302.0	530.5	258.9	541.0	236.4		
2010	300.1	72.4	541.0	367.9	596.5	339.9	531.0	241.9		

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

Table C.2: Continued.

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

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

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

Table C.2: Continued.

	Nevada[d]		Northeast U.S.[c]		Oregon		Washington		Wisconsin	
Year	Total ducks	Mallards	Total ducks	Mallards	Total ducks	Mallards	Total ducks	Mallards	Total ducks	Mallards
1996	26.4	1.7	1,430.9	848.6	298.9	108.3	163.3	61.6	536.3	314.4
1997	25.3	2.5	1,423.5	795.2	370.9	127.7	172.8	67.0	409.3	181.0
1998	27.9	2.1	1,444.0	775.2	358.0	132.9	185.3	79.0	412.8	186.9
1999	29.9	2.3	1,522.7	880.0	334.3	133.6	200.2	86.2	476.6	248.4
2000	26.1	2.1	1,933.5	762.6	324.4	116.3	143.6	47.7	744.4	454.0
2001	22.2	2.0	1,397.4	809.4			146.4	50.5	440.1	183.5
2002	11.7	0.7	1,466.2	833.7	276.2	112.2	133.3	44.7	740.8	378.5
2003	21.1	1.7	1,266.2	731.9	258.7	96.9	127.8	39.8	533.5	261.3
2004	12.0	1.7	1,416.9	805.9	245.6	92.3	114.9	40.0	651.5	229.2
2005	10.7	0.7	1,416.2	753.6	226.1	83.5	111.5	40.8	724.3	317.2
2006	37.4	1.8	1,384.2	725.2	263.5	88.4	135.4	45.5	522.6	219.5
2007	11.4	2.1	1,500.1	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	652.6	219.9	75.1	105.0	49.2	386.5	198.2

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

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

Table C.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	8777.3	457.1	651.5	149.5	3216.8	297.8	1807.2	291.5	5305.2	567.6
1956	10452.7	461.8	772.6	142.4	3145.0	227.8	1525.3	236.2	4997.6	527.6
1957	9296.9	443.5	666.8	148.2	2919.8	291.5	1102.9	161.2	4299.5	467.3
1958	11234.2	555.6	502.0	89.6	2551.7	177.9	1347.4	212.2	5456.6	483.7
1959	9024.3	466.6	590.0	72.7	3787.7	339.2	2653.4	459.3	5099.3	332.7
1960	7371.7	354.1	784.1	68.4	2987.6	407.0	1426.9	311.0	4293.0	294.3
1961	7330.0	510.5	654.8	77.5	3048.3	319.9	1729.3	251.5	3655.3	298.7
1962	5535.9	426.9	905.1	87.0	1958.7	145.4	722.9	117.6	3011.1	209.8
1963	6748.8	326.8	1055.3	89.5	1830.8	169.9	1242.3	226.9	3723.6	323.0
1964	6063.9	385.3	873.4	73.7	2589.6	259.7	1561.3	244.7	4020.6	320.4
1965	5131.7	274.8	1260.3	114.8	2301.1	189.4	1282.0	151.0	3594.5	270.4
1966	6731.9	311.4	1680.4	132.4	2318.4	139.2	1617.3	173.6	3733.2	233.6
1967	7509.5	338.2	1384.6	97.8	2325.5	136.2	1593.7	165.7	4491.5	305.7
1968	7089.2	340.8	1949.0	213.9	2298.6	156.1	1430.9	146.6	3462.5	389.1
1969	7531.6	280.2	1573.4	100.2	2941.4	168.6	1491.0	103.5	4138.6	239.5
1970	9985.9	617.2	1608.1	123.5	3469.9	318.5	2182.5	137.7	4861.8	372.3
1971	9416.4	459.5	1605.6	123.0	3272.9	186.2	1889.3	132.9	4610.2	322.8
1972	9265.5	363.9	1622.9	120.1	3200.1	194.1	1948.2	185.8	4278.5	230.5
1973	8079.2	377.5	1245.6	90.3	2877.9	197.4	1949.2	131.9	3332.5	220.3
1974	6880.2	351.8	1592.4	128.2	2672.0	159.3	1864.5	131.2	4976.2	394.6
1975	7726.9	344.1	1643.9	109.0	2778.3	192.0	1664.8	148.1	5885.4	337.4
1976	7933.6	337.4	1244.8	85.7	2505.2	152.7	1547.5	134.0	4744.7	294.5
1977	7397.1	381.8	1299.0	126.4	2575.1	185.9	1285.8	87.9	4462.8	328.4
1978	7425.0	307.0	1558.0	92.2	3282.4	208.0	2174.2	219.1	4498.6	293.3
1979	7883.4	327.0	1757.9	121.0	3106.5	198.2	2071.7	198.5	4875.9	297.6
1980	7706.5	307.2	1392.9	98.8	3595.5	213.2	2049.9	140.7	4895.1	295.6
1981	6409.7	308.4	1395.4	120.0	2946.0	173.0	1910.5	141.7	3720.6	242.1
1982	6408.5	302.2	1633.8	126.2	2458.7	167.3	1535.7	140.2	3657.6	203.7
1983	6456.0	286.9	1519.2	144.3	2636.2	181.4	1875.0	148.0	3366.5	197.2
1984	5415.3	258.4	1515.0	125.0	3002.2	174.2	1408.2	91.5	3979.3	267.6
1985	4960.9	234.7	1303.0	98.2	2050.7	143.7	1475.4	100.3	3502.4	246.3
1986	6124.2	241.6	1547.1	107.5	1736.5	109.9	1674.9	136.1	4478.8	237.1
1987	5789.8	217.9	1305.6	97.1	2012.5	134.3	2006.2	180.4	3528.7	220.2
1988	6369.3	310.3	1349.9	121.1	2211.1	139.1	2060.8	188.3	4011.1	290.4
1989	5645.4	244.1	1414.6	106.6	1972.9	106.0	1841.7	166.4	3125.3	229.8
1990	5452.4	238.6	1672.1	135.8	1860.1	108.3	1789.5	172.7	2776.4	178.7
1991	5444.6	205.6	1583.7	111.8	2254.0	139.5	1557.8	111.3	3763.7	270.8
1992	5976.1	241.0	2032.8	143.4	2208.4	131.9	1773.1	123.7	4333.1	263.2

Table C.3: Continued.

	Mallard		Gadwall		American wigeon		Green-winged teal		Blue-winged teal	
Year	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$
1993	5708.3	208.9	1755.2	107.9	2053.0	109.3	1694.5	112.7	3192.9	205.6
1994	6980.1	282.8	2318.3	145.2	2382.2	130.3	2108.4	152.2	4616.2	259.2
1995	8269.4	287.5	2835.7	187.5	2614.5	136.3	2300.6	140.3	5140.0	253.3
1996	7941.3	262.9	2984.0	152.5	2271.7	125.4	2499.5	153.4	6407.4	353.9
1997	9939.7	308.5	3897.2	264.9	3117.6	161.6	2506.6	142.5	6124.3	330.7
1998	9640.4	301.6	3742.2	205.6	2857.7	145.3	2087.3	138.9	6398.8	332.3
1999	10805.7	344.5	3235.5	163.8	2920.1	185.5	2631.0	174.6	7149.5	364.5
2000	9470.2	290.2	3158.4	200.7	2733.1	138.8	3193.5	200.1	7431.4	425.0
2001	7904.0	226.9	2679.2	136.1	2493.5	149.6	2508.7	156.4	5757.0	288.8
2002	7503.7	246.5	2235.4	135.4	2334.4	137.9	2333.5	143.8	4206.5	227.9
2003	7949.7	267.3	2549.0	169.9	2551.4	156.9	2678.5	199.7	5518.2	312.7
2004	7425.3	282.0	2589.6	165.6	1981.3	114.9	2460.8	145.2	4073.0	238.0
2005	6755.3	280.8	2179.1	131.0	2225.1	139.2	2156.9	125.8	4585.5	236.3
2006	7276.5	223.7	2824.7	174.2	2171.2	115.7	2587.2	155.3	5859.6	303.5
2007	8307.3	285.8	3355.9	206.2	2806.8	152.0	2890.3	196.1	6707.6	362.2
2008	7723.8	256.8	2727.7	158.9	2486.6	151.3	2979.7	194.4	6640.1	337.3
2009	8512.4	248.3	3053.5	166.3	2468.6	135.4	3443.6	219.9	7383.8	396.8
2010	8430.1	284.9	2976.7	161.6	2424.6	131.5	3475.9	207.2	6328.5	382.6

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	1642.8	218.7	9775.1	656.1	539.9	98.9	589.3	87.8	5620.1	582.1
1956	1781.4	196.4	10372.8	694.4	757.3	119.3	698.5	93.3	5994.1	434.0
1957	1476.1	181.8	6606.9	493.4	509.1	95.7	626.1	94.7	5766.9	411.7
1958	1383.8	185.1	6037.9	447.9	457.1	66.2	746.8	96.1	5350.4	355.1
1959	1577.6	301.1	5872.7	371.6	498.8	55.5	488.7	50.6	7037.6	492.3
1960	1824.5	130.1	5722.2	323.2	497.8	67.0	605.7	82.4	4868.6	362.5
1961	1383.0	166.5	4218.2	496.2	323.3	38.8	435.3	65.7	5380.0	442.2
1962	1269.0	113.9	3623.5	243.1	507.5	60.0	360.2	43.8	5286.1	426.4
1963	1398.4	143.8	3846.0	255.6	413.4	61.9	506.2	74.9	5438.4	357.9
1964	1718.3	240.3	3291.2	239.4	528.1	67.3	643.6	126.9	5131.8	386.1
1965	1423.7	114.1	3591.9	221.9	599.3	77.7	522.1	52.8	4640.0	411.2
1966	2147.0	163.9	4811.9	265.6	713.1	77.6	663.1	78.0	4439.2	356.2
1967	2314.7	154.6	5277.7	341.9	735.7	79.0	502.6	45.4	4927.7	456.1
1968	1684.5	176.8	3489.4	244.6	499.4	53.6	563.7	101.3	4412.7	351.8
1969	2156.8	117.2	5903.9	296.2	633.2	53.6	503.5	53.7	5139.8	378.5
1970	2230.4	117.4	6392.0	396.7	622.3	64.3	580.1	90.4	5662.5	391.4
1971	2011.4	122.7	5847.2	368.1	534.4	57.0	450.7	55.2	5143.3	333.8
1972	2466.5	182.8	6979.0	364.5	550.9	49.4	425.9	46.0	7997.0	718.0
1973	1619.0	112.2	4356.2	267.0	500.8	57.7	620.5	89.1	6257.4	523.1
1974	2011.3	129.9	6598.2	345.8	626.3	70.8	512.8	56.8	5780.5	409.8
1975	1980.8	106.7	5900.4	267.3	831.9	93.5	595.1	56.1	6460.0	486.0
1976	1748.1	106.9	5475.6	299.2	665.9	66.3	614.4	70.1	5818.7	348.7
1977	1451.8	82.1	3926.1	246.8	634.0	79.9	664.0	74.9	6260.2	362.8
1978	1975.3	115.6	5108.2	267.8	724.6	62.2	373.2	41.5	5984.4	403.0
1979	2406.5	135.6	5376.1	274.4	697.5	63.8	582.0	59.8	7657.9	548.6
1980	1908.2	119.9	4508.1	228.6	728.4	116.7	734.6	83.8	6381.7	421.2
1981	2333.6	177.4	3479.5	260.5	594.9	62.0	620.8	59.1	5990.9	414.2
1982	2147.6	121.7	3708.8	226.6	616.9	74.2	513.3	50.9	5532.0	380.9
1983	1875.7	105.3	3510.6	178.1	711.9	83.3	526.6	58.9	7173.8	494.9
1984	1618.2	91.9	2964.8	166.8	671.3	72.0	530.1	60.1	7024.3	484.7
1985	1702.1	125.7	2515.5	143.0	578.2	67.1	375.9	42.9	5098.0	333.1
1986	2128.2	112.0	2739.7	152.1	559.6	60.5	438.3	41.5	5235.3	355.5
1987	1950.2	118.4	2628.3	159.4	502.4	54.9	450.1	77.9	4862.7	303.8
1988	1680.9	210.4	2005.5	164.0	441.9	66.2	435.0	40.2	4671.4	309.5
1989	1538.3	95.9	2111.9	181.3	510.7	58.5	477.4	48.4	4342.1	291.3
1990	1759.3	118.6	2256.6	183.3	480.9	48.2	539.3	60.3	4293.1	264.9
1991	1716.2	104.6	1803.4	131.3	445.6	42.1	491.2	66.4	5254.9	364.9
1992	1954.4	132.1	2098.1	161.0	595.6	69.7	481.5	97.3	4639.2	291.9
1993	2046.5	114.3	2053.4	124.2	485.4	53.1	472.1	67.6	4080.1	249.4

Table C.3: Continued.

	Northern shoveler		Northern pintail		Redhead		Canvasback		Scaup	
Year	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$
1994	2912.0	141.4	2972.3	188.0	653.5	66.7	525.6	71.1	4529.0	253.6
1995	2854.9	150.3	2757.9	177.6	888.5	90.6	770.6	92.2	4446.4	277.6
1996	3449.0	165.7	2735.9	147.5	834.2	83.1	848.5	118.3	4217.4	234.5
1997	4120.4	194.0	3558.0	194.2	918.3	77.2	688.8	57.2	4112.3	224.2
1998	3183.2	156.5	2520.6	136.8	1005.1	122.9	685.9	63.8	3471.9	191.2
1999	3889.5	202.1	3057.9	230.5	973.4	69.5	716.0	79.1	4411.7	227.9
2000	3520.7	197.9	2907.6	170.5	926.3	78.1	706.8	81.0	4026.3	205.3
2001	3313.5	166.8	3296.0	266.6	712.0	70.2	579.8	52.7	3694.0	214.9
2002	2318.2	125.6	1789.7	125.2	564.8	69.0	486.6	43.8	3524.1	210.3
2003	3619.6	221.4	2558.2	174.8	636.8	56.6	557.6	48.0	3734.4	225.5
2004	2810.4	163.9	2184.6	155.2	605.3	51.5	617.2	64.6	3807.2	202.3
2005	3591.5	178.6	2560.5	146.8	592.3	51.7	520.6	52.9	3386.9	196.4
2006	3680.2	236.5	3386.4	198.7	916.3	86.1	691.0	69.6	3246.7	166.9
2007	4552.8	247.5	3335.3	160.4	1009.0	84.7	864.9	86.2	3452.2	195.3
2008	3507.8	168.4	2612.8	143.0	1056.0	120.4	488.7	45.4	3738.3	220.1
2009	4376.3	224.1	3225.0	166.9	1044.1	106.3	662.1	57.4	4172.1	232.3
2010	4057.4	198.4	3508.6	216.4	1064.2	99.5	585.2	50.8	4244.4	247.9

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

[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.4: Continued.

	Traditional Survey Area[a]	
Year	$\widehat{N}$	$\widehat{SE}$
1991	26,605.6	588.7
1992	29,417.9	605.6
1993	26,312.4	493.9
1994	32,523.5	598.2
1995	35,869.6	629.4
1996	37,753.0	779.6
1997	42,556.3	718.9
1998	39,081.9	652.0
1999	43,435.8	733.9
2000	41,838.3	740.2
2001	36,177.5	633.1
2002	31,181.1	547.8
2003	36,225.1	664.7
2004	32,164.0	579.8
2005	31,734.9	555.2
2006	36,160.3	614.4
2007	41,172.2	724.8
2008	37,276.5	638.3
2009	42,004.8	701.9
2010	40,893.1	718.4

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

Table C.5: Breeding population estimates and 90% confidence intervals or credible intervals (CIs; in thousands) for the 10 most abundant species of ducks in the eastern survey area, 1990–2010[a].

	Mergansers[b]		Mallard		American black duck		American wigeon		Green-winged teal	
Year	$\widehat{N}$	90% CI	$\widehat{N}$	90% CI	$\widehat{N}$	90% CI	$\widehat{N}$	90% CI	$\widehat{N}$	90% CI
1990	378.7	(317.3, 458.5)	350.6	(226.5, 589.4)	441.6	(390.1, 503.9)	13.5	(1.4, 25.7)	240.4	(188.3, 317.5)
1991	472.4	(391.9, 582.7)	396.9	(258.1, 658.2)	449.4	(393.3, 520.4)	15.2	(2.1, 28.3)	229.1	(178.5, 305.3)
1992	462.8	(375.3, 589.3)	397.6	(256.5, 664.1)	423.7	(372.2, 486.1)	5.1	(0.5, 9.7)	216.7	(167.3, 287.8)
1993	434.7	(354.9, 543.9)	402.5	(261.3, 668.3)	422.3	(368.6, 485.4)	10.4	(3.4, 17.5)	195.7	(148.6, 261.4)
1994	449.2	(356.7, 599.8)	419.9	(270.4, 696.9)	383.4	(334.8, 441.7)	10.2	(2.4, 18.1)	206.6	(158.4, 279.7)
1995	503.1	(402.8, 649.3)	348.4	(223.4, 590.3)	440.6	(384.2, 508.8)	9.5	(0.0, 21.4)	211.9	(161.6, 285.8)
1996	423.2	(355.4, 512.2)	376.3	(242.5, 629.7)	511.5	(455.1, 579.1)	10.0	(3.8, 16.3)	279.5	(221.1, 365.8)
1997	437.5	(366.6, 530.1)	399.4	(257.3, 670.5)	456.4	(408.5, 513.0)	18.2	(10.2, 26.2)	217.2	(170.1, 284.0)
1998	352.5	(295.5, 426.5)	442.2	(289.5, 726.2)	491.8	(440.4, 551.3)	58.1	(21.8, 94.5)	207.6	(163.5, 269.9)
1999	423.3	(352.3, 517.9)	451.2	(296.3, 739.0)	551.1	(492.7, 620.5)	14.1	(10.1, 18.1)	234.2	(184.5, 306.7)
2000	433.8	(364.5, 523.2)	401.9	(265.2, 666.8)	507.2	(454.6, 569.5)	38.1	(6.0, 70.2)	269.4	(214.6, 344.7)
2001	411.8	(346.1, 496.2)	436.7	(288.4, 716.8)	475.9	(425.9, 534.7)	43.9	(24.5, 63.3)	221.6	(174.8, 286.6)
2002	551.3	(461.5, 666.0)	429.1	(283.2, 701.7)	529.6	(474.9, 594.1)	13.1	(4.7, 21.4)	257.8	(204.3, 336.1)
2003	486.4	(406.2, 593.0)	448.3	(295.0, 742.5)	482.7	(432.0, 542.9)	11.6	(3.4, 19.8)	253.3	(199.9, 332.0)
2004	502.7	(423.1, 603.4)	472.3	(312.2, 768.1)	494.4	(442.1, 557.0)	22.8	(11.0, 34.5)	288.0	(227.6, 376.9)
2005	480.6	(401.5, 585.6)	459.5	(299.2, 760.0)	483.2	(431.3, 546.2)	31.1	(17.6, 44.7)	233.5	(184.5, 303.4)
2006	434.6	(365.2, 525.0)	426.3	(281.6, 696.6)	500.7	(448.0, 562.6)	11.5	(5.2, 17.8)	239.4	(188.5, 314.7)
2007	471.6	(392.6, 576.3)	468.5	(308.5, 766.0)	572.2	(508.8, 647.6)	14.0	(5.0, 23.0)	268.5	(212.2, 350.1)
2008	448.9	(377.5, 542.8)	462.3	(305.0, 749.3)	494.6	(442.9, 556.3)	8.4	(2.5, 14.4)	281.0	(214.3, 392.1)
2009	457.1	(384.4, 551.3)	488.2	(322.8, 792.6)	465.8	(416.2, 524.3)	12.0	(6.0, 18.0)	273.8	(213.1, 367.9)
2010	386.4	(324.4, 465.9)	402.9	(265.5, 666.4)	444.2	(397.1, 498.2)	7.3	(1.1, 13.4)	256.1	(202.9, 332.8)

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

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

Table C.5: Continued

	Scaup[c]		Ring-necked duck		Goldeneyes[d]		Bufflehead		Scoters[e]	
Year	$\widehat{N}$	90% CI	$\widehat{N}$	90% CI	$\widehat{N}$	90% CI	$\widehat{N}$	90% CI	$\widehat{N}$	90% CI
1990	64.0	(12.0, 116.0)	530.7	(420.8, 688.5)	370.9	(290.7, 492.7)	35.5	(23.4, 47.6)	99.5	(0.1, 199.5)
1991	39.7	(17.8, 61.5)	469.2	(373.5, 606.7)	385.4	(302.2, 510.4)	28.4	(14.9, 41.9)	89.8	(24.7, 154.9)
1992	50.7	(14.7, 86.8)	471.4	(375.6, 605.7)	398.5	(313.0, 530.4)	45.3	(27.3, 63.2)	85.2	(0.1, 190.7)
1993	16.9	(6.2, 27.7)	428.5	(342.0, 552.0)	384.4	(299.4, 512.6)	6.6	(3.0, 10.3)	104.4	(18.3, 190.5)
1994	52.3	(16.0, 88.5)	446.8	(353.9, 579.3)	396.2	(308.8, 524.7)	24.3	(7.5, 41.2)	162.2	(38.6, 285.9)
1995	22.8	(3.6, 42.1)	463.4	(366.2, 607.1)	352.8	(272.8, 472.5)	10.3	(4.2, 16.4)	25.9	(7.8, 44.1)
1996	34.5	(12.0, 57.0)	570.9	(458.1, 732.3)	418.7	(327.4, 555.0)	36.1	(23.1, 49.1)	31.6	(16.2, 47.0)
1997	51.9	(15.7, 88.1)	508.2	(408.4, 650.6)	421.6	(328.9, 557.4)	15.3	(8.1, 22.5)	52.6	(28.7, 76.5)
1998	9.6	(2.3, 16.8)	449.1	(359.6, 575.8)	371.8	(291.7, 493.7)	26.8	(19.3, 34.3)	58.9	(35.3, 82.6)
1999	25.4	(5.0, 45.8)	520.1	(419.1, 663.9)	449.6	(348.3, 605.7)	15.0	(9.3, 20.7)	24.2	(8.7, 39.7)
2000	65.9	(39.6, 92.2)	557.8	(446.9, 718.2)	431.8	(336.2, 578.5)	15.9	(9.4, 22.4)	51.7	(28.9, 74.4)
2001	137.9	(0.3, 286.3)	501.8	(403.6, 643.1)	502.1	(390.4, 670.7)	40.4	(24.4, 56.5)	57.1	(28.5, 85.7)
2002	69.2	(0.3, 151.3)	491.5	(394.2, 632.0)	555.1	(421.4, 769.1)	53.2	(35.9, 70.4)	202.1	(0.6, 469.6)
2003	38.8	(12.1, 65.4)	521.4	(419.6, 668.5)	424.7	(331.7, 563.3)	18.9	(11.9, 26.0)	73.4	(27.3, 119.5)
2004	27.0	(9.9, 44.1)	574.0	(459.0, 746.2)	420.2	(331.5, 552.8)	17.3	(10.1, 24.6)	103.3	(57.3, 149.2)
2005	32.8	(16.0, 49.7)	521.7	(421.0, 663.0)	388.0	(305.0, 512.4)	18.8	(8.9, 28.8)	74.8	(45.6, 104.1)
2006	13.6	(7.0, 20.2)	538.6	(433.3, 688.8)	385.9	(303.5, 509.2)	15.1	(9.1, 21.1)	78.8	(27.6, 130.1)
2007	34.6	(20.1, 49.1)	661.0	(528.1, 850.4)	457.9	(356.7, 610.6)	15.7	(8.8, 22.6)	103.2	(40.7, 165.7)
2008	35.3	(24.2, 46.4)	534.7	(429.7, 682.0)	431.1	(336.2, 573.8)	30.2	(19.5, 40.9)	85.6	(56.0, 115.2)
2009	53.9	(31.5, 76.3)	542.1	(433.9, 699.8)	400.3	(312.5, 533.2)	26.9	(18.6, 35.2)	101.4	(62.2, 140.7)
2010	51.1	(33.4, 68.8)	566.6	(448.7, 741.9)	394.9	(307.2, 528.2)	25.4	(18.4, 32.4)	74.9	(43.5, 106.4)

[c] Greater and lesser.

[d] Common and Barrow's.

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

D Historical estimates of goose and swan populations

Table D.1: Abundance indices (in thousands) for North American Canada goose populations, 1969–2010.

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	1037.3	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	1140.5	99.3
1998/99	96.8	77.5		108.1	465.5	1163.3	139.5
1999/00	58.0	93.2		78.7	352.6	1436.7	130.0
2000/01	57.8	146.7		68.4	325.4	1296.3	122.2
2001/02	62.0	164.8		55.2	286.5	1415.2	152.0
2002/03	60.8	156.9	1126.7	90.2	360.1	1416.3	122.4
2003/04	67.8	174.8	1048.7	75.2	276.3	1430.4	145.5
2004/05	51.3	162.4	1167.1	42.2	344.9	1367.0	161.6
2005/06	49.2	160.2	1144.0	128.9	384.4	1575.2	134.8
2006/07	69.9	195.7	1128.0	64.8	402.6	1454.7	153.4
2007/08	41.9	169.7	1024.9	92.3	305.2	1459.8	161.1
2008/09	53.7	176.1	1006.1	69.2	239.6	1463.7	169.2
2009/10	54.6	154.0	969.9	76.4	339.3	1608.1	172.6

[a] Surveys conducted in spring.

[b] Number of breeding pairs.

Table D.1: Continued

Year	W. Prairie & Great Plains[b]	Tall Grass Prairie[b,c]	Short Grass Prairie[d]	Hi-line[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		32.1	4.2
1985/86	115.0	189.4	181.0	101.8	68.4	17.1	51.4	4.3
1986/87	324.0	159.0	190.9	95.4	70.4	15.8	54.8	5.0
1987/88	272.1	306.1	139.1	131.3	107.0	16.0	69.9	5.4
1988/89	330.3	213.0	284.8	124.8	95.0	17.4	76.8	5.8
1989/90	271.0	146.5	378.1	185.8	91.5	16.3	110.2	6.3
1990/91	390.0	305.1	508.5	148.3	85.6	10.7	104.6	7.0
1991/92	341.9	276.3	620.2	168.0	102.1	17.8	149.3	7.7
1992/93	318.0	235.3	328.2	158.0	116.4	16.5	164.3	11.7
1993/94	272.5	224.2	434.1	160.9	138.5	16.3	152.5	15.7
1994/95	352.5	245.0	697.8	234.6	148.2	12.1	161.4	19.2
1995/96	403.3	264.0	561.2	200.5	145.7	12.0	134.6	20.9
1996/97	453.4	262.9	460.7	208.0	103.5	13.5	205.1	20.2
1997/98	482.3	331.8	440.6	257.7	146.7	14.5	148.6	32.6
1998/99	467.2	548.2	403.2	204.5	164.6	10.5	169.6	38.9
1999/00	594.7	295.7	200.0	287.7	180.8	10.3	175.0	34.6
2000/01	682.7	149.1	164.1	261.9	177.4	11.1	176.2	
2001/02	710.3	504.7	160.9	239.0	149.8	12.4	127.9	
2002/03	561.0	611.9	156.7	239.1	147.7	9.8	165.2	76.1
2003/04	622.1	458.7	203.6	208.4	164.2	11.2	130.2	115.2
2004/05	415.1	400.8	177.2	245.4	165.7	16.1	156.9	90.8
2005/06	444.4	499.8	234.7	217.6	146.0	12.1	169.3	110.0
2006/07	446.0	680.3	190.5	309.5	150.9	10.2	173.4	110.0
2007/08	669.5	402.7	212.4	348.2	218.6	9.1	193.3	110.8
2008/09	628.0	309.9	220.3	306.7	129.7	6.7	160.6	83.3
2009/10	462.8	417.0	290.7	277.6	148.9	9.5	188.6	126.4

[a] Surveys conducted in spring.

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

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

[d] Surveys conducted in January.

[e] Indirect or preliminary estimate.

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

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

	Snow and Ross' geese				White-fronted geese		Emperor geese[a]
Year	Greater snow geese[a]	Mid-continent[b]	Western Central Flyway[c]	Western Arctic & Wrangel Isl.[d]	Mid-continent[d]	Pacific[e]	
1969/70	89.6	777.0	6.9				
1970/71	123.3	1,070.2	11.1				
1971/72	134.8	1,313.4	13.0				
1972/73	143.0	1,025.3	11.6				
1973/74	165.0	1,189.8	16.2				
1974/75	153.8	1,096.6	26.4				
1975/76	165.6	1,562.4	23.2				
1976/77	160.0	1,150.3	33.6				
1977/78	192.6	1,966.4	31.1				
1978/79	170.1	1,285.7	28.2			73.1	
1979/80	180.0	1,398.1	30.4	528.1		93.5	
1980/81	170.8	1,406.7	37.6	204.2		116.5	93.3
1981/82	163.0	1,794.1	50.0	759.9		91.7	100.6
1982/83	185.0	1,755.5	76.1	354.1		112.9	79.2
1983/84	225.4	1,494.5	43.0	547.6		100.2	71.2
1984/85	260.0	1,973.0	62.9	466.3		93.8	58.8
1985/86	303.5	1,449.4	96.6	549.8		107.1	42.0
1986/87	255.0	1,913.8	63.5	521.7		130.6	51.7
1987/88		1,750.7	46.2	525.3		161.5	53.8
1988/89	363.2	1,956.2	67.6	441.0		218.8	45.8
1989/90	368.3	1,724.3	38.7	463.9		240.8	67.6
1990/91	352.6	2,135.8	104.6	708.5		236.5	71.0
1991/92	448.1	2,021.9	87.9	690.1		230.9	71.3
1992/93	498.4	1,744.1	45.1	639.3	622.9	295.1	52.5
1993/94	591.4	2,200.8	84.9	569.2	676.3	324.8	57.3
1994/95	616.6	2,725.1	80.1	478.2	727.3	277.5	51.2
1995/96	669.1	2,398.1	93.1	501.9	1,129.4	344.1	80.3
1996/97	657.5	2,957.7	127.2	366.3	742.5	319.0	57.1
1997/98	836.6	3,022.2	103.5	416.4	622.2	413.1	39.7
1998/99	803.4	2,575.7	236.4	354.3	1,058.3	393.4	54.6
1999/00	813.9	2,397.3	137.5	579.0	963.1	352.7	62.6
2000/01	837.4	2,341.3	105.8	656.8	1,067.6	438.9	84.4
2001/02	639.3	2,696.1	99.9	448.1	712.3	359.7	58.7
2002/03	678.0	2,435.0	105.9	596.9	637.2	422.0	71.2
2003/04	957.6	2,214.3[f]	135.4	587.8	528.2	374.9	47.4
2004/05	814.6	2,344.2	143.0	750.3	644.3	443.9	54.0
2005/06	1,017.0	2,221.7	140.6	710.7	522.8	509.3	76.0
2006/07	1,019.0	2,917.1	170.6	799.7	751.3	604.7	77.5
2007/08	947.0	2,455.1	188.5	1,073.5	764.3	627.0	64.9
2008/09	1,428.0	2,753.4	284.4	957.4	751.7	536.7	91.9
2009/10	814.0	2,657.5	238.1	901.0	583.2	649.8	64.6

[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, 1969–2010.

	Brant			Tundra swans	
Year	Atlantic	Pacific[a]	Western High Arctic	Western	Eastern
1969/70		136.6	5.1	31.0	
1970/71	151.0	141.1	8.1	98.8	
1971/72	73.2	121.8	3.0	82.8	
1972/73	40.8	122.4	2.7	33.9	
1973/74	87.7	128.0	2.7	69.7	
1974/75	88.4	119.7	3.7	54.3	
1975/76	127.0	117.1	5.0	51.4	
1976/77	73.6	136.1	10.9	47.3	
1977/78	42.8	151.5	11.4	45.6	
1978/79	43.5	126.2	3.2	53.5	
1979/80	69.2	141.3	5.1	65.2	
1980/81	97.0	186.1	8.1	83.6	
1981/82	104.5	117.1	4.0	91.3	73.2
1982/83	123.5	107.2	2.1	67.3	87.5
1983/84	127.3	128.4	5.1	61.9	81.4
1984/85	146.3	136.0	8.8	48.8	96.9
1985/86	110.4	126.9	9.4	66.2	90.9
1986/87	109.4	98.5	10.4	52.8	95.8
1987/88	131.2	131.6	15.3	59.2	78.7
1988/89	138.0	120.9	14.3	78.7	91.3
1989/90	135.4	141.1	10.5	40.1	90.6
1990/91	147.7	119.5	12.2	47.6	98.2
1991/92	184.8	108.2	9.5	63.7	113.0
1992/93	100.6	113.6	10.8	62.6[b]	78.2
1993/94	157.2	118.8	11.2	79.4	84.8
1994/95	148.2	116.8	16.9	52.9[b]	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

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

Table D.3: Continued.

	Brant			Tundra swans	
Year	Atlantic	Pacific[a]	Western High Arctic	Western	Eastern
2000/01	145.3	119.9	4.9	87.3	98.4
2001/02	181.6	127.8	9.0	58.7	114.7
2002/03	164.5	101.7	4.9	102.7	111.7
2003/04	129.6	111.5	7.7	83.0	110.8
2004/05	123.2	101.4	10.0	92.1	72.5
2005/06	146.6	133.9	9.5	106.9	81.3
2006/07	150.6	133.9	6.1	109.4	114.4
2007/08	161.6	147.4	9.2	89.7	96.2
2008/09	151.3		16.2	105.2	100.2
2009/10	139.7	143.9	6.0	76.7[b]	97.3

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

[b] Incomplete or preliminary.

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