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Waterfowl Population Status, 2008

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Waterfowl

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In North America the process of establishing hunting regulations for waterfowl is conducted annually. In the United States the process involves a number of scheduled meetings in which information regarding the status of waterfowl is presented to individuals within the agencies responsible for setting hunting regulations. In addition the proposed regulations are published in the Federal Register to allow public comment. This report includes the most current breeding population and production information available for waterfowl in North America and is a result of cooperative efforts by the U.S. Fish 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 2008-2009 hunting season.

Cover: 2008-2009 Duck stamp. Northern pintails by Joe Hautman, winner of the 75th Anniversary Federal Duck Stamp Design competition.

ACKNOWLEDGEMENTS

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. Some habitat and weather information was taken from the NOAA/USDA Joint Agriculture Weather Facility (http://www.cpc.ncep.noaa.gov/index.html), Environment Canada (http://www.pnr-rpn.ec.gc.ca/index.en.html), and Migratory Bird Population Surveys Branch reports under Waterfowl Population Surveys on the Division of Migratory Bird Management's home page (http://migratorybirds.fws.gov/reports/reports.html). Appendix A provides a list of individuals responsible for the collection and compilation of data for the "Status of Ducks" section of this report. Appendix B 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 Pamela Garrettson, Timothy Moser, Nathan Zimpfer, and Kathy Fleming. The authors compiled information from the numerous sources to provide an assessment of the status of waterfowl populations.

Report Preparation: The preparation of this report involved substantial efforts on the part of many individuals. Support for the processing of data and publication was provided by Emily Silverman, Guthrie Zimmerman, and John Sauer. Ray Bentley, John Bidwell, Karen Bollinger, Dale Caswell, Carl Ferguson, Kathy Fleming, Elizabeth Huggins, Mark Koneff, Ed Mallek, Dan Nieman, Fred Roetker, John Solberg, Phil Thorpe, Jim Bredy, and James Wortham provided habitat narratives, reviewed portions of the report that addressed major breeding areas, and provided helpful comments. Dale Caswell, Kathy Dickson, Rebecca Rau, Khristi Wilkins, Robert Raftovich, Emily Silverman, and Guthrie Zimmerman provided helpful comments on earlier drafts. Kathy Fleming provided the survey area map, and the colorized revisions to the goose and swan range maps.

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STATUS OF DUCKS

Abstract: In the Waterfowl Breeding Population and Habitat Survey traditional survey area (strata 1–18, 20–50, and 75–77), the total duck population estimate was 37.3 ± 0.6 [SE] million birds. This was 9% lower than last year's estimate of 41.2 ± 0.7 million birds, but 11% above the 1955-2007 long-term average. Mallard (*Anas platyrhynchos*) abundance was 7.7 ± 0.3 million birds, similar to last year's estimate of 8.3 ± 0.3 million birds and to the long-term average. Blue-winged teal (*A. discors*) estimated abundance was 6.6 ± 0.3 million birds similar to last year's estimate of 6.7 ± 0.4 million birds, and 45% above the long-term average. Estimated abundances of gadwall (*A. strepera*; 2.7 ± 0.2 million) and northern shovelers (*A. clypeata*; 3.5 ± 0.2 million) were lower than those of last year (−19% and −23%, respectively), but both remained 56% above their long-term averages. Estimated abundance of American wigeon (*A. americana*; 2.5 ± 0.2 million) was similar to the 2007 estimate and the long-term average. Estimated abundances of green-winged teal (*A. crecca*; 3.0 ± 0.2 million) and redheads (*Aythya americana*; 1.1 ± 0.1 million) were similar to last year's, but were each >50% above their long-term averages. The redhead and green-winged teal estimates were the highest and the second highest ever for the traditional survey area. The canvasback (*A. valisineria*) estimate of 0.5 ± 0.05 million was down 44% relative to 2007's record high, and 14% below the long-term average. Northern pintails (*Anas acuta*; 2.6 ± 0.1 million) were 22% below last year's estimate and 36% below their long-term average. The scaup (*Aythya affinis* and *A. marila* combined; 3.7 ± 0.2 million) estimate was similar to that of 2007, and remained 27% below the long-term average. Habitat conditions during the 2008 Waterfowl Breeding Population and Habitat Survey were characterized in many areas by a delayed spring compared to several preceding years. Drought in many parts of the traditional survey area contrasted sharply with record snow and rainfall in the eastern survey area. The total pond estimate (Prairie Canada and U.S. combined) was 4.4 ± 0.2 million ponds, 37% below last year's estimate of 7.0 ± 0.3 million ponds and 10% lower than the long-term average of 4.9 ± 0.03 million ponds. The 2008 estimate of ponds in Prairie Canada was 3.1 ± 0.1 million. This was a 39% decrease from last year's estimate (5.0 ± 0.3 million), and 11% below the 1955-2007 average (3.4 ± 0.03 million). The 2008 pond estimate for the north-central U.S. (1.4 ± 0.1 million) was 30% lower than last year's estimate (2.0 ± 0.1 million) and 11% below the long-term average (1.5 ± 0.02 million). The projected mallard fall-flight index was 9.2 ± 0.8 million, similar to the 2007 estimate of 10.9 ± 1.0 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 (*B. albeola*), American black duck (*A. rubripes*), ring-necked duck (*Aythya collaris*), mergansers (red-breasted [*Mergus serrator*], common [*M. merganser*], and hooded [*Lophodytes cucullatus*]), and goldeneye (common [*Bucephala clangula*] and Barrow's [*B. islandica*]) all were similar to their 2007 estimates and long-term averages.

This section summarizes the most recent information about the status of North American duck populations and their habitats to facilitate the development of harvest regulations. The annual status of these populations is assessed using the databases resulting from surveys which include estimates of the size of breeding populations, production, and harvest. This report details abundance estimates and production outlooks; 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 fixed-wing aircraft 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 includes approximately 1.3 million square miles (Appendix C). 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 C).

In prairie and parkland Canada and the north-central U.S., aerial waterfowl counts are corrected annually for visibility bias by conducting ground counts. In the northern portions of the traditional survey area and the eastern survey area, duck estimates are adjusted using visibility correction factors derived from a comparison of airplane and helicopter counts. Annual estimates of duck abundance are available since 1955 for the traditional survey area and since 1996 for all strata (except 57–59, and 69) in the eastern survey area. However, portions of the eastern survey area have been surveyed since 1990. In the traditional survey area, estimates of pond abundance in Prairie Canada are available since 1961 and in the northcentral U.S. since 1974. Several provinces and states also conduct breeding waterfowl surveys using various methods; some have survey designs that allow calculation of measures of precision for their estimates. Information about habitat conditions was supplied primarily by biologists working in the survey areas. However, much ancillary weather information was obtained from agricultural and weather internet sites (see references). Unless otherwise noted, z-tests were used for assessing statistical significance, with alpha levels set at 0.1; P-values are given in tables along with wetland and waterfowl estimates.

Since 1990, the U.S. Fish and Wildlife Service (USFWS) has conducted aerial transect surveys using fixed-wing aircraft in eastern Canada and the northeast U.S., similar to those in the mid-continent in order to estimate waterfowl abundance. Additionally, the Canadian Wildlife Service (CWS) has conducted a helicopter-based aerial plot survey in core American black duck breeding regions of Ontario, Quebec, and the Atlantic Provinces. Historically, data from these surveys were analyzed separately, despite overlap in geographic areas of inference. In 2004, the USFWS and CWS agreed to integrate the two surveys, produce composite estimates from both sets of survey data, and expand the geographic scope of the survey in eastern North America.

Consequently, as of 2005, waterfowl population sizes for eastern North America (strata 51–72) are estimated using a hierarchical modeling approach that combines USFWS and CWS data. For strata containing both CWS and USFWS surveys (51, 52, 63, 64, 66, 67, 68, and 70), USFWS estimates were visibility-adjusted by CWS plot estimates, and then averaged to derive stratum-level estimates. Traditional visibility correction factors were used in strata with only USFWS survey estimates (53, 54, 56, 57, 58, 59, 62, 65, and 69), whereas no 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, and goldeneyes), estimates were produced for multi-species groupings in 2008. 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 coincide with the geographic extent of the CWS helicopter plot survey, which is overlapped by the USFWS fixed-wing survey with the exceptions of strata 71 and 72 where only plots occur.

For widely-distributed and abundant species (American black ducks, mallards, green-winged teal, ring-necked duck, goldeneyes and mergansers), composite estimates of population size were constructed using a hierarchical model (Link and Sauer 2002). The model estimated the mean count per unit area surveyed for each stratum, year, and method (i.e., fixed-wing 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 fixed-wing surveys were adjusted for visibility bias by multiplying them by the total CWS helicopter survey population estimates for all years divided by the total USFWS fixed-wing survey population estimates for all years. The composite estimate was calculated as the average of the CWS estimate and adjusted USFWS estimate to provide estimated total indicated birds for each stratum and year. For two species groups, goldeneyes and mergansers, for which there are many survey units with no observations, a zero-inflated Poisson distribution (Martin et al. 2005) was used to fit the model. Using this technique, the binomial probability of encountering the species on a transect or a plot is modeled separately. This step may not be necessary in the future as more years are added to the time series. 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, and American wigeon); estimates for these species were the means of CWS and visibility-adjusted FWS 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 were calculated using the CWS method of scaling observed pairs. Observed black duck pairs were scaled by 1.5 rather than the 1.0 scaling traditionally applied by the USFWS. Total indicated birds is estimated using the conventional definition applied by the USFWS. Only estimates based on total indicated birds are presented in this report. 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 other species, the standard USFWS definition of total indicated birds was used.

This model-based approach and changes in analytical procedures for some species preclude comparisons of 2008 results to 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

For the past five years, we have had no traditional Waterfowl Production and Habitat Survey (conducted in July) to verify the early predictions of our biologists in the field, due to budget constraints within the migratory bird program and modern analytical procedures which reduced the utility of brood indices produced by this survey. However, pilot-biologists returned to several survey areas (southern Alberta, southern Manitoba, southern Saskatchewan, the Dakotas, and Montana) in early July for a brief flight over representative portions of these regions as a rough assessment of habitat changes since May and expected duck production. This information, along with reports from local biologists in the field, helped formulate an overall perspective on duck production this year.

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, in 2008, the status of western mallards will be considered separately in setting regulations for the Pacific Flyway, and thus Alaska 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 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 2008).

Review of Estimation Procedures

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

RESULTS AND DISCUSSION

2007 in Review

Overall, habitat conditions for breeding waterfowl in 2007 were similar or slightly improved compared to conditions in 2006. The total pond estimate (Prairie Canada and U.S. combined) was 7.0 ± 0.3 million ponds. That was 15% greater than the 2006 estimate of 6.1 ± 0.2 million ponds and 44% higher than the long-term average of 4.9 ± 0.03 million ponds. For the third year in a row, habitat conditions were good or excellent in the northern grasslands and parklands of southern Saskatchewan and southern Manitoba.

Three years of plentiful precipitation had generally maintained or improved the quality of the wetland and upland vegetation in this region. The 2007 estimate of ponds in Prairie Canada was 5.0 ± 0.3 million, which was a 13% increase over the 2006 estimate (4.4 ± 0.2 million), 49% above the 1955-2006 average (3.4 ± 0.03 million), and the fourth highest number of Canadian ponds on record. However, some areas of the parklands in southern Saskatchewan experienced severe flooding due to record-high spring runoff. The southern grasslands of Saskatchewan and Manitoba remained dry, and were in fair-to-poor condition in 2007. Conditions in southern Alberta, which had generally been either fair or poor for much of the prior decade, improved for the second consecutive year, largely due to melting of large snow packs.

Habitat conditions in U.S. prairies were highly variable, and ranged from good to poor. The 2007 pond estimate for the north-central U.S. of 2.0 ± 0.1 million was 19% greater than the 2006 estimate (1.6 ± 0.09 million) and 29% above the long-term average of 1.5 ± 0.02 million. The drought conditions seen in 2006 in the eastern Dakotas had been improved by abundant fall and winter precipitation, especially in eastern South Dakota. Exceptionally heavy rain during May of 2007 helped to improve conditions in eastern Montana and parts of the Dakotas. Unfortunately, the area affected by this rain did not include the high quality duck habitat of the Missouri Coteau region in the eastern Dakotas. Although this precipitation occurred after many ducks had moved through the survey area, it probably benefited renesting birds and improved vegetation quality in wetlands and uplands, thereby aiding brood survival in the summer of 2007.

Habitat in the bush regions of the traditional survey area (Alaska, northern Manitoba, northern Saskatchewan, western Ontario) was largely classified as good during 2007 due to a normal spring ice breakup and generally good water conditions in the beaver ponds, river deltas, and small lakes and ponds characteristic of this region. Western Ontario was rated excellent over the northern two-thirds of the region. Spring phenology and water levels varied slightly in local areas. For example, in 2007, spring was slightly late in the Old Crow Flats, slightly early in the Yukon Delta, and slightly drier in the Yukon Flats compared to other regions in Alaska, but habitat conditions were still generally good across the bush region. Exceptions were the somewhat drier conditions in northwest Saskatchewan and central Alberta and the potential for some flooding in northern Saskatchewan and Manitoba.

The boreal forests of the eastern survey area were generally in good or excellent condition during the spring of 2007, except for a few drier patches in northern Quebec that were in fair condition. Spring had arrived early in the James and Hudson Bay Lowlands for the third consecutive year, and habitat conditions were classified as excellent. In eastern and southern Ontario, the winter snowpack was below normal; however, a good frost seal, spring runoff, and spring storms left this region in good condition at the time of the 2007 survey. Storms following the survey period produced local flooding of some nesting habitat. Wetland basins in Quebec were adequately charged and spring temperatures were near normal. There was some potential for flooding of nests in Maine and the Maritimes due to heavy rain during mid-May, but this was not as problematic as it had been during the previous few years. Newfoundland and Labrador experienced a late spring in 2007 relative to the five years prior, and the northernmost part of the survey region in Labrador was still frozen as of late May 2007. However, this region was still considered in good condition.

In the traditional survey area, the 2007 total duck population estimate (excluding scoters, eiders, long-tailed ducks, mergansers, and wood ducks) was 41.2 ± 0.7 million birds. That was 14% greater than the 2006 estimate of 36.2 ± 0.6 million birds and 24% above the 1955-2006 long-term average of 33.3 ± 0.1 million.

In the eastern Dakotas, total duck numbers were 52% higher than the 2006 estimate, and 86% above the long-term average. The total duck estimate in southern Alberta was similar to that of 2006, and to the long-term average. The total duck estimate was similar to that of 2006 in southern Saskatchewan and remained 49% above the long-term average. The total duck count in southern Manitoba was 26% below the 2006 estimate, and 15% below its long-term average. The total duck estimate in central and northern Alberta, northeastern British Columbia and the Northwest Territories was 20% higher than in 2006, but still 14% below the long-term average. The estimate in the northern Saskatchewan-northern Manitoba-western Ontario area was 18% higher than that of 2006, but similar to the long-term average. Total ducks in the western Dakotas-Eastern Montana area were 15% below their 2006 estimate, and similar to their long-term average. In the Alaska-Yukon Territory-Old Crow Flats region the total duck estimate was 20% above the 2006 estimate, and 59% above its long-term average.

Several states and provinces conduct breeding waterfowl surveys in areas outside the geographic extent of the Waterfowl Breeding Population and Habitat Survey of the USFWS and CWS. In California, the northeastern U.S., Oregon, and Wisconsin, measures of precision for survey estimates are available. In Ore-

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

			Change from 2007			Change from LTA	
Region	2008	2007	%	*P*	LTA	%	*P*
Prairie Canada							
S. Alberta	849	1,225	-31	0.023	739	+15	0.112
S. Saskatchewan	1,608	3,000	-46	<0.001	2,001	-20	0.002
S. Manitoba	598	815	-27	0.010	677	-12	0.066
Subtotal	3,055	5,040	-39	<0.001	3,417	-11	0.016
Northcentral U.S.							
Montana & Western Dakotas	531	740	-28	0.014	537	-1	0.902
Eastern Dakotas	845	1,223	-31	<0.001	1,002	-16	0.009
Subtotal	1,376	1,963	-30	<0.001	1,539	-11	0.028
Total	4,431	7,003	-37	<0.001	4,931	-10	0.003

gon, the total duck estimate was 27% higher than in 2006, but similar to the long-term average. Total duck estimates in California, Wisconsin, and the northeastern U.S. were similar to those of 2006 and to long-term averages. Of the states without measures of precision for total duck numbers, the estimate in Michigan was nearly double that of 2006, and decreased slightly in Minnesota relative to last year's count. Estimates increased in Washington and Nevada relative to 2006.

In the traditional survey area in 2007, mallard abundance was 8.3 ± 0.3 million, 14% higher than the 2006 estimate of 7.3 ± 0.2 million, and 11% above the long-term average. Blue-winged teal abundance was estimated at 6.7 ± 0.4 million birds, 15% higher than the 2006 estimate of 5.9 ± 0.3 million birds and 48% higher than the 1955–2006 average. Gadwall (3.4 ± 0.2 million) were 19% higher than their 2006 estimate, and 96% above their long-term average. American wigeon (2.8 ± 0.2 million) numbers increased 29% relative to 2006, and were at their long-term average in 2007. The estimate for northern pintails (3.3 ± 0.2 million) was similar to that of 2006, and 19% below the long-term average. The northern shoveler (4.6 ± 0.2 million) estimate was 24% higher than that of 2006, and 106% above the long-term average. Green-winged teal (2.9 ± 0.2 million), redhead (1.0 ± 0.08 million), and canvasback (0.9 ± 0.09 million) estimates were all similar to their 2006 estimates and 54%, 60% and 53% above long-term averages, respectively. The scaup estimate (3.5 ± 0.2 million) was also similar to that of 2006, but 33% below the long-term average for this species.

Of the 10 most abundant species in the eastern survey area, American black duck and ring-necked duck estimates were 14% and 19% higher in 2007 than in 2006, and were 22% and 27% above their 1990–2006 averages, respectively. Estimates of mergansers and goldeneyes were 27% and 49% higher than those of 2006, respectively, but both these species were similar to their 1990–2006 averages. Estimates of all other species were similar to 2006 estimates, and the long-term averages for the eastern survey area.

2008 Breeding Habitat Conditions, Populations, and Production Outlook

Overall Habitat and Population Status

Habitat conditions during the 2008 Waterfowl Breeding Population and Habitat Survey were characterized in many areas by a delayed spring in comparison with several preceding years. Drought in parts of the traditional survey area contrasted sharply with record amounts of snow and rainfall in the eastern survey area. The total pond estimate (Prairie Canada and U.S. combined) was 4.4 ± 0.2 million (Table 1, Figure 1). This was 37% below last year's estimate of 7.0 ± 0.3 million ponds and 10% below the long-term average of 4.9 ± 0.03 million ponds. The 2008 estimate of ponds in Prairie Canada was 3.1 ± 0.1 million. This was a 39% decrease from last year's estimate (5.0 ± 0.3 million), and 11% below the 1955–2007 average (3.4 ± 0.03 million). The parklands were drier in 2008 than in 2007, when excess water created much additional waterfowl habitat; still this area was classified as fair to good overall with most seasonal and semi-permanent wetlands full. A late April snowstorm recharged wetlands in some areas

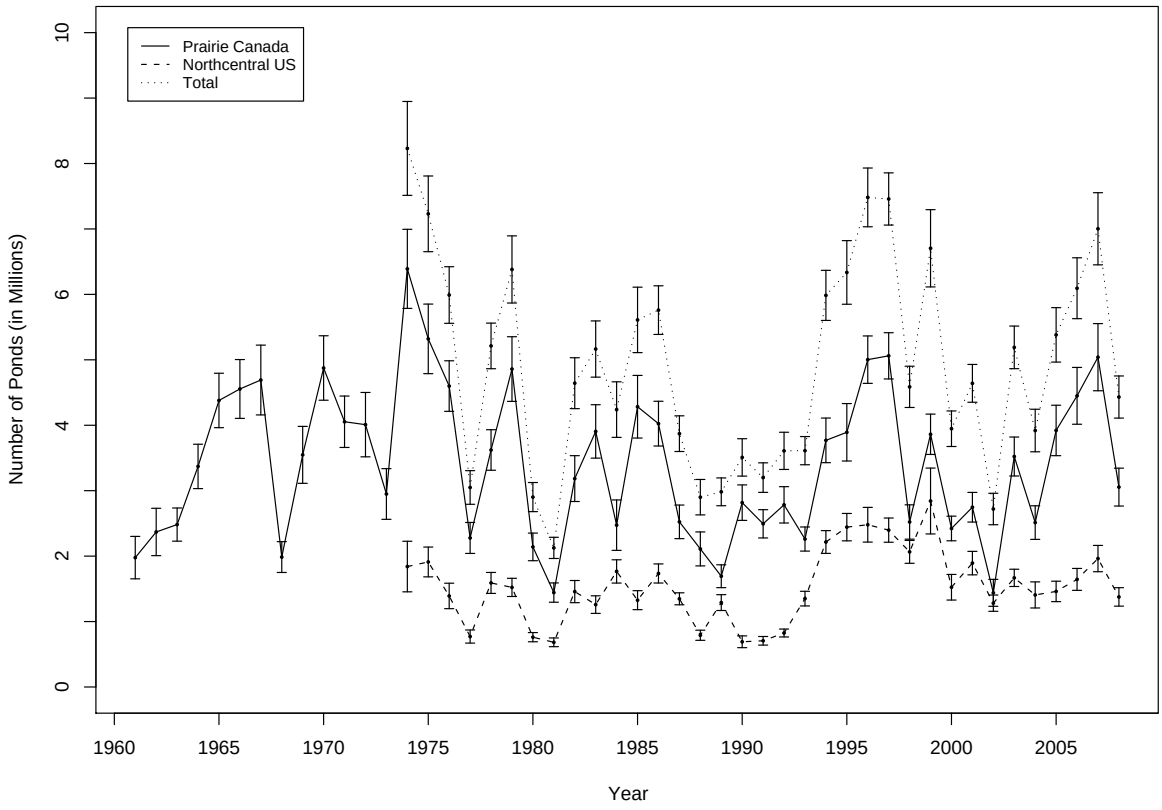

Figure 1: Number of ponds in May and 90% confidence intervals in prairie Canada and the northcentral U.S.

of the northern parklands; these were classified as excellent.

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

In the bush regions of the traditional survey area (Alaska, Yukon, Northwest Territories, northern Manitoba, northern Saskatchewan, and western Ontario) spring break-up was later in 2008 than in recent years. Locally variable snowfall and, consequently, variable runoff, resulted in habitat conditions that ranged from fair in the east to good in the west. Most large lakes were still frozen on May 20 in the Northwest Territories; however, warmer temperatures in late May led to habitat conditions suitable for nesting during the survey period. Good conditions were present throughout Alaska, with slightly late spring conditions in some coastal areas.

The boreal forest of the eastern survey area was generally in good condition this spring, although in most areas spring was delayed by 1–2 weeks relative to the early springs of preceding years. Most of the eastern survey area experienced record or near-record winter snowfall and spring precipitation accompanied by average to below-average temperatures. These conditions caused extensive flooding in some parts of Maine and the Maritimes and likely disrupted normal waterfowl nesting chronology. Newfoundland and Labrador also received above-average winter precipitation, but snow melt and breakup was gradual with minimal flooding. The frost seal throughout much of southern Ontario was poor; however, winter snowfall

and spring rains led to good to excellent habitat conditions across most of the area with the exception of extreme southwestern Ontario which was characterized as fair. Conditions in western Ontario initially pointed toward a late spring, but higher temperatures and winds provided good melting conditions so habitats were ready for the arrival of breeding pairs. In more northern sections of Ontario, ice persisted on lakes late into May and early June. Conditions in northern Quebec were slightly drier than average, and spring-like conditions came early.

In the traditional survey area (strata 1–18, 20–50, and 75–77), the total duck (excluding scoters, eiders, long-tailed ducks, mergansers, and wood ducks) population estimate was 37.3 ± 0.6 [SE] million birds. This was 9% lower than last year's estimate of 41.2 ± 0.7 million birds, but 11% above the 1955–2007 long-term average (Table 2, Appendix G). In the eastern Dakotas, total duck numbers were 17% lower than last year's estimate, but 53% above the long-term average. The total duck estimate in southern Alberta was similar to last year's count, and to the long-term average. The total duck estimate was 19% lower than that of 2007 in southern Saskatchewan, but remained 20% above the long-term average. The total duck count in southern Manitoba was similar to the 2007 estimate, and 21% below its long-term average. The total duck estimate in central and northern Alberta, northeastern British Columbia and the Northwest Territories was 13% higher than the 2007 estimate and similar to the long-term average. The estimate in the northern Saskatchewan-northern Manitoba-western Ontario area was similar to last year's, but 11% below the long-term average. Total ducks in the western Dakotas-eastern Montana area were 30% below both their 2007 estimate and long-term average. In the Alaska-Yukon Territory-Old Crow Flats region the total duck estimate was 10% below last year's, but remained 42% above its long-term average.

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

Trends and annual breeding population estimates for 10 principal duck species from the traditional survey area are provided in Figure 2, Tables 3-12, and Appendix F. Percent change was computed prior to rounding and therefore may not match calculations that use the rounded estimates presented in the tables and text. Mallard abundance was 7.7 ± 0.3 million birds, similar to last year's estimate of 8.3 ± 0.3 million birds and to the long-term average (Table 3). The mallard estimate in southern Alberta was similar to last year's but remained 20% below the long-term average. In the eastern Montana-western Dakotas survey area, mallard counts were 36% below the 2007 estimate but 30% below the long-term mean. The mallard estimate was similar to last year's, and the long-term average in the central and northern Alberta-northeastern British Columbia-Northwest Territories region. In the northern Saskatchewan-northern Manitoba-western Ontario survey area, the mallard estimate was similar to that of 2007, and the long-term average. Mallard numbers were similar to the 2007 estimate and 46% above their long-term average in the Alaska-Yukon Territory-Old Crow Flats region. In the southern Manitoba and southern Saskatchewan crew areas, mallard estimates were similar to last years' and to long-term averages. In the eastern Dakotas, mallards were 24% below last year's count, but 75% above the long-term average. In other areas where surveys are conducted and measures of precision for estimates are provided (the same states as for total ducks, as well as Michigan and Minnesota), mallard abundance remained unchanged relative to 2007, except for Michigan (−40%), and Oregon (−17%). Mallard estimates were below the long-term average in Michigan (−52%), Oregon (−22%) and the northeastern U.S. (−21%). The Minnesota mallard estimate was 34% above the long-term average. In the states without estimates of precision, mallards increased in Washington, and decreased in Nevada relative to 2007.

In the traditional survey area blue-winged teal estimated abundance was 6.6 ± 0.3 million birds, similar to last year's estimate of 6.7 ± 0.4 million birds, and 45% above the long-term average. Estimated abundances of gadwall (2.7 ± 0.2 million) and northern shovelers (3.5 ± 0.2 million) were lower than those of last year (−19% and −23%, respectively), but both remained 56% above their long-term averages. Estimated abundance of American wigeon (2.5 ± 0.2 million) was similar to the 2007 estimate and the long-term average. Estimated abundances of green-winged teal (3.0 ± 0.2 million) and redheads (1.1 ± 0.1 million) were similar to last year's, but were each >50%

Table 2: Total duck[b] breeding population estimates (in thousands) for regions in the traditional survey area, and states that conduct breeding surveys.

			Change from 2007			Change from LTA	
Region	2008	2007	%	*P*	LTA[a]	%	*P*
Alaska-Yukon Territory -Old Crow Flats	5,123	5,690	-10	0.041	3,614	+42	<0.001
C. & N. Alberta -N.E. British Columbia - NWT	6,934	6,137	+13	0.055	7,096	-2	0.604
N. Saskatchewan -N. Manitoba -W. Ontario	3,162	3,212	-2	0.853	3,535	-11	0.039
S. Alberta	4,199	4,293	-2	0.726	4,289	-2	0.628
S. Saskatchewan	8,949	11,036	-19	0.001	7,470	+20	<0.001
S. Manitoba	1,223	1,322	-7	0.285	1,545	-21	<0.001
Montana & Western Dakotas	1,139	1,625	-30	<0.001	1,619	-30	<0.001
Eastern Dakotas	6,546	7,857	-17	0.001	4,289	+53	<0.001
Total	37,276	41,172	-9	<0.001	33,455	+11	<0.001
Other regions							
California	554	628	-12	0.417	601	-8	0.443
Northeastern U.S.[c]	1,197	1,500	-20	0.062	1,431	-16	0.010
Oregon	240	337	-29	0.009	297	-19	<0.001
Wisconsin	627	471	+33	0.092	433	+45	0.012

[a] Long-term average, 1955-2007.

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

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

Table 3: Mallard breeding population estimates (in thousands) for surveyed regions.

			Change from 2007			Change from LTA	
Region	2008	2007	%	*P*	LTA[a]	%	*P*
Alaska-Yukon Territory -Old Crow Flats	532	581	-8	0.497	364	+46	<0.001
C. & N. Alberta -N.E. British Columbia - NWT	1,079	887	+22	0.127	1,072	+1	0.942
N. Saskatchewan -N. Manitoba -W. Ontario	1,046	864	+21	0.246	1,144	-9	0.401
S. Alberta	875	830	+5	0.567	1,090	-20	<0.001
S. Saskatchewan	1,907	2,155	-12	0.260	2,069	-8	0.316
S. Manitoba	381	387	-2	0.900	381	+0	0.999
Montana & Western Dakotas	354	553	-36	0.003	504	-30	<0.001
Eastern Dakotas	1,549	2,049	-24	0.013	883	+75	<0.001
Total	7,724	8,307	-7	0.129	7,507	+3	0.406
Eastern survey area	450	453	-1	[b]	405	+11	[b]
Other regions							
California	297	388	-23	0.205	370	-20	0.140
Michigan	189	315	-40	0.012	396	-52	<0.001
Minnesota	298	243	+23	0.178	222	+34	0.007
Northeastern U.S.[c]	619	688	-10	0.269	787	-21	<0.001
Oregon	84	102	-17	0.083	108	-22	0.001
Wisconsin	188	210	-10	0.572	181	+4	0.769

[a] Long-term average. Traditional survey area 1955–2007; eastern survey area 1990–2007; years for other regions vary (see Appendix E).

[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.

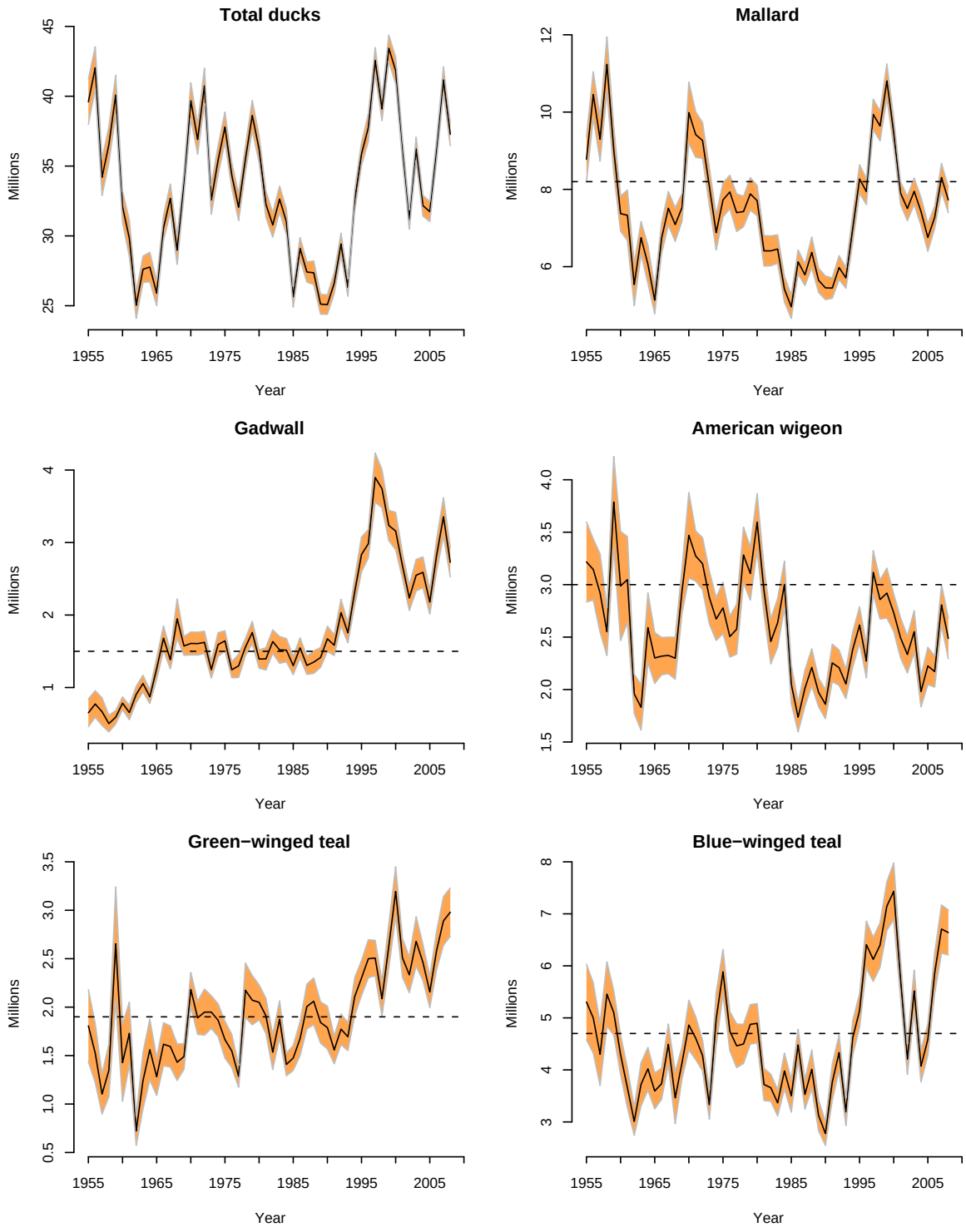

Figure 2: Breeding population estimates, 95% confidence intervals, and North American Waterfowl Management Plan population goal (dashed line) for selected species in the traditional survey area (strata 1–18, 20–50, 75–77).

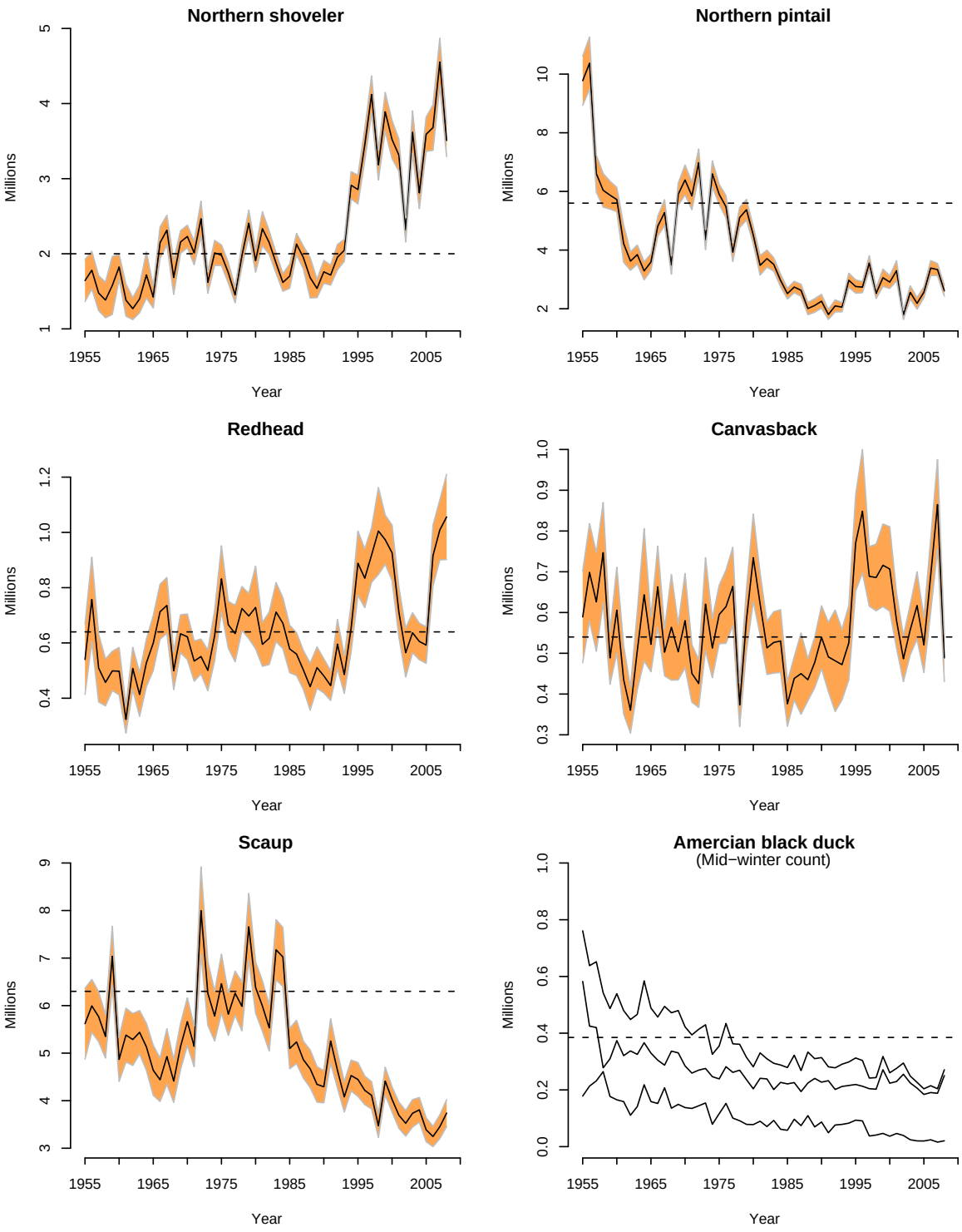

Figure 2: Continued.

above their long-term averages. The redhead and green-winged teal estimates were the highest and the second highest ever for this region. The canvasback estimate of 0.5 ± 0.05 million was down 44% relative to 2007's record high, and 14% below the long-term average. Northern pintails (2.6 ± 0.1 million) were 22% below last year's estimate and 36% below their long-term average). The scaup (3.7 ± 0.2 million) estimate was similar to that of 2007, and remained 27% below the long-term average. Population estimates for the 10 most abundant species in the eastern survey area (Table 13, Figures 3 and 4, Appendix H), were all similar to last year's estimates and to long-term averages.

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. Midwinter counts of American black ducks (271,200) in both flyways combined increased 33% relative to 2007 counts (204,100), and were 9% higher than the 10-year mean (249,100). In the Atlantic Flyway, the midwinter index of 250,600 was 33% higher than the 2007 count of 188,100, and was 15% above the most recent 10-year mean (217,600). In the Mississippi Flyway, the American black duck midwinter index increased 29% from 16,000 in 2007 to 20,600, which was still 35% below the 10-year mean (31,500). A shorter time series for assessing changes in American black duck population status is provided by the breeding waterfowl surveys conducted by the USFWS and CWS in the eastern survey area (Table 13, Figure 3). In the eastern survey area, the 2008 estimate for breeding American black ducks (496,000) was statistically similar to the 2007 estimate (571,000) and to the 1990-2007 average (475,000). Black duck population estimates for northeastern states from New Hampshire south to Virginia are available from the Atlantic Flyway Breeding Waterfowl Survey. The estimate from the 2008 survey (65,100) was statistically similar to the 2007 estimate (62,400) and to the 1993-2007 average (68,600).

Trends in wood duck populations are monitored by the North American Breeding Bird Survey (BBS), a series of roadside routes surveyed during May and June each year. Wood ducks are encountered with low frequency along BBS routes, limiting the amount and quality of available information for analysis (Sauer and Droege 1990). However, the BBS provides the only long-term indices of this species' breeding populations. Trend analysis suggested that wood duck numbers have increased 3.2% per year over the entire survey period (1966–2007) and 2.2% over the past 30 years (1978–2007), in the Atlantic and Mississippi Flyways combined. For the Atlantic Flyway, the BBS indicated a 4.0% average annual increase in wood ducks over the entire 42 years of the survey (1966–2007), and 3.4% increase over the past 30 years (1978–2007). In the Mississippi Flyway, the 42-year BBS trend indicated a 2.7% annual increase, and 30-year trend showed annual growth of 1.4%. Analysis of wood duck BBS data over the past 10-year (1998–2007), and 20-year (1988–2007) periods yielded no significant short-term trend for the Atlantic or Mississippi Flyways, or the two flyways combined (J. Sauer, U. S. Geological Survey/Biological Resources Division, unpublished data). Wood duck population estimates are available for the northeastern states from New Hampshire south to Virginia, from the Atlantic Flyway Breeding Waterfowl Survey. The estimate from the 2008 survey (386,100) was statistically similar to the 2007 estimate (420,600) and to the 1993–2007 average (376,000).

Weather and habitat conditions during the summer months can influence waterfowl production. Good summer wetland conditions increase re-nesting effort and improve brood survival. While no formal July surveys were flown this year, pilot biologists flew survey areas in Montana and the western Dakotas, the eastern Dakotas, southern Alberta, southern Manitoba, and southern Saskatchewan in early July to qualitatively assess habitat changes between May and July. Biologists responsible for other survey areas monitored weather conditions and communicated with local biologists for assessments of 2008 waterfowl production. As of early July 2008, habitat conditions over some of the traditional survey area had improved due to late-spring precipitation, but generally not enough to upgrade production predictions. Below-average production was generally expected in the eastern Dakotas, southern Manitoba, and the southernmost portions of southern Saskatchewan and southern Alberta. A line from Brandon, Manitoba to Kindersley, Saskatchewan separated the generally poor, dry conditions to the south from the wetter conditions to the north. Good-to-excellent production was expected in the northwest parklands of Saskatchewan. Despite very poor conditions that extended from western North Dakota into extreme eastern and northern Montana, normal production was predicted for the crew area as a whole because of early summer precipitation. Summer rains and cool temperatures also improved wetland conditions in the eastern Dakotas, but not enough to raise the production outlook appreciably. The outlook for production was good in Alaska and most of the Northwest Territories and northern Alberta. Conditions for waterfowl production were only fair in most of northern Saskatchewan and northern Manitoba due to cold spring weather. Conditions were good over most of the eastern survey area, except for small patches

of excellent habitat in Quebec and southern Ontario. Extensive flooding disrupted nesting in Maine, Nova Scotia, and New Brunswick, so only fair production was expected there.

Regional Habitat and Population Status

A description of habitat conditions, populations, and production for each of the major breeding areas follows. More detailed reports of specific regions are available under *Waterfowl Population Surveys*, located on the Division of Migratory Bird Management's reports page. Some of the habitat information that follows was taken from those reports (http://www.fws.gov/migratorybirds/reports/reports.html).

Southern Alberta: The outlook was poor over much of this crew area (strata 26–29, 75–76), following two good years. The winter of 2007–08 and spring 2008 in Alberta was colder than normal, with below-normal precipitation. Spring was 7–10 days later than normal. Winter precipitation was 40% below normal for much of prairie Alberta but 90 to 125% above normal in the mountains. Due to the cold spring, the mountain run-off was the tenth lowest observed in the past 90 years. The majority of the prairies were in poor condition, but areas around Calgary, Red Deer, Edmonton and Lloydminster received above-normal precipitation and had good waterfowl nesting conditions. The Aspen parklands of stratum 75 received 90% of normal precipitation, and permanent wetlands there were in fair condition. The eastern Peace parklands of stratum 76 were generally in fair condition, having received nearly normal precipitation. The western portion of stratum 76 received only 69% of normal precipitation, and was in poor condition. A late May storm filled some dry basins and recharged existing wetlands, which may have helped late-nesting and re-nesting waterfowl.

Overall, May ponds were 31% lower than the 2007 estimate, and similar to the long-term average. Total duck and canvasback estimates were similar to those of 2007 and to long-term averages. Mallard and scaup estimates were similar to those of 2007, but these species remained 20% and 50% below their long-term averages, respectively. Northern pintail numbers declined 26% relative to 2007, and were 66% below their long-term average for this crew area. Blue-winged teal and gadwall estimates were similar to those of 2007, and 33% and 35% higher than their respective long-term averages. The northern shoveler estimate was 37% lower than in 2007, but remained 63% above its long-term average. The green-winged teal estimate was similar to last year's, and was 52% higher than the long-term average. American wigeon were also similar to their 2007 estimate, but 38% below their long-term average. The redhead estimate was 86% higher than in 2007 and 182% above its long-term average for the crew area.

July habitat conditions in southern Alberta were similar to those observed during the May surveys. Conditions generally progressed from good in the northwestern quarter to fair and poor conditions in the southeastern region bordering Montana. The central portions of southern Alberta were a mix of good and fair late-nesting and brood-rearing habitat. Fair to good conditions in the rest of the crew area offset less favorable rankings in the southeast so overall, an average production year was predicted for the entire region.

Southern Saskatchewan: Habitat conditions for nesting waterfowl deteriorated in southern Saskatchewan since 2007 due to a drought that spread north and west into the northern grasslands and Aspen parkland region (parklands). Dry conditions prevailed from the U.S. border into the central grasslands and on many grassland transects only about 10% of the wetland basins contained water. Consequently, poor waterfowl production and recruitment was predicted for most of the grasslands, with the exception of the northern grasslands and the Cypress Hills which were considered fair, and the mixed grasslands in the Allan Hills, southeast of Saskatoon, which were rated good. Although the parklands have dried to some extent since 2007, habitat conditions were still favorable for waterfowl nesting and brood rearing, as seasonal and semi-permanent wetlands remained full. Strata 31 and 34 were drier than 2007 and had lost some waterfowl habitat because of the drier conditions, but had fair to good potential for waterfowl recruitment. In particular, the northeastern edge of stratum 34 was rated good. The northwest parklands (stratum 30) continued to show good to excellent potential for recruitment. The transition zone between grasslands and parklands has dried out slightly since 2007 and had fair production potential. A late April snowstorm provided much needed moisture to the northwest parklands and recharged many wetlands prior to the survey.

The May pond estimate was 46% below last year's, and 20% below the long-term average. Total ducks were 19% below the 2007 estimate, but remained 20% above their long-term average. Mallard and American wigeon estimates were similar to 2007 estimates and to long-term averages. Blue-winged teal, redhead, and green-winged teal estimates were also similar to last year's, and were 84%, 92%, and 136% higher than their respective long-term averages. Gadwall and Northern shoveler numbers fell 23% and 29% relative to last year's estimates, but remained 74% and 73% above their respective long-term averages. Canvasbacks were 49% below the 2007 estimate and

similar to their long-term average for the crew area. Scaup estimated abundance was similar to last year's estimate, but 38% below the long-term average for the crew area. Northern pintail estimated abundance was 56% below the 2007 estimate and 65% below the long-term average.

As of July, production predictions in most of southern Saskatchewan remained unchanged. The southwest grasslands (stratum 33) received above-average precipitation in June, but not enough to change predictions for the area. The grasslands in stratum 32 also received above-average June rainfall, but the forecast there remained unchanged as well. Some water levels were higher than during the May survey, which should help broods and late-nesting species. However, several months of above-average precipitation would be needed to overcome the ongoing drought in stratum 32. No changes were reported in the northern parts of stratum 32 or in the coteau; they remained very dry. The transition zone between grasslands (stratum 32) and parklands (stratum 30) remained unchanged from May. Normal drying of temporary and seasonal wetlands was apparent in stratum 30. However, good-to-excellent conditions persisted in stratum 30 and the area with excellent conditions had expanded toward Saskatoon and Prince Albert. In the high-density wetland landscapes of stratum 30 and 31 there was abundant water for brood rearing. The southern portion of the northeast parklands (stratum 31) were also improved relative to May, with sheet-water and higher water levels due to recent rains. Improved conditions will not help ducks that over-flew or left the area, but should help those remaining. The southern portions of stratum 34 were still dry, but the northern parts were very wet and wetlands were in good-to-excellent condition. Stratum 35 remained very dry.

Southern Manitoba: Habitat conditions were dry throughout most of southern Manitoba (strata 36–40). Conditions were extremely dry in stratum 38 (except the Turtle Mountains), in stratum 39, and in the southern and southwestern two-thirds of stratum 35. Conditions were dry in stratum 36 and in stratum 37. Stratum 40 was the major exception to the mostly dry conditions, as approximately half of it was in good condition. The unusually dry conditions meant that many semi-permanent wetland basins were dry and thus susceptible to modification. Many had been tilled, several burned, and a few bulldozed of all vegetation and trees.

The May pond count was 27% below the 2007 estimate and 12% below the long-term average. Despite the dry conditions, the total-duck count and estimates for most species were similar to those of 2007. Canvasbacks were the exception; they were 60% below last year's estimate. Total duck numbers were 21% below the long-term average. Blue-winged teal (−30%), canvasbacks (−46%) scaup (−55%), northern pintails (−73%), and American wigeon (−80%) were all below their long-term averages for the crew area. Gadwall were 64% above the long-term average in 2008. Mallard, northern shoveler, and redhead estimates were all similar to long-term averages. As of July 2008, conditions in southern Manitoba remained largely unchanged since the May survey. In general, a line running from Brandon to Kindersley, Saskatchewan divided poor, dry conditions to the south from the wetter conditions to the north. The parklands near Shoal Lake remained in good condition, and were surrounded by a ring of fair habitat, but the remainder of the crew area remained in poor condition.

Montana and Western Dakotas: In early May of 2008, western South Dakota (stratum 44) was in moderate drought, and western North Dakota (stratum 43) was officially classified as in a severe drought. Conditions in western South Dakota were better near the western end of the survey area, and the region between Mobridge and Pierre was rated fair; 40–60% of wetland basins held water, though upland vegetation was in poor condition. An early May snow storm likely disrupted early nesting but dramatically improved water conditions near, and up to 40 miles north of Sturgis. Stratum 43 was almost uniformly bleak, as only 10–35% of wetland basins held water. In the area near Garrison, only 10% of the normally numerous natural wetlands contained water, and the regions north of Dickinson and Bismarck were rated very poor. Little vegetation growth had occurred, and crowding of waterfowl was evident on the few available wetlands. Habitat conditions in eastern Montana were variable. South of the Missouri River (stratum 42), the area near Camp Cook benefited from the same early May snow storm, and conditions there were good, with abundant sheet water and nearly 80% of wetland basins full. Farther west, the region between Billings and Lewistown was only fair, while the northeast portion of the stratum near Glendive was rated as poor. With the exception of the southeast corner, the stratum suffered from moderate drought, as approximately half of basins were dry and vegetation development was delayed or reduced. Residual cover was adequate in areas with water, but conversion of CRP to cereal grain crops, along with low spring moisture pointed toward marginal predicted production for the region. North of the Missouri River (stratum 41) conditions in northeastern Montana along the highline were an extension of the extreme drought in western North Dakota. Exceptions were isolated areas northeast of Malta and east of Glasgow. Relatively good conditions prevailed to the west, and immediately east of the Front Range, but not enough

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

			Change from 2007			Change from LTA	
Region	2008	2007	%	*P*	LTA	%	*P*
Alaska-Yukon Territory -Old Crow Flats	4	3	+25	0.816	2	+110	0.443
C. & N. Alberta -N.E. British Columbia - NWT	109	100	+9	0.696	50	+119	<0.001
N. Saskatchewan -N. Manitoba -W. Ontario	10	15	-34	0.308	27	-64	<0.001
S. Alberta	420	343	+22	0.200	312	+35	0.039
S. Saskatchewan	1,011	1,317	-23	0.086	583	+74	<0.001
S. Manitoba	112	110	+2	0.933	68	+64	0.029
Montana & Western Dakotas	200	266	-25	0.210	196	+2	0.845
Eastern Dakotas	861	1,201	-28	0.043	508	+70	<0.001
Total	2,728	3,356	-19	0.016	1,745	+56	<0.001

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

			Change from 2007			Change from LTA	
Region	2008	2007	%	*P*	LTA	%	*P*
Alaska-Yukon Territory -Old Crow Flats	921	1,113	-17	0.067	528	+74	<0.001
C. & N. Alberta -N.E. British Columbia - NWT	819	843	-3	0.885	904	-9	0.471
N. Saskatchewan -N. Manitoba -W. Ontario	90	143	-37	0.072	248	-64	<0.001
S. Alberta	180	170	+5	0.758	292	-38	<0.001
S. Saskatchewan	372	325	+15	0.551	421	-12	0.473
S. Manitoba	12	9	+40	0.350	60	-80	<0.001
Montana & Western Dakotas	58	121	-52	0.013	109	-47	<0.001
Eastern Dakotas	34	83	-59	0.009	49	-31	0.046
Total	2,487	2,807	-11	0.136	2,612	-5	0.415

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

			Change from 2007			Change from LTA	
Region	2008	2007	%	*P*	LTA	%	*P*
Alaska-Yukon Territory -Old Crow Flats	655	823	-20	0.098	374	+75	<0.001
C. & N. Alberta -N.E. British Columbia - NWT	1,068	862	+24	0.308	754	+42	0.029
N. Saskatchewan -N. Manitoba -W. Ontario	282	307	-8	0.547	201	+40	0.001
S. Alberta	297	283	+5	0.877	195	+52	0.072
S. Saskatchewan	561	495	+13	0.597	238	+136	0.001
S. Manitoba	48	33	+44	0.113	52	-7	0.645
Montana & Western Dakotas	56	44	+29	0.307	40	+42	0.067
Eastern Dakotas	13	43	-69	0.036	46	-71	<0.001
Total	2,980	2,890	+3	0.746	1,900	+57	<0.001

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

			Change from 2007			Change from LTA	
Region	2008	2007	%	*P*	LTA	%	*P*
Alaska-Yukon Territory -Old Crow Flats	0	9	-100	0.191	2	-100	<0.001
C. & N. Alberta -N.E. British Columbia - NWT	393	369	+7	0.802	273	+44	0.069
N. Saskatchewan -N. Manitoba -W. Ontario	87	121	-28	0.399	259	-66	<0.001
S. Alberta	818	669	+22	0.389	615	+33	0.046
S. Saskatchewan	2,318	2,380	-3	0.864	1,259	+84	<0.001
S. Manitoba	265	274	-3	0.848	381	-30	0.001
Montana & Western Dakotas	235	277	-15	0.414	265	-12	0.316
Eastern Dakotas	2,525	2,610	-3	0.746	1,515	+67	<0.001
Total	6,640	6,708	-1	0.891	4,568	+45	<0.001

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

			Change from 2007			Change from LTA	
Region	2008	2007	%	*P*	LTA	%	*P*
Alaska-Yukon Territory -Old Crow Flats	466	580	-20	0.161	275	+69	<0.001
C. & N. Alberta -N.E. British Columbia - NWT	322	346	-7	0.770	216	+50	0.010
N. Saskatchewan -N. Manitoba -W. Ontario	37	28	+32	0.546	42	-12	0.632
S. Alberta	618	977	-37	<0.001	378	+63	0.001
S. Saskatchewan	1,184	1,656	-29	0.047	685	+73	<0.001
S. Manitoba	90	116	-23	0.211	109	-18	0.271
Montana & Western Dakotas	134	169	-20	0.465	150	-10	0.661
Eastern Dakotas	657	682	-4	0.782	395	+66	<0.001
Total	3,508	4,553	-23	<0.001	2,250	+56	<0.001

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

			Change from 2007			Change from LTA	
Region	2008	2007	%	*P*	LTA	%	*P*
Alaska-Yukon Territory -Old Crow Flats	1,250	1,135	+10	0.424	919	+36	0.003
C. & N. Alberta -N.E. British Columbia - NWT	331	234	+41	0.179	371	-11	0.478
N. Saskatchewan -N. Manitoba -W. Ontario	4	5	-25	0.699	40	-90	<0.001
S. Alberta	240	324	-26	0.096	712	-66	<0.001
S. Saskatchewan	423	960	-56	<0.001	1,210	-65	<0.001
S. Manitoba	29	15	+97	0.110	109	-73	<0.001
Montana & Western Dakotas	50	118	-57	<0.001	266	-81	<0.001
Eastern Dakotas	285	544	-48	<0.001	457	-38	<0.001
Total	2,613	3,335	-22	0.001	4,083	-36	<0.001

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

			Change from 2007			Change from LTA	
Region	2008	2007	%	*P*	LTA	%	*P*
Alaska-Yukon Territory -Old Crow Flats	2	2	+22	0.834	2	+34	0.720
C. & N. Alberta -N.E. British Columbia - NWT	94	80	+18	0.720	39	+138	0.132
N. Saskatchewan -N. Manitoba -W. Ontario	12	10	+20	0.744	27	-56	0.001
S. Alberta	333	179	+86	0.050	118	+182	0.003
S. Saskatchewan	383	414	-8	0.769	199	+92	0.027
S. Manitoba	56	72	-22	0.490	72	-23	0.153
Montana & Western Dakotas	3	6	-45	0.463	9	-66	0.001
Eastern Dakotas	173	247	-30	0.104	170	+2	0.911
Total	1,056	1,009	+5	0.749	637	+66	0.001

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

			Change from 2007			Change from LTA	
Region	2008	2007	%	*P*	LTA	%	*P*
Alaska-Yukon Territory -Old Crow Flats	72	92	-22	0.557	91	-21	0.356
C. & N. Alberta -N.E. British Columbia - NWT	84	139	-40	0.142	75	+12	0.620
N. Saskatchewan -N. Manitoba -W. Ontario	23	34	-32	0.559	54	-57	0.032
S. Alberta	79	127	-38	0.185	65	+21	0.486
S. Saskatchewan	166	324	-49	0.022	187	-11	0.440
S. Manitoba	31	77	-60	0.007	57	-46	<0.001
Montana & Western Dakotas	9	17	-48	0.114	8	+9	0.666
Eastern Dakotas	25	54	-54	0.034	33	-25	0.161
Total	489	865	-44	<0.001	570	-14	0.079

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

			Change from 2007			Change from LTA	
Region	2008	2007	%	*P*	LTA	%	*P*
Alaska-Yukon Territory -Old Crow Flats	1,071	1,191	-10	0.410	920	+16	0.112
C. & N. Alberta -N.E. British Columbia - NWT	1,627	1,261	+29	0.100	2,574	-37	<0.001
N. Saskatchewan -N. Manitoba -W. Ontario	406	271	+50	0.085	576	-30	0.016
S. Alberta	176	182	-4	0.875	347	-49	<0.001
S. Saskatchewan	256	302	-15	0.564	414	-38	0.001
S. Manitoba	60	50	+19	0.558	133	-55	<0.001
Montana & Western Dakotas	16	15	+10	0.799	52	-69	<0.001
Eastern Dakotas	127	179	-29	0.118	99	+28	0.174
Total	3,738	3,452	+8	0.331	5,115	-27	<0.001

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

Species	2008	2007	% Change from 2007	Average[b]	% Change from average[c]
Mergansers (common, red-breasted, and hooded)	412	429	-4	413	+0[d]
Mallard	450	453	-1	405	+11
American black duck	496	571	-13	475	+4
American wigeon	8	14	-40	19	-57
Green-winged teal	261	260	+0[d]	233	+12
Scaup (greater and lesser)	32	31	+4	38	-16
Ring-necked duck	551	664	-17	529	+4
Goldeneyes (common and Barrow's)	424	455	-7	410	+3
Bufflehead	30	16	+93	24	+24
Scoters (black, white-winged, and surf)	86	103	-17	82	+4

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

[b] Average for 1990–2007.

[c] Significance (P <0.10) determined by non-overlap of Bayesian credibility intervals or confidence intervals. In 2008, no species differed significantly from their 2007 estimates or their long-term averages.

[d] Rounded values mask change in estimates.

to improve the overall outlook for the stratum even to average.

Overall in Montana and the western Dakotas, May pond counts were 28% below the 2007 estimate and similar to the long-term average. Total ducks were 30% lower than their 2007 estimate, and their long-term average. Mallard (−36%, −30% LTA), American wigeon (−52%, −47% LTA), and northern pintail (−57%, −81% LTA) estimates were lower than 2007 estimates and long-term averages. The green winged teal estimate was similar to last year's and 42% above the long-term average. Redhead and scaup estimates were similar to last year's, but 66% and 69% below their respective long-term averages. Northern shoveler, blue-winged teal, gadwall, and canvasback estimates were similar to those of 2007, and their long-term averages.

By July 2008, habitat conditions in the western Dakotas and eastern Montana had improved slightly relative to May. Early May precipitation in portions of western South Dakota produced good to excellent late-nesting and brood-rearing conditions. Habitat in western North Dakota and northeastern Montana that was rated as poor in May was upgraded due to recovery of upland vegetation and maintenance of brood habitat. However, because of the original moisture deficit the area was only rated fair. Portions of eastern Montana that received heavy snow accumulation in mountainous regions had good brood habitat, which included oxbow and beaver ponds on full, flowing streams. Overall, the relatively good conditions in western South Dakota balanced the below-average production potential in western North Dakota, so average waterfowl production was expected for the western Dakotas combined. Late-spring precipitation also upgraded eastern Montana's predicted waterfowl production potential to average overall.

Eastern Dakotas: Habitat conditions deteriorated over much of the eastern Dakotas (Strata 45–49) since 2007. Winter precipitation was adequate to maintain wetland quality only in small portions of southern and eastern South Dakota and extreme southeastern North Dakota. The only good portion of the crew area contained a modest amount of temporary and seasonal water, and was a narrow (15–40 miles wide) swath from the glacial drift plain in southeastern South Dakota near the Nebraska border northeast through the southern tip of the prairie coteau, ending at the Sioux drift region at the North Dakota border. The remainder of the prairie coteau and the drift prairie, south of about Huron, South Dakota were considered fair. The entire northwest quarter of the South Dakota portion of the crew area, the drift prairie north of Huron, including the Leola Hills, was considered poor, with no temporary or seasonal water, and dry or recessed dugouts and semi-permanent wetlands. North Dakota exhibited more overall habitat deterioration than did South Dakota. The southern third of the Missouri Coteau and a triangle in the northeast bounded by the cities of Tolna, Devils Lake, and Langdon, were considered marginally fair to fair. A small area about 50 miles in length and width in the extreme southeastern part of the state was also considered fair to good. The remainder of the North Dakota portion of the crew area was in poor condition. The pressures of high commodity prices on nesting cover were evident in the many observations of grass that had been plowed under in preparation for seeding and wetland basins that had been burned or tilled and already seeded. Where grass or pasture was undisturbed, the cool, dry conditions stimulated little new growth of cool-season grass species. Overall, available nesting cover in this crew area was probably the lowest in recent history.

Overall in the eastern Dakotas, May pond counts were 31% below the 2007 estimate, but 16% below the long-term average. Total ducks were 17% lower than their 2007 estimate, and 53% above than their long-term average. Mallard and gadwall counts fell 24% and 28% relative to 2007 estimates, but remained 75% and 70% above their long-term averages. Northern shoveler and blue-winged teal numbers were similar to last year's estimates, and 66% and 67% above their long-term averages. Northern pintail (−48%, −38% LTA), American wigeon (−69%, −31% LTA), and green-winged teal (−59%, −71%) estimates were all well below those of 2007 and their long-term averages for the crew area. The canvasback estimate was 54% lower than last year's, but similar to its long-term average. Estimates for scaup and redheads were similar to those of 2007, and to long-term averages.

As of July, the best conditions in the crew area were in eastern South Dakota (stratum 49), which was a mix of fair and good habitat. Stratum 45, in northwestern North Dakota, still had the worst conditions, uniformly poor, except an area of fair habitat near Devils Lake. Stratum 47 also remained in poor condition. Cooler-than-average temperatures prevailed in June in eastern North and South Dakota. Precipitation since May was variable; in some locations, conditions improved slightly but overall, precipitation did little more than maintain wetland conditions. In South Dakota, some good habitat in the southeast was downgraded, and some poor habitat upgraded to fair. In North Dakota, June and July precipitation in eastern stratum 45 and 46 slightly increased the total area of fair habitat, and maintained the only area of good conditions in the state, which should improve late-nesting opportunities for a limited number of birds. Although North Dakota experienced a

net gain in wetland quality and quantity since May, cool temperatures and dry soils over much of the area depressed development of much of the upland nesting cover. In addition to the tilling and planting of dry wetlands and the loss of approximately 500,000 acres of Conservation Reserve Program (CRP) since 2007, dry conditions have triggered pressure from the farming community to release remaining CRP acres for emergency haying. Despite the recent precipitation, much of eastern North Dakota and about 25% of South Dakota remains in the poor category. Overall, below-average-to-average waterfowl production was expected in the Eastern Dakotas as of July 2008.

Northern Saskatchewan, Northern Manitoba, and Western Ontario: In northern Saskatchewan and northern Manitoba (strata 21–25) spring break-up was later than in several previous years. Thicker-than-normal ice on large, deep lakes was slow to break up. However, while large lakes were thawing, smaller habitats were being well used by waterfowl. Flocked mallard drakes were prevalent by mid-May, and the first observation of a Canada goose brood occurred on May 23, as the short window of mild spring weather gave several species enough open water to begin nesting. Wetland conditions were variable throughout northern Saskatchewan and Manitoba. Water levels were generally low in streams and major rivers. However, some drainages had uncharacteristically high water or minor flooding. Snowfall, and thus runoff, was quite variable across the region. Water levels in the countless small wetlands and beaver ponds across the landscape were not as high as usual. Many were dry and others recessional. The Nelson River system in Manitoba was lower than typical; loafing sites along with miles of quality shoreline nesting habitat abounded. Abundant snowfall during the winter over the southern portions of western Ontario (stratum 50) provided abundant spring water to charge wetlands. Early indications pointed toward a late spring in these areas, but later, higher temperatures and winds hastened ice melting, and habitats were ready for the arrival of breeding pairs. In the more northern regions, ice persisted on lakes well into late May, a delay of 2–3 weeks in some areas. Although water was adequate, many traditional habitats were not available to birds until late in the spring, but many birds were observed in the few beaver sloughs and string bogs that became ice-free earlier than the lakes and traditional wetlands. Overall, good-excellent production was expected in the crew area.

The total duck estimate was similar to the 2007 estimate, and 11% below the long-term average. All the major species estimates in this crew area were similar to last year's, except for American wigeon, which were 37% below, and scaup, which were 50% above, 2007 estimates. These species were also 64% and 30% below their respective long-term averages for the crew area. Mallard and northern shoveler estimates were similar to long-term averages. Green-winged teal (+40%) was the only species above its long-term average for the crew area. Gadwall (−64%), blue-winged teal (−67%), northern pintails (−90%), redheads (−56%), and canvasbacks (−57%) all remained well below their long-term averages.

Northern Alberta, Northeastern British Columbia, and Northwest Territories In strata 15–18, 20, and 77, conditions were rated good, with the exception of stratum 20 and small area in stratum 17. Average or above-average winter snowfall and spring precipitation filled beaver flowages, wetland drainage basins, shallow natural boreal wetlands, and lakes, all of which contained sufficient water to attract and hold waterfowl. Spring was later than normal in the entire survey area and some early dabbler nesting attempts were delayed. All large lakes in the Northwest Territories were still frozen on May 20. Spring came quickly thereafter, however. During the survey period all mid-size to large lakes were either melted or had sufficient water margins at the edge to allow for nesting activity. Stratum 20 (Athabasca-Peace Delta) was rated fair due to lower-than-normal spring flooding. Many shallow sloughs and shallow ends of lakes were dry, which reduced available waterfowl breeding and nesting habitat. A small portion of stratum 17 in the southern Northwest Territories was rated only fair due to local flooding from snowmelt and spring precipitation. Aside from delayed nesting by some early-arriving dabbler species, waterfowl production should be above average this summer. Additional production should come from ducks that have over flown dry prairie pothole regions this spring, as higher than normal concentrations of typical prairie-nesting species were observed. Conditions in the McKenzie River Delta and the boreal taiga strata (13 and 14) also were good for duck production.

Total duck numbers were 13% higher than the 2007 estimate, and similar to the long-term average for the survey area. Counts of all species except scaup were similar to last year's. Estimated scaup abundance was 29% higher than the 2007 estimate, but still 37% below the long-term average. Estimates of green-winged teal (+42%), blue-winged teal (+44%), Northern shoveler (+50%), and gadwall (+119%) remained well above their long-term averages. Estimates for all other species were similar to last year's estimates and long-term averages. As of July, habitat conditions and the production outlook for this survey area remained unchanged since the survey was flown.

Alaska, Yukon Territory, and Old Crow Flats: In Alaska, the Yukon Territory, and Old Crow Flats

(strata 1–12), breeding conditions depend largely on the timing of spring phenology, because wetland conditions are less variable than on the prairies. Good conditions were present throughout Alaska in 2008, though spring was slightly late in some coastal areas. Spring arrived later than average on the Copper River Delta (stratum 7) with leaf-out on approximately May 29 and temperatures remaining cooler than in recent years. Water levels were initially lower than normal through May and the first half of June, but subsequently rose to average levels. Spring arrived on the Yukon-Kuskokwim Delta near the long-term mean; ice on the Kuskokwim River broke up at Bethel three days later than the most recent 10-year mean and one day later than the long-term (37-year) mean, and water levels were lower than average.

Spring conditions arrived approximately a week earlier than average on eastern portions of the North Slope, whereas breeding conditions on the western North Slope were close to average. Water levels were normal for most of the North Slope survey area, with higher-than-normal levels on the western Arctic Coastal Plain. Despite the early breakup of snow and ice, cold temperatures persisted, which delayed green-up through the month of June. Conditions were variable throughout the interior portion of the state. In general, temperatures were cooler than average which led to a delayed and protracted ice breakup. Extensive flooding occurred on the Innoko National Wildlife Refuge (NWR). Further north on Koyukuk-Nowitna NWR, water levels were high, but flooding was limited. The south-central region of Alaska experienced a late, very cool spring and a delayed ice breakup. Ice-out on the lakes was up to seven days late, but waterfowl were on the lakes as soon as open water appeared. Water levels in major rivers were average to lower than normal.

The total duck estimate for the crew area was 10% lower than that of 2007, but 42% above the long-term average. Estimates for American wigeon (−17%, +74% LTA), and green-winged teal (−20%, +75% LTA) were lower than those of 2007 but well above their long-term averages. Northern pintail, mallard, and northern shoveler numbers were similar to last year's, but 36%, 46%, and 69% above their long-term averages, respectively. Estimates of gadwall, scaup, redheads, and canvasbacks were similar to those of 2007 and their long-term averages. With the exception of blue-winged teal, which is not a common breeding bird in Alaska, all species were at or above their long-term averages. In particular, this crew area was once again the only one in which the estimate for northern pintail, a species of concern, was above its long-term average. Overall, good waterfowl production was expected.

Eastern Survey Area: The boreal forest of the eastern survey area (strata 51–72) was generally in good condition this spring, although in most places spring was delayed by 1–2 weeks relative to the early springs of preceding years. Most of the eastern survey area experienced record or near-record winter snowfall and spring precipitation accompanied by average to below-average temperatures. These conditions caused extensive flooding in some parts of Maine and the Maritimes (strata 62–65) and likely disrupted normal waterfowl nesting chronology. Conditions there were rated fair. Newfoundland and Labrador (strata 66 and 67) also received above-average winter precipitation, but snow melt and breakup was gradual with minimal flooding, so conditions there were judged good for waterfowl production. The frost seal throughout much of southern Ontario (strata 52–54) was poor; however, winter snowfall and spring rains led to good-to-excellent habitat conditions across most of the area with the exception of extreme southwestern Ontario (stratum 54) which was characterized as fair. In more northern sections of Ontario, ice persisted on lakes late into May and early June but conditions were still classified as good. Conditions in northern Quebec (strata 69 and 70) were slightly drier than average; however, spring-like conditions came early so the area was classified as good to excellent.

Estimates of mallards, scaup, scoters, green-winged teal, American wigeon, buffleheads, American black ducks, ring-necked ducks, mergansers, and goldeneyes were all similar to their 2007 estimates and long-term averages (Table 13). As of July, habitat conditions in the eastern survey area appeared unchanged since surveys were flown.

Other areas: Wetland conditions along the West Coast of the U.S. and Canada were variable. In western Oregon, a good snow pack and spring rains generally improved water conditions. A late spring in eastern Oregon affected higher elevation breeding areas and a slow snow pack melt did little to improve wetland conditions. Late-spring flooding likely affected duck production. Total mallards in the breeding population were estimated at 84,300, 17% lower than last year's count of 101,700 and 22% below the long-term average. The estimate for total ducks (239,900) was down 29% relative to 2007, and 19% below the long-term average. In California, winter precipitation was below average. Above-average spring rains in northeastern California improved habitat there and good production is expected from that area. However, the Central Valley recorded the driest spring on record, and poor production was expected there. The total duck estimate in 2008 was 554,300, which was not different from last year's estimate or their long-term average of 601,000. The mallard estimate in 2008 was

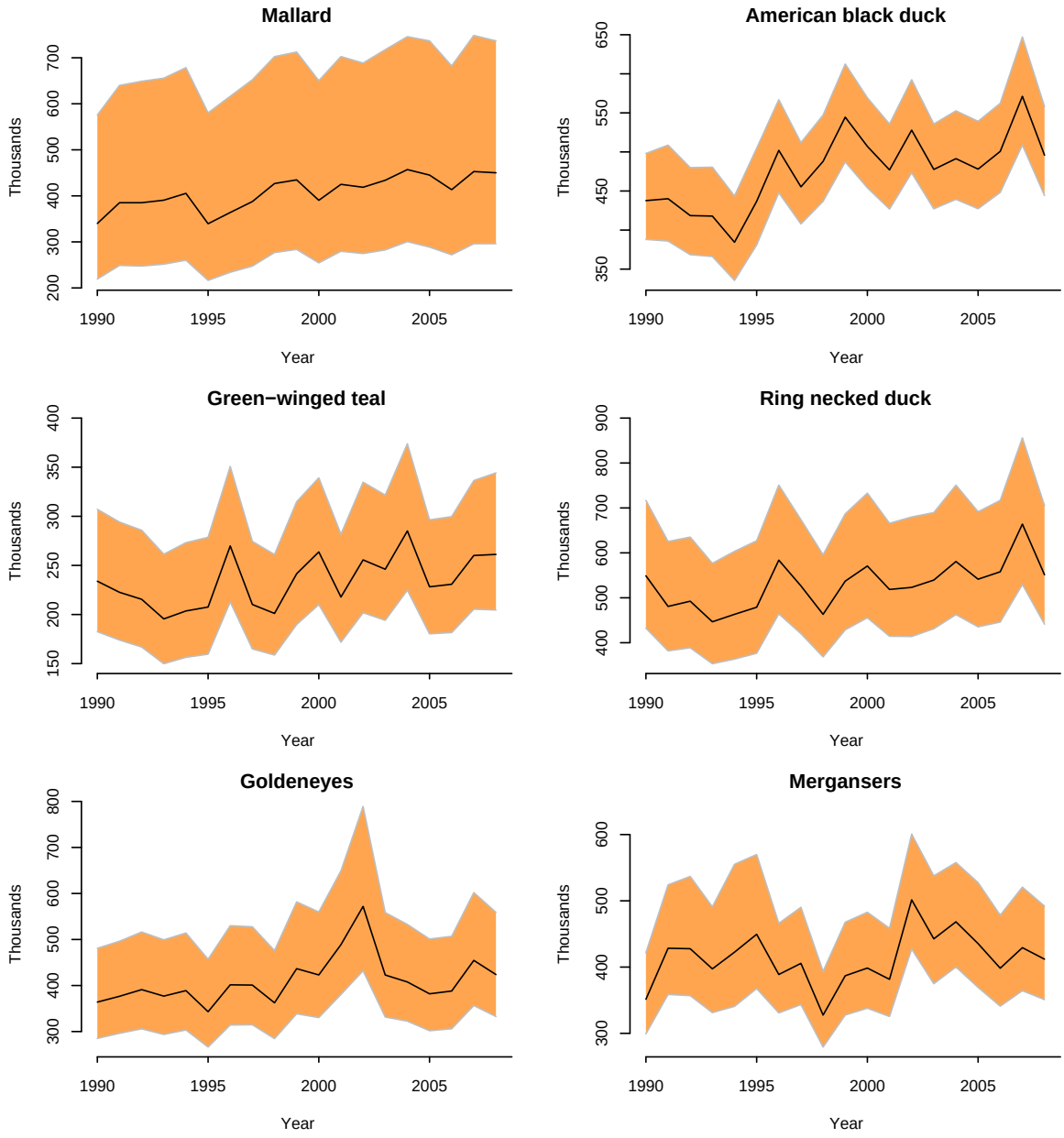

Figure 3: Breeding population estimates from Bayesian hierarchical models, and 90% credibility intervals for selected species in the eastern survey area (strata 51, 52, 63, 64, 66–68, 70–72).

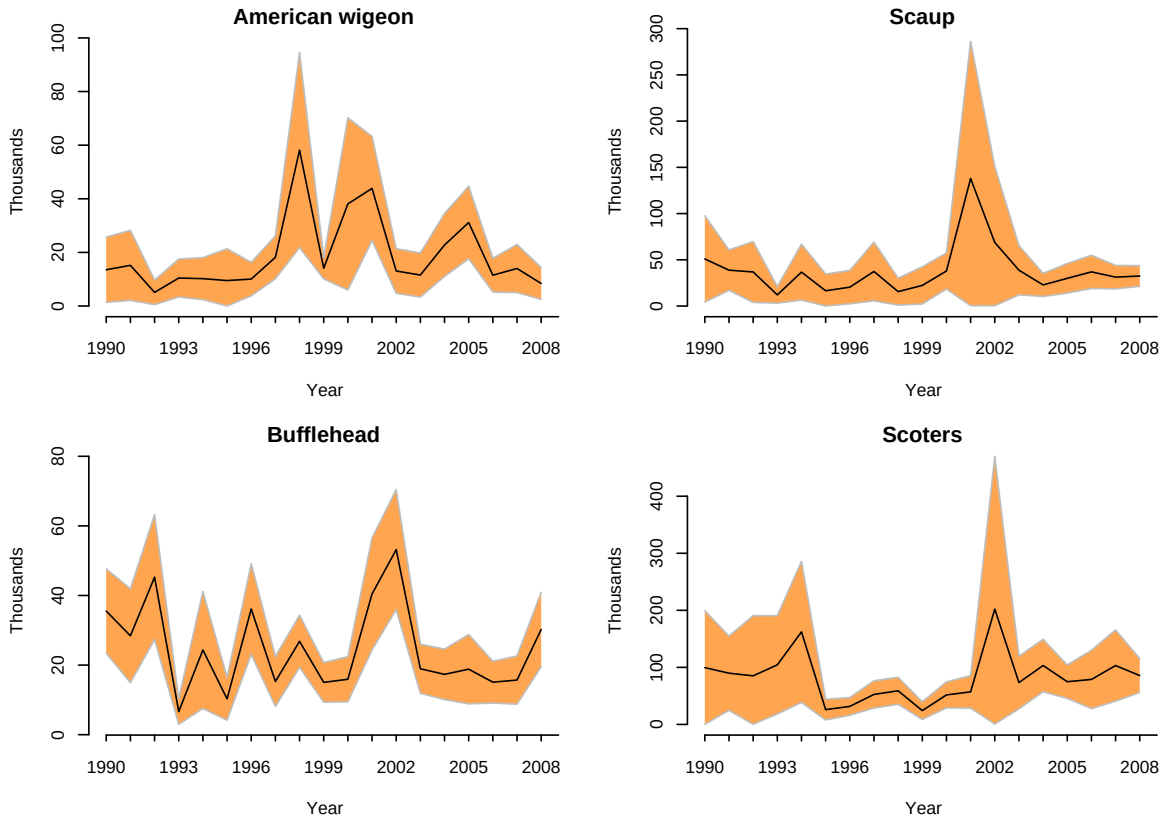

Figure 4: Breeding population estimates (precision-weighted means) and 90% confidence intervals for selected species in the eastern survey area (strata 51, 52, 63, 64, 66–68, 70–72).

297,100, also similar to the 2007 estimate and their long-term average (370,000). In eastern Washington, pond counts in non-irrigated areas were down 18% relative to 2007, contrary to expectations, likely because a cool, wet spring and slow snowmelt allowed water to soak into the ground rather than run off and fill wetland basins. In western Washington, abundant winter rains and a cool spring produced good breeding conditions. The index for total breeding ducks was 120,900; down 6% from 2007, and 21% below the long-term average. The total mallard index was estimated at 50,600, 10% higher than 2007, and 4% below the long-term average. In Nevada, the total duck index was 11,500, and the mallard index was 1,900.

In Nebraska, habitat conditions were good to excellent this year for duck production. The Sandhills received good moisture during April, May, and June, and production there should be better than average. Conditions were variable in the Great Lakes states. In Minnesota, pond numbers increased 24% compared to 2007 and were 32% above the long-term average. Estimated numbers of temporary wetlands increased 115% over 2007, and were similar to the long-term average. The mallard breeding population index (297,600) was similar to 2007 (242,500), was 34% higher than the long-term average (222,000), and similar to the 10-year average. The blue-winged teal breeding population index (152,000) was similar to the 2007 estimate (124,000) and below the 10-year (−28%) and long-term (−32%) averages. Spring was late in Minnesota, so leaf-out of deciduous trees and emergence of wetland vegetation was delayed. Wetland conditions in spring 2008 were improved relative to 2007. Ice-out on most lakes across the state was 1-2 weeks later than normal, especially in northern regions. April temperatures averaged 2.7°F below normal statewide; regional temperatures ranged from 3.7°F above average in west-central Minnesota to 1.4°F below average in east-central Minnesota. Breeding and brood-rearing habitat across Wisconsin was expected to be good in 2008, as fall-and-winter precipitation was 29% above normal. Winter came late in many areas, which increased spring flooding across key waterfowl breeding areas in the southern and eastern parts of the state. Above-average (+19% statewide) precipitation continued into the spring. Wetland numbers counted during the spring breeding waterfowl survey increased relative to 2007 and above-average wetland conditions prevailed across most of the state. The total duck estimate was 626,900 ± 77,200 and the mallard estimate was 188,000 ± 24,000. Wisconsin total duck numbers were 33% higher than the 2007 estimate and 45% above the 1974-2007 average. Mallard numbers were similar to their 2007 level, and similar to the long-term mean. In Michigan, the 2008 mallard population estimate of 189,000 birds was the lowest recorded since the survey began in 1992 and was 52% below the long-term (1992–2007) average. The number of wetlands observed was 20% below the long-term average and May water levels in Lake Huron and Lake Michigan remained low at about 0.5m below the 1918–2007 average. The total duck index of 457,000 fell 47% relative to the 2007 count.

In the Atlantic Flyway states along the East Coast of the U.S., habitat conditions were generally reported as good for nesting waterfowl. May temperatures were cooler than normal over much of the mid-Atlantic region. In New Jersey, March and April precipitation was well below normal, but Maryland experienced near-record precipitation in April and May, along with some flooding in late April. An intense coastal storm on May 12 produced exceptionally high tides in New Jersey and Maryland and likely destroyed early nests in coastal areas. In Virginia, the cool spring delayed nest initiation by a week or more and several storms produced local flooding, but average to slightly below-average production was still expected. Mallard numbers (619,100) from the 2008 Atlantic Flyway Breeding Waterfowl Survey were similar to the 2007 estimate of 687,600 and 21% below their long-term average of 787,500. Total duck numbers (1.2 million) were similar to the 2007 estimate of 1.5 million, and to their 1993–2007 average (1.4 million).

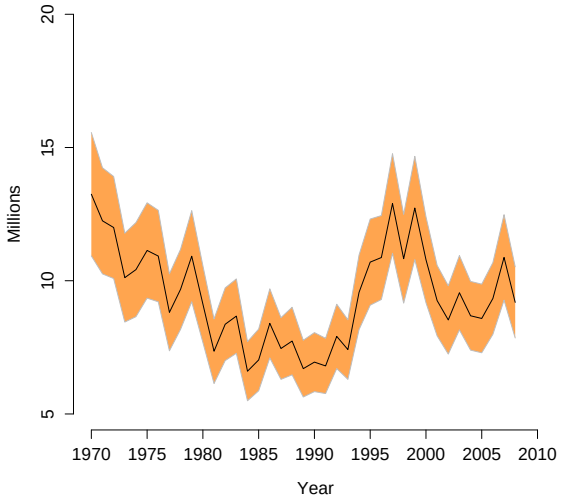

Figure 5: Estimates and 90% confidence intervals for the size of the mallard population in the fall.

Mallard Fall-flight Index

The mid-continent mallard population is composed of mallards from the traditional survey area (revised in 2008 to exclude Alaska mallards), Michigan, Minnesota, and Wisconsin, and was estimated

to be 7.7 ± 0.3 million. This was similar to to the revised 2007 estimate of 8.5 ± 0.3 million. In 2007, we reported a projected mallard fall-flight index of 11.4 million ± 1.0 million. After the removal of Alaska mallards from the mid-continent stock, the revised 2007 fall-flight estimate was 10.9 ± 1.0 million, with was not significantly different from the 2008 estimate of 9.2 ± 0.8 million. These indices were based on mid-continent mallard population models revised in 2002, and the 2008 updated model weights, and therefore differ from those previously published (U.S. Fish and Wildlife Service 2008, Runge et al. 2002).

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STATUS OF GEESE AND SWANS

Abstract: We provide information on the population status and productivity of North American Canada geese (*Branta canadensis)*, brant (*B. bernicla*), snow geese (*Chen caerulescens*), Ross' geese (*C. rossii*), emperor geese (*C. canagica*), white-fronted geese (*Anser albifrons*), and tundra swans (*Cygnus columbianus*). In May of 2008, much of eastern Arctic and subarctic Canada experienced well above-average temperatures which contributed to average or early availability of nesting sites. Reports from most other important goose and swan nesting areas indicated near-average nesting phenology and average production of young in 2008. Poor nesting conditions were reported from Wrangel Island, Russia and relatively small areas along western Hudson Bay, Bristol Bay (Alaska), and interior Alaska. Reduced wetland abundance in the Canadian and U.S. prairies, and a cool and wet spring in other southern areas may have reduced the production of some temperate-nesting Canada geese in 2008. Primary abundance indices increased for 17 goose populations and decreased for nine goose populations in 2008 compared to 2007. Primary abundance indices for both populations of tundra swans decreased in 2008 from 2007 levels. The following populations displayed significant positive trends during the most recent 10-year period ($P < 0.05$): Mississippi Flyway Giant, Aleutian, Atlantic Canada geese, Western Arctic/Wrangel Island snow geese, and Pacific white-fronted geese. No populations showed a significant negative 10-year trend. The forecast for the production of geese and swans in North America in 2008 is regionally variable, but production for many populations will be improved from the generally low production observed in 2007.

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 I, J, and K) are derived from a variety of surveys conducted by biologists from federal, state, and provincial agencies, and universities (Appendices B). Surveys include the Midwinter Survey (MWS, conducted each January in wintering areas), the Waterfowl Breeding Population and Habitat Survey (WBPHS, see Status of Ducks section of this report), surveys that are specifically designed for various populations, and others. 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.

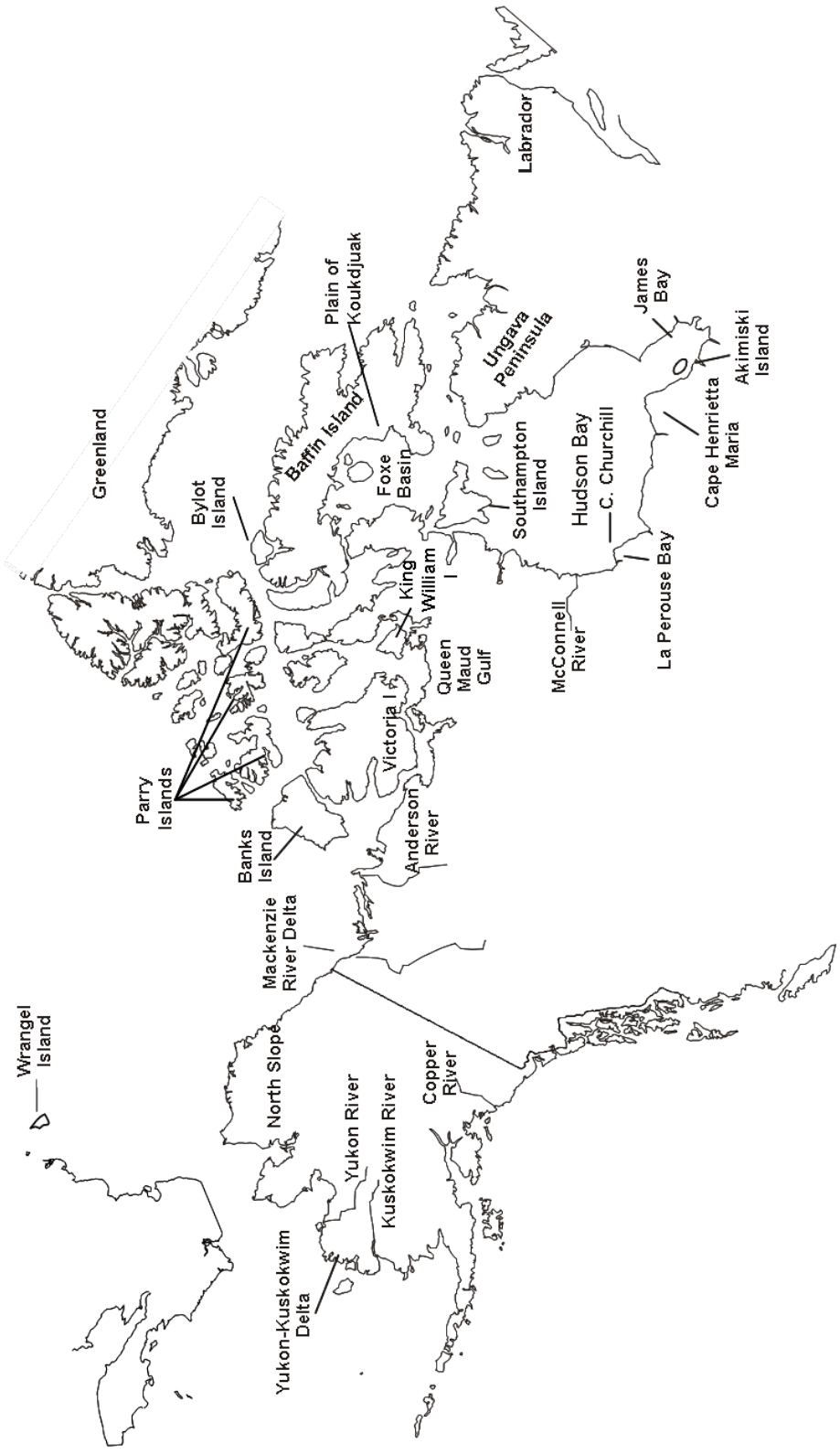


Figure 6: Important goose nesting areas in Arctic and subarctic North America.

Figure 7: The extent of snow and ice cover in North America on 2 June 2008 and 2 June 2007 (data from National Oceanic and Atmospheric Administration).

RESULTS AND DISCUSSION

Conditions in the Arctic and Subarctic

Spring nesting conditions for geese and swans across the Canadian and Alaskan Arctic were improved in 2008 compared with 2007. Much of the eastern Arctic and subarctic experienced well-above average temperatures in May, which promoted conditions favorable for the production of young. Reports from most other areas indicated near-average nesting phenology and average production of young in 2008. Poor nesting conditions were reported from the Mississippi Valley Population Canada goose range, Wrangel Island (Russia), some areas along western Hudson Bay, Bristol Bay (Alaska), and interior Alaska. The snow and ice cover graphic (Figure 7, National Oceanic and Atmospheric Administration, http://www.natice.noaa.gov/ims/) indicates substantially less snow cover on 2 June in 2008 than in 2007.

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. However, reduced wetland abundance in the Canadian and U.S. prairies in 2008 may have reduced nesting effort for these geese. In several areas of the midwest and the west, a cool, wet spring may have reduced gosling production. Although production of temperate-nesting Canada geese may be reduced in some localized areas, overall production of most populations is expected to be near average in 2008.

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, but we continue to present interim indices until that new index is adopted. Based on data from the 2008 WBPHS, biologists estimated 41,900 (± 20,100) indicated pairs (singles plus pairs) within the NAP range (strata 66 and 67), 40% fewer than in 2007 ($P = 0.155$, Figure 9(a)). Indicated pair estimates declined an average of 5% per year during 1999–2008 ($P = 0.063$). The 2008 estimate of 108,400 (± 51,000) total NAP Canada geese was 35% lower than last year's estimate ($P = 0.218$). Preliminary information from the CWS helicopter plot surveys in Newfoundland and Labrador show that indicated pairs increased about 19% from 2007 levels. The timing of spring snowmelt was near average in eastern Newfoundland and early in other NAP breeding areas in 2008. Although some spring flooding occurred, clutch sizes and the number of observed goose nests appeared higher than average. A fall flight higher than in 2007, a poor nesting year, is expected.

Atlantic Population (AP): AP Canada geese nest throughout much of Quebec, especially along Ungava Bay, the eastern shore of Hudson Bay, and on the Ungava Peninsula. The AP winters from New England to South Carolina, but the largest concentrations occur on the Delmarva Peninsula (Figure 8). Spring surveys in 2008 yielded an estimate of 169,700 (± 28,100) breeding pairs, 13% fewer than in 2007 ($P = 0.236$, Figure 9(b)). Breeding pair estimates increased an average of 8% per year during 1999–2008

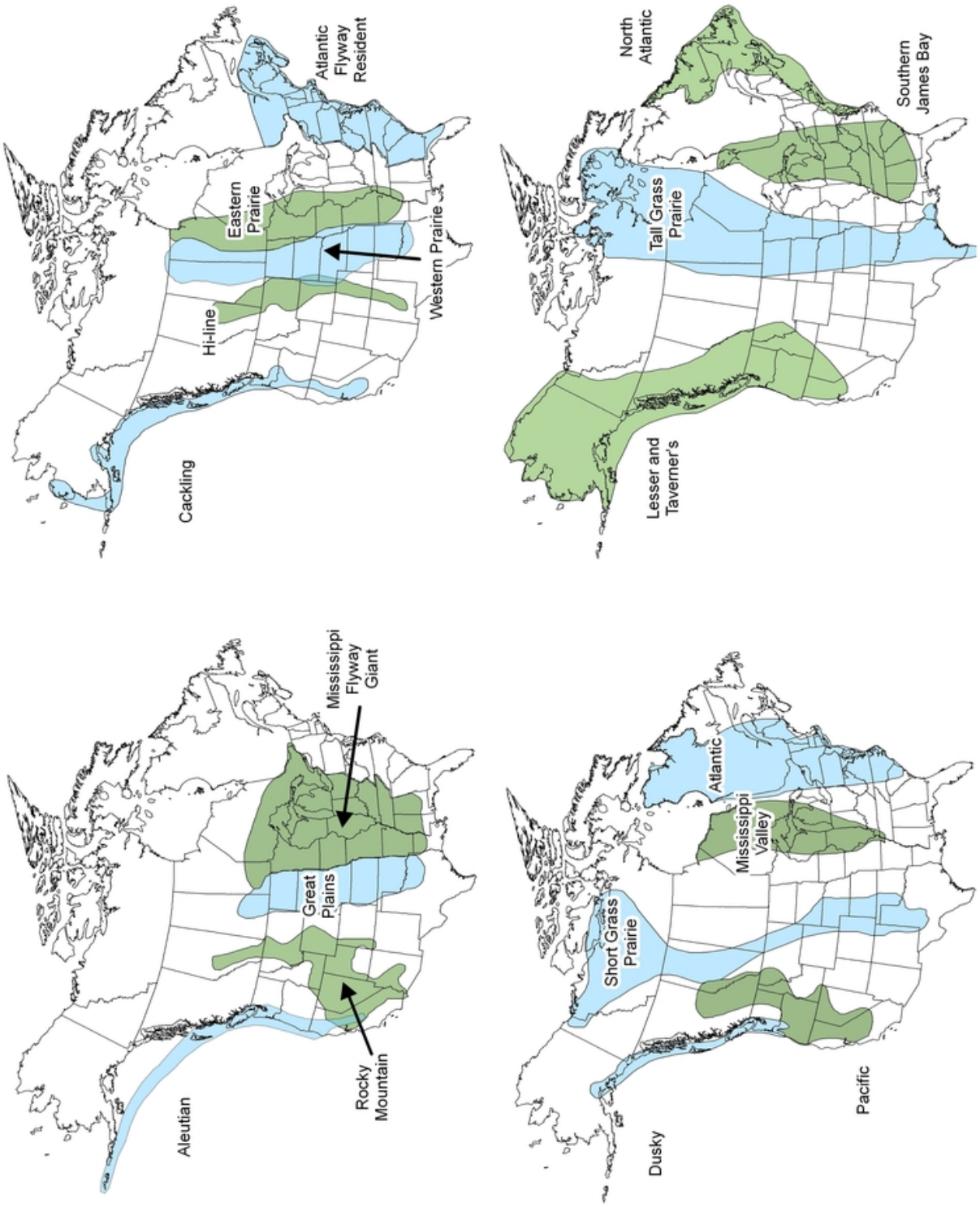
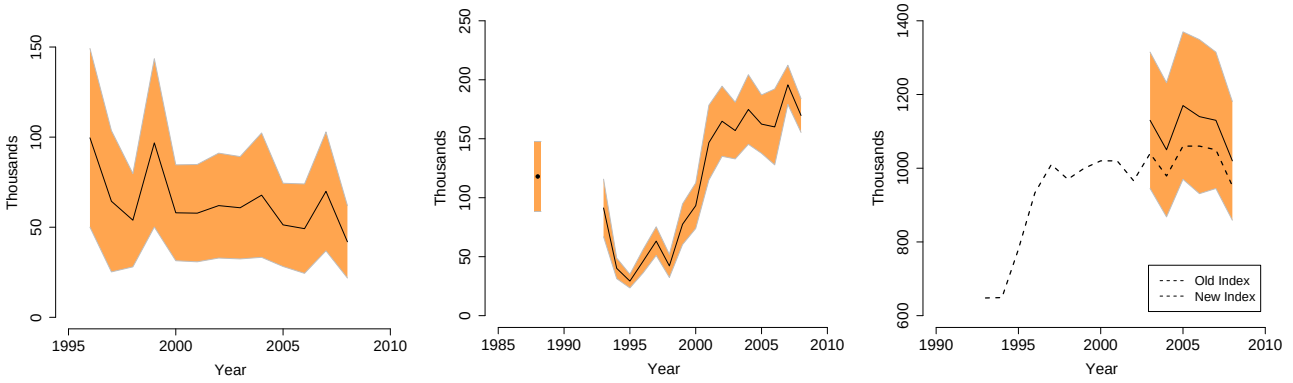


Figure 8: Approximate ranges of Canada goose populations in North America.



(a) North Atlantic Population (b) Atlantic Population (c) Atlantic Flyway Resident Population

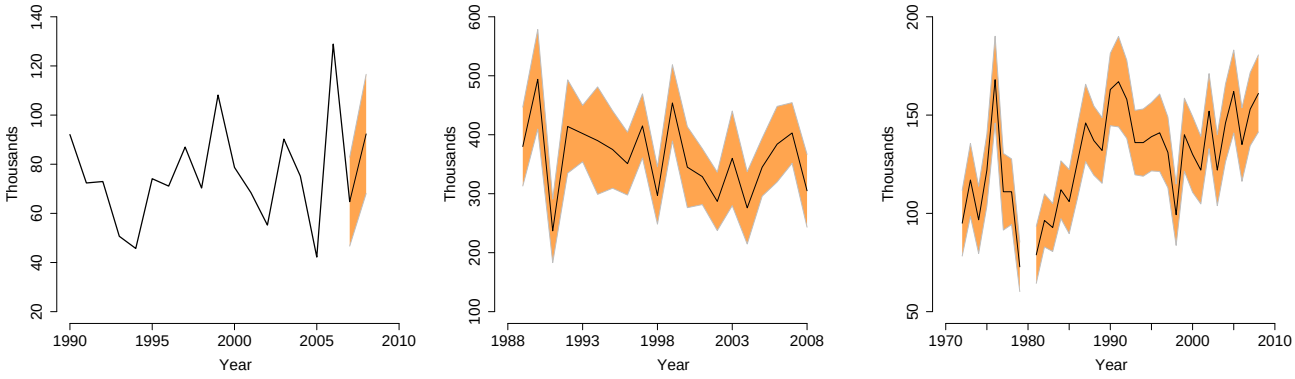
Figure 9: Estimated number (and 95% confidence intervals) of North Atlantic Population breeding pairs, Atlantic Population breeding pairs, and the Atlantic Flyway Resident Population Canada geese counted during spring surveys.

($P = 0.006$). The estimated total spring population of 989,000 (± 159,000) in 2008 was 19% lower than in 2007 ($P = 0.078$). This year, 61% of indicated pairs were observed as singles, well above the 16-year average, which suggested a good-to-excellent breeding effort. May temperatures in 2008 were 4–5°C warmer than average, and habitat appeared excellent during the survey period. Nesting studies along Ungava Bay in 2008 indicated nesting phenology was about four days earlier than average. Average clutch size was 4.7 eggs, the largest recorded since 1996. An improved fall flight from that of 2007 is expected.

Atlantic Flyway Resident Population (AFRP): This population of large Canada geese inhabits southern Quebec, the southern Maritime provinces, and all states of the Atlantic Flyway (Figure 8). Surveys during spring 2008 estimated 1,024,900 (± 161,000) Canada geese in this population, 9% fewer than in 2007 ($P = 0.411$, Figure 9(c), using the method initiated in 2003). These new indices decreased an average of 1% per year during the last six years ($P = 0.586$). Although several southeastern states experienced below-average wetland conditions in 2008 following an extended drought, gosling production did not appear to be depressed. In most of the AFRP range, gosling production, measured by young to adult ratios during banding operations, appeared to be average or above average. The 2008 fall flight was expected to be similar to that of 2007.

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). In 2008, the estimated number of breeding SJBP geese was 92,300 (± 24,200), 43% higher than last year's index ($P = 0.075$, Figure 10(a)). These SJBP indices have shown no trend since 1999 ($P = 0.926$). Transect level analyses of this year's breeding pair estimates appeared similar to the previous five years on Akimiski Island and the mainland. The 2008 survey indicated a total spring population of 110,400 (± 27,000) Canada geese, 13% more than in 2007. Surveys in 2008 were conducted with the traditionally used aircraft and within the target period. Above-average snow pack and a cold April, followed by above-average temperatures, contributed to near-average nesting phenology in 2008, later than that observed during the previous three years. Nesting studies on Akimiski Island indicated above-average nesting effort, but slightly below-average clutch sizes. Biologists anticipate the fall flight in 2008 to be near average.

Mississippi Valley Population (MVP): The principal nesting range of this population is in northern Ontario, especially 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 2008 indicated the presence of 305,200 (± 61,800) MVP breeding adults, 24% fewer than in 2007 ($P = 0.017$, Figure 10(b)). Estimates of breeding adults decreased an average of 1% per year during 1999–2008 ($P = 0.639$). Surveys indicated a total population of 626,400 (± 156,900) Canada geese, a 9% increase from the revised 2007 estimate ($P = 0.654$). Nesting phenology in the MVP range in 2008 was later than the last several years, but near



(a) Southern James Bay Population (b) Mississippi Valley Population (c) Eastern Prairie Population

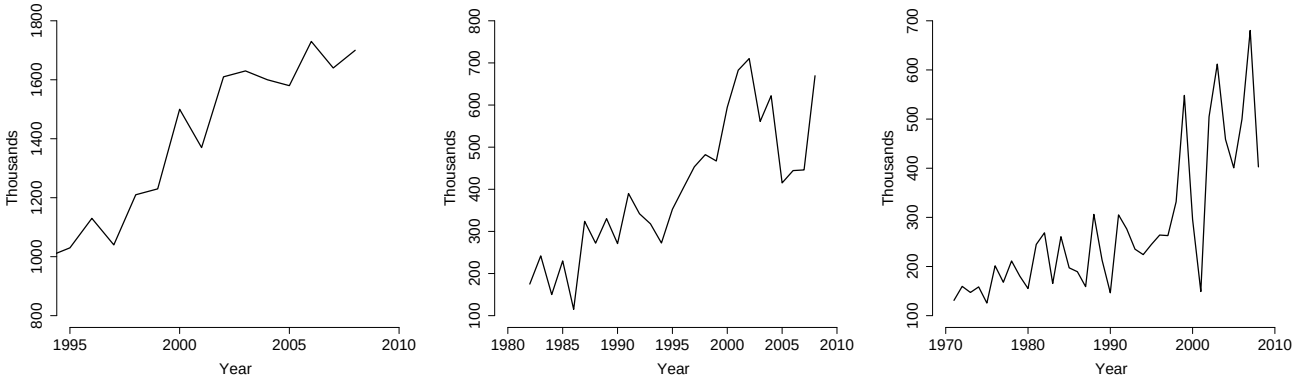
Figure 10: Estimated number (and 95% confidence intervals) of Southern James Bay Population breeding geese, Mississippi Valley Population breeding geese, and Eastern Prairie Population single and paired geese counted during spring surveys.

the average since 1989. An April blizzard and freezing temperatures through much of May and June may have contributed to delayed phenology and a high number of non-breeding adults. Nest densities at the Burntpoint camp east of Peawanuck, Ontario, were only 33% of those observed in 2007. Clutch sizes there were smaller than in 2007 and apparent nest success was low (34%). Biologists expect poor production in 2008 and a fall flight lower than that of last year.

Eastern Prairie Population (EPP): These geese nest in the Hudson Bay Lowlands of Manitoba and concentrate primarily in Manitoba, Minnesota, and Missouri during winter (Figure 8). The 2008 survey estimate of single and paired EPP geese was 161,100 (± 19,600), 5% higher than last year ($P = 0.576$, Figure 10(c)). Estimates of these population components have increased an average of 2% per year during 1999-2008 ($P = 0.081$). The 2008 spring estimate of total geese was 256,600 (± 33,600), 18% higher than the 2007 estimate ($P = 0.059$). The estimated number of productive geese (nesting pairs and singles) in 2008 declined 24% from the record-high level of 2007. Nesting phenology at Cape Churchill in 2008 was substantially later than in 2006 and 2007 (2 years of very early phenology), but was only four days later than the long-term average. Biologists there observed a median hatch date of 28 June, the highest nest density since 1988, slightly below-average clutch sizes, and average nest success. The fall flight in 2008 is expected to be similar to that of last year but with a somewhat lower proportion of young.

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 1,700,500 MFGP geese during the spring of 2008, 3% more than the 2007 estimate, and only slightly below the record-high estimate of 1.73 million in 2006 (Figure 11(a)). These estimates have increased an average of 3% per year since 1999 ($P = 0.004$). Cold, wet weather or flooding during early spring of 2008 substantially reduced gosling production in portions of four states (Arkansas, Iowa, Michigan, and Ohio) and may have reduced production somewhat in additional areas. Alabama reported above-average nesting conditions in 2008, while other states in MFGP range reported near-average conditions. Biologists expect a fall flight this year similar to that of 2007.

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 2008 MWS, 669,500 WPP/GPP geese were counted, 50% above last year's estimate (Figure 11(b)). These indices decreased 1% per year during 1999–2008 ($P = 0.540$). In 2008, the estimated spring population in the portion of WPP/GPP range included in the WBPHS was 834,800 (± 122,700)



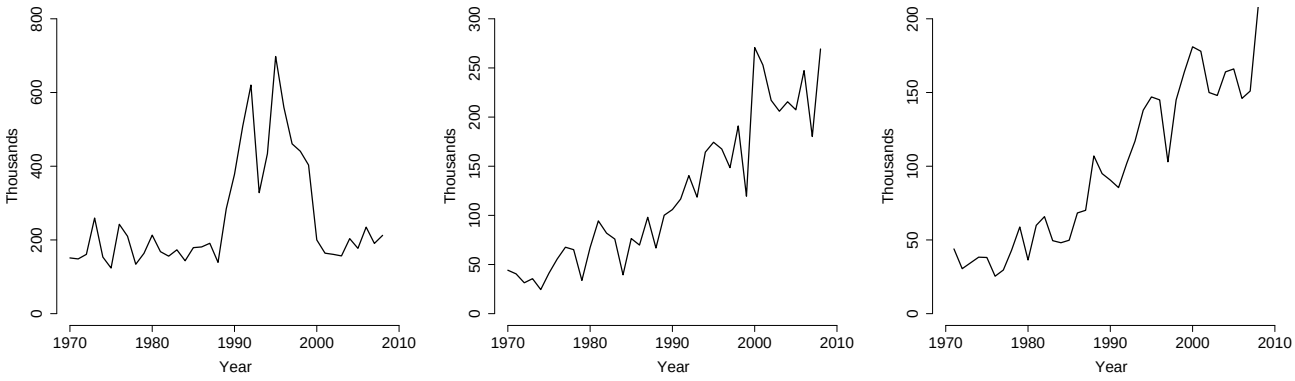
(a) Mississippi Flyway Giant Population (b) Western Prairie/Great Plains Population (c) Tall Grass Prairie Population

Figure 11: Number of Mississippi Flyway Giant Population geese counted during spring, Western Prairie/Great Plains Population geese counted during winter, and Tall Grass Prairie Population Canada geese counted during winter.

geese, 8% fewer than last year ($P = 0.422$). The WBPHS estimates have increased an average of 5% per year since 1999 ($P = 0.004$). Wetland conditions in the Canadian WPP range varied from dry in the prairies to wet in the parklands. Goose abundance in South and North Dakota declined in 2008 according to WBPHS data but remained above the 10-year averages. Gosling production was expected to be above average in Nebraska, poor in North Dakota, and near average in other GPP states. A fall flight similar to that of last year 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 2008 MWS in the Central Flyway, 402,700 TGPP geese were counted, 41% fewer than last year's record-high index (Figure 11(c)). These estimates increased an average of 5% per year during 1999–2008 ($P = 0.334$). May temperatures throughout most of the TGPP nesting range in 2008 were 4–5°C above average and likely promoted early availability of nest sites. An early snowmelt was reported over much of Baffin Island. June temperatures in most of the TGPP range were near average, but substantial snowfall occurred on Southampton Island in early June. Biologists there reported that geese arrived early, but nesting phenology was delayed and near average. Limited information from the McConnell River area indicated the timing of nesting there was slightly later than average. Nesting phenology in the Queen Maud Gulf Sanctuary was reported as near average and goose production from that area is expected to be average. Available information suggests that the production of TGPP Canada geese will be improved over the poor nesting season of 2007.

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 2008 was 212,400, 12% higher than the 2007 index (Figure 12(a)). These indices have declined an average of 2% per year since 1999 ($P = 0.484$). In 2008, the estimated spring population of SGPP geese in the Northwest Territories (WBPHS strata 13-18) was 116,200 ($\pm$ 53,100), a 35% decrease from 2007 ($P = 0.334$). WBPHS estimates have increased an average of 4% per year since 1999 ($P = 0.287$). In most of the Arctic range of the SGP geese, May temperatures were 2-3°C warmer than average, and June temperatures were near average. May snowfall was well below average near Cambridge Bay and Kugluktuk. Nesting phenology in the Queen Maud Gulf Sanctuary was reported as near average, and average goose production from that area is expected. Exploratory aerial surveys were conducted over western Victoria Island 19 June to 1 July 2008, and observers reported little snow cover and a good Canada goose nesting effort. Canada goose



(a) Short Grass Prairie Population (b) Hi-line Population (c) Rocky Mountain Population

Figure 12: Estimated number of Short Grass Prairie, Hi-line, and Rocky Mountain Population Canada geese. Short Grass Prairie and Hi-line Populations surveys are conducted during winter and the Rocky Mountain Population surveys are conducted during spring.

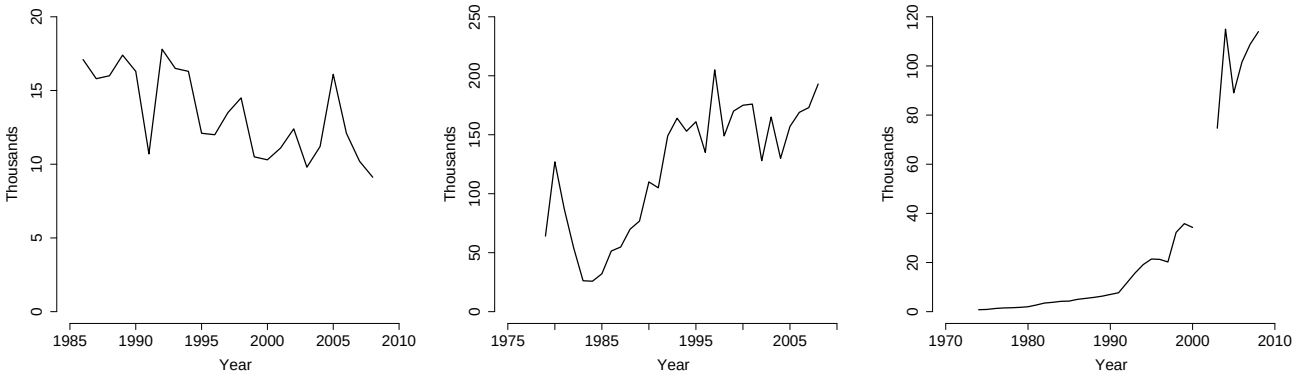
nesting effort in coastal areas of the western Canadian mainland was estimated as near average. Wetland conditions in boreal forest nesting areas were assessed as good. Although specific information is limited at this time, production from SGPP geese is expected to be improved from that of 2007.

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). The 2008 MWS indicated a total of 269,300 HLP Canada geese, 49% more than last year's estimate (Figure 12(b)). The MWS estimates have increased an average of 3% per year since 1999 ($P = 0.363$). The 2008 WBPHS estimate for Saskatchewan, Alberta, and Montana was 337,300 ($\pm$ 75,200), 13% higher than the 2007 estimate ($P = 0.433$). The WBPHS population estimates have increased an average of 3% per year during 1999-2008 ($P = 0.200$). Wetland abundance and levels were generally lower than average throughout the northern HLP range in 2008. Cool and wet weather during nesting and hatching may have reduced production in Wyoming and other states. The fall flight of HLP geese is expected to be similar to that of 2007.

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 2008 totaled 210,400 geese, 39% more than in 2007 (Figure 12(c)). These estimates have shown no trend during the last 10 years ($P = 0.866$). Population indices in 2008 increased in Alberta, Montana, Nevada, and Arizona, but decreased in Utah. Production is expected to be near average throughout RMP range except in Arizona where production was excellent. The fall flight of RMP geese is expected to be at least as large as that of last year.

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 2008 was 243,700, 78% higher than last year. Most PP geese are surveyed in Alberta (WBPHS strata 76–77) where 184,300 ($\pm$ 106,700) were estimated in 2008, 105% more than in 2007 ($P = 0.063$). The 2008 indices of statewide nesting effort increased 3% in Oregon and 38% in Washington from 2007 levels. Much of the PP range experienced a cool and wet spring, which improved wetland habitats but may have delayed nesting or reduced nest success, especially in British Columbia. In general, however, gosling production was expected to be near average in most of PP goose range, and a fall flight larger than that of 2007 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). The official population index of DCG was changed from a wintering mark-resight method to a direct count of geese on DCG breeding areas in 2007. Figure 13(a) includes the new indices for the period 1986–2008. The 2008 spring population estimate was 9,100 DCG, 10% below



(a) Dusky Canada Geese (b) Cackling Canada Geese (c) Aleutian Canada Geese

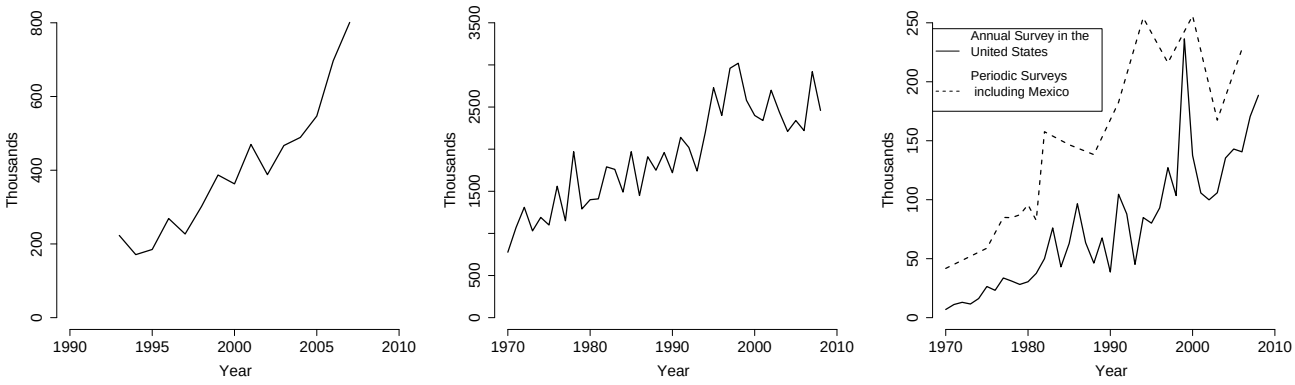
Figure 13: Estimated numbers of Dusky, Cackling, and Aleutian Population Canada geese. Dusky and Cackling geese are surveyed during the spring. Numbers of Aleutian geese are estimated using mark-resight methods.

2007, and a record low for this population since comparable surveys have been conducted (1986). These estimates have shown no trend over the last 10 years ($P = 0.998$). In 2008, dusky Canada geese on the Copper River Delta experienced cooler than average spring temperatures and delayed their nesting activities several days later than average. The spawning of eulachon (a common prey fish of eagles) in 2008 was protracted, which usually results in decreased eagle predation of DCG. Near average production and a fall flight similar to that of last year is expected.

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). Since 1999, the primary index of this population has been an estimate of the fall population derived from the previous spring counts of adults on the YKD. The fall estimate for 2008 is 193,300 geese, 12% higher than that of 2007. These estimates have increased an average of 1% per year since 1999 ($P = 0.622$, Figure 13(b)). Indices of total geese and indicated pairs obtained during the 2008 survey of the YKD coastal zone were the second highest on record since surveys were started in 1985. The timing of spring snowmelt on the YKD was near average and the hatch of cackling geese was about two days earlier than the long-term average. Yukon Delta nesting surveys conducted during 2008 indicated clutch sizes were slightly below average and that fox predation reduced production substantially in some areas. Overall, near-average production and a fall flight similar to that of last year are expected.

Lesser and Taverner's Canada Geese: These populations nest throughout Alaska and winter in Washington, Oregon, and California (Figure 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 2008 estimate of Canada geese within WBPHS strata predominantly occupied by these subspecies (strata 1–6, 8, 10–12) was 93,100, 25% higher than the 2007 estimate ($P = 0.494$). These estimates have declined an average of 2% per year since 1999 ($P = 0.283$). In much of Alaska's interior, spring break-up was delayed by cool spring temperatures, and nesting was delayed by up to one week. Flooding was variable but not extreme. Production of lesser Canada geese in the interior is expected to be near average. Spring phenology was nearly a week early in eastern portions of the North Slope, and near average to the west and on the Yukon Delta. Production of Taverner's geese was expected to be better than average on the Yukon Delta and near average on the North Slope.

Aleutian Canada Geese (ACG): The Aleutian Canada goose was listed as endangered in 1967 (the population numbered approximately 800 birds in 1974) and was de-listed in 2001. These geese now nest primarily on the Aleutian Islands, although historically they nested from near Kodiak Island, Alaska to the Kuril Islands in Asia. They now winter along the Pacific Coast to central California (Figure 8). Their population estimate has been based on observations of neck-banded geese in California since 1996. These estimates have been recalculated using new analytical



(a) Ross' Geese (b) Mid-continent Population Light Geese (c) Western Central Flyway

Figure 14: Estimated numbers of adult Ross' geese nesting at the Karrak Lake colony, Nunavut, and Mid-continent Population snow and Ross' geese surveyed during winter.

methods. The preliminary population estimate during the winter of 2007–2008 was 114,000 (± 14,400), 5% higher than the revised 2007 estimate ($P = 0.633$, Figure 13(c)). These estimates have increased by an average of 14% per year during the last 10 winters ($P = 0.001$). A hatch date of 21 June and a clutch size of 4.1 eggs was determined from 35 nests on Buldir Island in 2008. A fall flight similar to that of last year was 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 along the western coast of Hudson Bay, and Southampton, Baffin, and Banks Islands. Ross' geese are present in the range of three different populations of light geese and primarily winter in California, New Mexico, Texas, and Mexico, with increasing numbers in Louisiana and Arkansas (Figure 15). 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 801,000 adult Ross' geese nested there in 2007, a 15% increase from 2006 and another consecutive record high (Figure 14(a)). These estimates increased an average of 9% per year during 1998-2007 ($P < 0.001$). Colony 10, about 60 miles to the east of Karrak Lake, has grown to contain similar or higher numbers of Ross' geese. Nesting studies at the McConnell River colony where approximately 80,000 (± 25,500) Ross' geese nested in 2007 were discontinued this year. In much of the central Canadian Arctic, May temperatures were 2–3°C warmer than average, and June temperatures were near average. Snowfall in May was well below average near Cambridge Bay and Kugluktuk. Nesting phenology in the Queen Maud Gulf Sanctuary was 1–2 days later than average. Biologists there expected Ross' goose production to be near average and result in a fall flight comprised of 20–30% young. May temperatures in the eastern Canadian Arctic were even warmer, 4–5°C above average, which likely promoted early availability of nest sites and good production. However, substantial snowfall occurred on Southampton Island in early June. Biologists there reported that geese arrived early, but initiation was delayed until near-average timing. Limited information from the McConnell River area indicated the timing of nesting there was slightly later than average. Ross' goose production is expected to be improved from that of last year, and near an average level.

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 15). These geese winter primarily in eastern Texas, Louisiana, and Arkansas. During the 2008 MWS, biologists counted 2,455,100 light geese, 16%

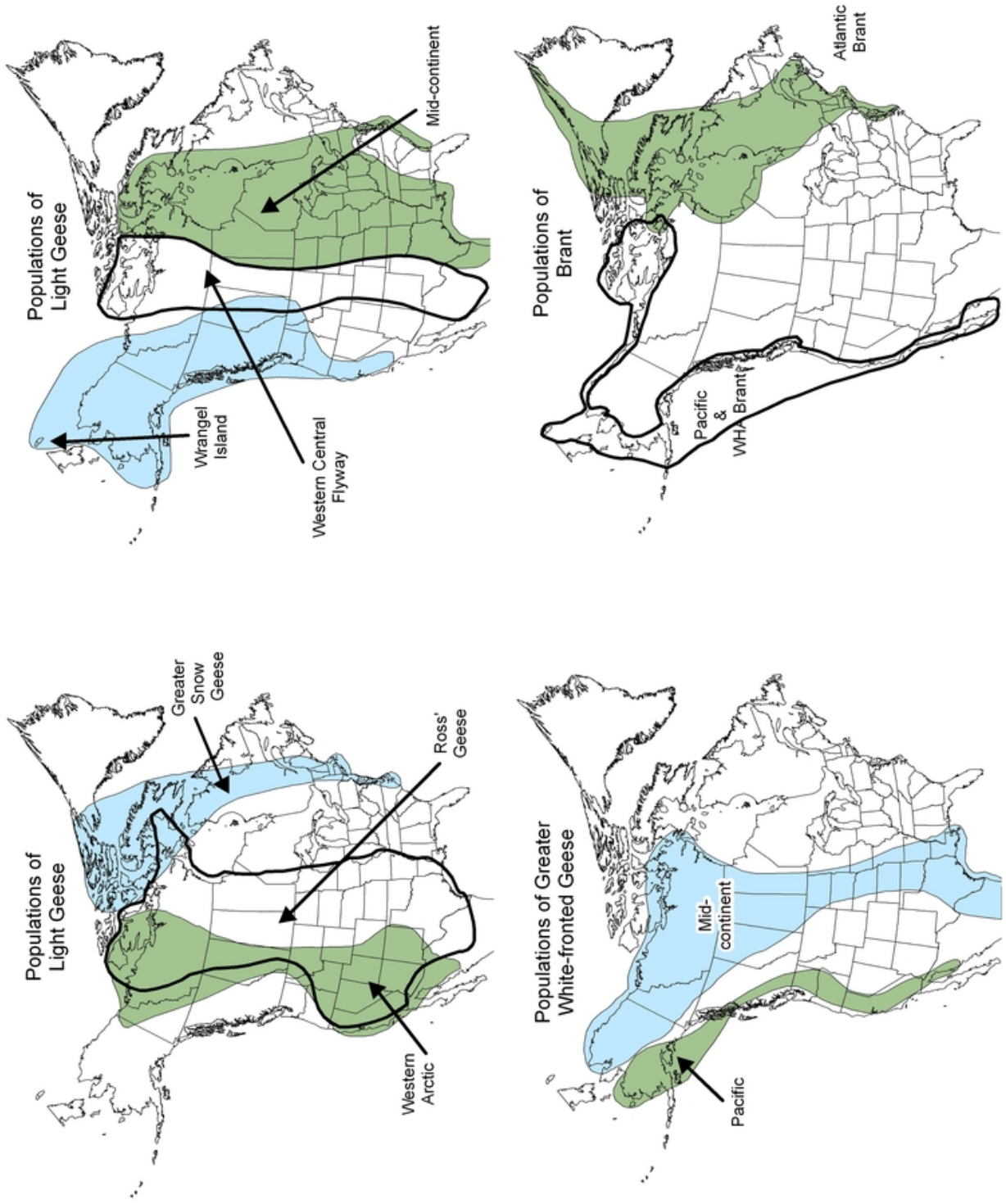
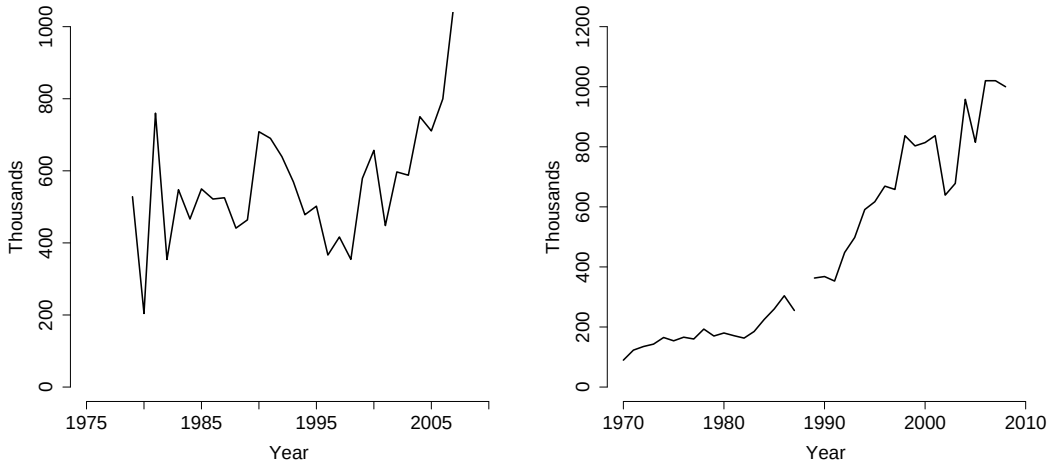


Figure 15: Approximate ranges of brant and snow, Ross', and white-fronted goose populations in North America.



(a) Western Arctic/Wrangel Island Population

(b) Greater Snow Goose Population

Figure 16: Estimated numbers of Western Arctic/Wrangel Island Population snow geese and Greater Snow Goose Population geese counted during the fall and spring surveys, respectively.

fewer than in 2007 (Figure 14(b)). Winter indices during 1999–2008 indicated no annual trend in this population ($P = 0.923$). May temperatures in the eastern Canadian Arctic were 4–5°C above average, June temperatures were near average, and an early snowmelt was reported for much of Baffin Island. On Southampton Island, June snowfall was greater than average and biologists there reported that geese arrived early, but nesting was initiated with near average timing. Limited observations at smaller southerly colonies suggested that nesting phenology was slightly later than average near the McConnell River and near average on Akimiski Island. Reports from La Perouse Bay suggested poor production due to flooding and harsh spring conditions. Average or better production was expected from the large northern colonies and should produce a fall flight with a higher proportion of young than in 2007.

Western Central Flyway Population (WCFP): This population is composed primarily of snow geese, but Ross' geese now comprise nearly a third of the WCFP. 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 15). WCFP geese wintering in the U.S. portion of their range are surveyed annually, but the entire range, including Mexico, is surveyed only once every three years. In the U.S. portion of the survey, 188,500 geese were counted in January 2008, 11% more than in 2007 (Figure 14(c)). These population indices have increased 1% per year during 1999–2008 ($P = 0.682$). May temperatures were 2–3°C warmer than average in much of the central Arctic. Snowfall in May was well below average near Cambridge Bay and Kugluktuk and June temperatures were near average. Nesting phenology in the Queen Maud Gulf Sanctuary was reported as approximately two days later than average and goose production from that area is expected to be near average. Reports indicate that spring phenology on Banks Island was relatively early. Lemmings were abundant there, which generally provides nest predators with alternative prey, and increases goose nesting success. Production was expected to be better than that of last year and near average for this population.

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 15). In winter, WA and WI segments commingle with light geese from other populations in California, complicating surveys. The fall 2007 estimate of WAWI snow geese was 1,073,500, 34% higher than the previous year,

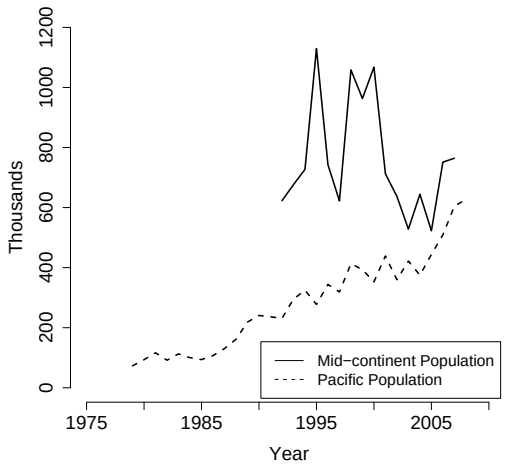


Figure 17: Estimated number of Mid-continent and Pacific white-fronted goose Population geese surveyed during fall and spring surveys.

and a record high (Figure 16(a)). Fall estimates increased 9% per year during 1998–2007 ($P = 0.002$). Reports indicate that spring phenology on Banks Island was relatively early. Lemmings were abundant, which generally provides nest predators with alternative prey, and increases goose nesting success. Similar to 2007, snow goose nesting effort at the small Anderson River and Kendall Island colonies appeared to be strong in 2008. Nesting conditions at Wrangel Island's Tundra River colony were poorer than during the last several years. Preliminary estimates from Wrangel Island included a spring population of 145,000 adults, but only 10–12,000 nesting pairs, down from 40,000 pairs in 2007. Estimates of the Wrangel Island spring population have increased an average of 5% per year since 1999 ($P < 0.001$). Biologists expect poor production from Wrangel Island with nest success below 25% and less than 10% young in the fall population. With average production from Banks Island in 2008, a fall flight somewhat reduced from that of last year is expected.

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 15). This population is monitored on their spring staging areas near the St. Lawrence Valley in Quebec. The preliminary estimate from spring surveys in 2008 was 1,004,000 (± 124,000) geese, 1% fewer than during last year's estimate ($P = 0.839$, Figure 16(b)). Spring estimates of greater snow geese have increased an average of 3% per year since 1999 ($P = 0.054$). The number of snow geese counted during the 2008 MWS in the Atlantic Flyway was 407,200, a 17% decrease from the previous survey. Midwinter counts have increased an average of 2% per year during 1999–2008 ($P = 0.472$). The largest known greater snow goose nesting colony is on Bylot Island. Snowmelt on Bylot Island in 2008 was one of the earliest on record due to a low snowpack and warm May temperatures. The peak of nest initiation was two days earlier than average. Nest density in the colony was very high, mean clutch size (4.0) was above average (3.7), and nesting success appeared to be quite high through mid-incubation. The forecast was for very high production and a fall flight above average.

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 15). The index for this population was a fall estimate from 1979–1998. Since 1999, the index has been a fall population estimate derived from spring surveys of adults on the YKD and Bristol Bay. The 2008 fall estimate is 627,000, 4% higher than the 2007 estimate and another record high (Figure 17). These estimates have increased an average of 6% per year since 1999 ($P = 0.003$). The timing of spring snowmelt on the YKD was near average and nesting phenology of white-fronted geese was about one day earlier than average. Surveys conducted on the Yukon Delta during 2008 indicated clutch sizes were slightly below average but that nest success was near average. Good production and a fall flight larger than that of 2007 was 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. They concentrate in southern Saskatchewan during the fall and in Texas, Louisiana, Arkansas, and Mexico during winter (Figure 15). During the fall 2007 survey in Saskatchewan and Alberta, biologists counted 764,300 MCP geese, 2% more than the previous year (Figure 17). During 1998–2007, these estimates declined by an average of 5% per year ($P = 0.059$). In most nesting areas of MCP white-fronted geese May temperatures were 2–4°C warmer than average, and June temperatures were near average. Snow fall in May was well below average near Cambridge Bay and Kugluktuk. Nesting phenology in the Queen Maud Gulf Sanctuary was reported as near average and goose production from that area was expected to be average. During surveys to the west, near the Mackenzie River Delta, relatively large numbers of non-breeding white-fronted geese were observed, suggesting reduced production from that area.

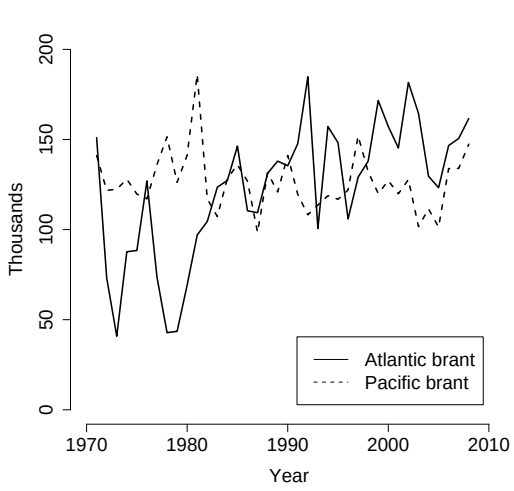


Figure 18: Estimated number of Atlantic and Pacific brant during winter surveys.

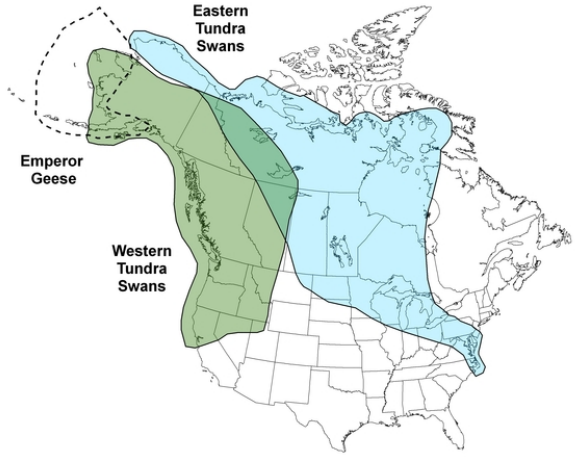


Figure 19: Approximate range of emperor geese, and Eastern and Western tundra swan Populations in North America.

In much of Alaska's interior, spring break-up was delayed by cool spring temperatures and nesting was delayed by up to one week. Flooding was variable but not extreme. Indices of white-front production here were variable; excellent near Koyukuk/Nowitna and poor near Kanuti Refuges. Good production of white-fronted geese is expected on Alaska's North Slope. Overall, production of MCP white-fronted geese in 2008 is expected to be improved from 2007 and near average.

Status of Brant

Atlantic Brant (ATLB): Most of this population nests on islands of the eastern Canadian Arctic. These brant winter along the Atlantic Coast from Massachusetts to North Carolina (Figure 15). The 2008 MWS estimate of brant in the Atlantic Flyway was 161,600, 7% higher than the 2007 estimate (Figure 18). These estimates have declined an average of 1% per year during the most recent 10-year period ($P = 0.344$). Weather reports indicate a large area of the central and eastern Canadian Arctic from King William Island to Southampton, Baffin, and Devon Islands experienced a much warmer than average May (+3 to 5°C). An early snowmelt was indicated for much of Baffin and Southampton Islands. However, substantial snowfall occurred on Southampton Island in early June and apparently preempted early nesting. Biologists there reported that geese arrived early, but initiation was delayed until near average timing. Spring breakup in important staging areas in James Bay was near average in 2008. Indications of average or advanced spring phenology in the eastern Arctic in 2008 suggest that Atlantic brant production will be improved from that of last year.

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 15). The 2008 MWS estimate of brant in the Pacific Flyway and Mexico was 147,400, 10% more than the estimate in 2007 (Figure 18). These estimates have increased an average of 1% per year during 1999–2008 ($P = 0.356$). The timing of spring ice breakup on the YKD was near average in 2008, and brant nesting phenology was about one day earlier than the long-term average. Brant nest densities at five primary colonies on the YKD in 2008 were 40% lower than in 2007, and 43% below the long-term average. Low nest density, frequent fox predation of brant nests, and lower than average clutch sizes indicated brant production on the YKD will be poor this year. Good brant production was expected on Alaska's North Slope. Spring phenology was expected to be near average on Banks Island and near the Queen Maud Gulf. The fall flight was expected to be similar to that of last year.

Western High Arctic Brant (WHA): This population of brant nests on the Parry Islands of the Northwest Territories (Figure 15). 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. The

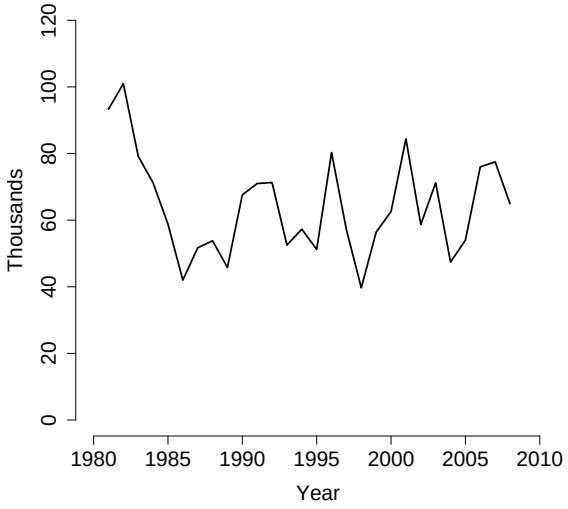


Figure 20: Estimated numbers of emperor geese present during spring surveys.

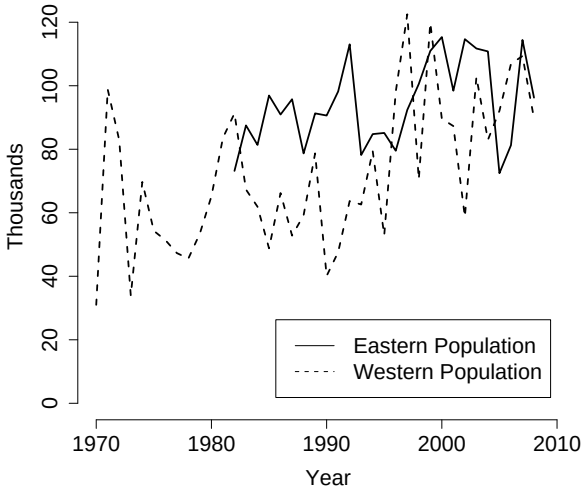


Figure 21: Estimated numbers of Eastern and Western Population tundra swans during winter.

2008 MWS indicated 9,200 brant, 52% more than in 2007. These estimates have increased an average of 1% per year during 1999-2008 ($P = 0.672$). Satellite imagery indicateed little snowpack on the Parry Islands during the nesting period and suggests good production for WHA brant in 2008.

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 19). Since 1981, emperor geese have been surveyed annually on spring staging areas in southwestern Alaska. The 2008 emperor goose survey estimate was 64,900, 16% lower than in 2007 (Figure 20). These estimates increased an average of 1% per year during 1999–2008 ($P = 0.607$). Aerial surveys during the YKD coastal survey indicated slight decreases in the number of pairs and total birds from 2007 levels but a long-term increasing trend in both indices is still apparent. Spring phenology on the YKD was near average and emperor goose phenology was about one day earlier than the long-term average. Nesting surveys conducted on the YKD during 2008 indicated clutch sizes were near average and that emperor geese were not greatly affected by increased fox predation observed on brant and cackling geese. Good production and a fall flight similar to that of 2007 is 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 19). The 2008 MWS estimate of 89,700 swans was 18% lower than the 2007 estimate (Figure 21). These estimates have increased by an average of 1% per year over the last 10 years ($P = 0.809$). Surveys in the coastal zone of the YKD during spring 2008 indicated record-high estimates of swan pairs and total birds since surveys were initiated in 1985. In 2008, the timing of spring ice breakup on the YKD was near average, swan nesting phenology was about two days later than average, and swan clutch sizes were just slightly below the long-term average. Indices of nest success were similar to the long-term average. Near-average production and a fall flight similar to that of last year is expected.

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 19). A revised primary index for EP tundra swans includes swans counted during winter in the Atlantic and Mississippi flyways. During the 2008 MWS, 96,200 EP tundra swans were observed, 16% fewer than in 2007 (Figure 21). These estimates decreased by an average of 2% per year during 1999–

2008 ($P = 0.231$). Spring phenology was near average, or earlier, over much of EP tundra swan range in 2008. Surveys conducted near the Mackenzie River Delta indicated 60% of observed swans pairs were nesting, well above the long-term average, and similar to 2007 observations. Swan production was expected to be average or better in 2008.

APPENDICES

Appendix A. 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 C. Ferguson and T. Lewis

Northern Saskatchewan and Northern Manitoba (Strata 21-25)

Air F. Roetker and P. Yackupzack

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

Air E. Huggins and D. Fronczak

Ground F. Baldwin[a], J. Leafloor[a], N. Wiebe[a], M. Gillespie[a], J. Traylor[a], S. Leach[d], G. Raven[a], M. Watmough[a], and K. Drake[d]

Southern Saskatchewan (Strata 30-35)

Air P. Thorpe, W. Rhodes, K. Bollinger, and G. Zimmerman

Ground D. Neiman[a], K. Dufour[a], K. Warner[a], A. Williams[a], B. Bartzen[a], D. Johns[a], P. Neiman[d], L. Sitter[a], and D. Wilkinson[a]

Southern Manitoba (Strata 36-40)

Air K. Bollinger and G. Zimmerman

Ground D. Caswell[a], M. Schuster[a], P. Rakowski[a], J. Caswell[a], G. Ball[b], C. Meuckon[d], D. Walker[a], N. Astleford[a], and D. Routhier[a]

Montana and Western Dakotas (Strata 41-44)

Air R. Bentley and D. Yparraguirre[b]

Ground K. Fleming and J. Hoskins

Eastern Dakotas (Strata 45-49)

Air J. Solberg and T. Liddick

Ground P. Garrettson, K. Kruse, and S. Beauchaine

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

Air J. Wortham and G. Boomer

Helicopter P. Padding and P. Devers

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

Air M. Koneff and G. Foulks

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

Air J. Bredy and P. Fastbender

Maine and Maritimes (Strata 62-67)

Air J. Bidwell and H. Obrecht

Appendix A. Continued.

Canadian Wildlife Service helicopter plot survey

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

California

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

Michigan

Ground	B. Barlow[b], K. Bissell[b], B. Berger[b], S. Chadwick[b], K. Cleveland[b], E. Flegler[b], C. Hanaburgh[b], E. Kafcas[b], A. Karr[b], T. Maples[b], T. McFadden[b], J. Niewoonder[b]

Minnesota

Air	T. Pfingsten[b] and S. Cordts[b]
Ground	S. Kelly, W. Brininger, J. Holler, R. Papasso, T. Rondeau, T. Cooper, J. Kelley, D. Hertel, S. Zodrow, K. Bousquet, L. Deede, P. Soler, G. Dehmer, F. Osland, L. Anderson, G. Houdek, J. Lawrence[b], S. Cordts[b], S. Lewis, J. West, S. Wilds[d]

Nebraska

Mark Vrtiska[b]

Northeastern U.S.

Data Analysis	J. Klimstra and R. Raftovich
Connecticut	M. Huang[b] and K. Kubik[b]
Delaware	R. Hossler[b]
Maryland	L. Hindman[b], D. Brinker[b], J. Buchanan[b], T. Decker[b], B. Evans[b], C. Harris[b], D. Heilmeier[b], R. Hill[b], R. Norris[b], D. Price[b], G. Timko[b], and D. Webster[b]
Massachusetts	Massachusetts Division of Fisheries and Wildlife personnel and cooperators.
New Hampshire	E. Robinson[b], J. Robinson[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], E. Laskowski[b], T. Watts[b], R. Somes[b], P. Winkler[b], and P. Woerner[b]
New York	Staff of New York Department of Environmental Conservation
Pennslyvania	Biologists from the Research Division of the Bureau of Wildlife Management and Pennsylvania Game Commission Region Biologists
Rhode Island	J. Osenkowski[b], L. Gibson[b], C. Brown[b], B. Tefft[b]
Vermont	B. Crenshaw[b], J. Gobeille[b], D. Sausville[b], J. Mlcuch[b], T. Appleton[b], J. Buck[b], A. Alfiere[b], K. Royar[b], F. Hammond[b], D. Blodgett[b], and R. Smith[b]
Virginia	G. Costanzo[b] and T. Bidrowski[b]

Nevada

Air	M. King[b] and K. Neill[b]
Ground	D. Johnson[b], R. Mills[b], and K. Brose[b]

Appendix A. Continued.

Oregon

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

Washington

Air/Ground	M. Moore[b], D. Base[b], J. Bernatowicz[b], J. Cotton[b], H. Ferguson[b], S. FItkin[b], R. Finger[b], P. Fowler[b], T. Hames[b], J. Heinlen[b], E. Krausz[b], M. Livingston[b], T. McCall[b], W. Moore[b], J. Tabor[b], and D. Volsen[b]

Wisconsin

Air	D. Cardinal[b], M. Weinfurter[b], P. Beringer[b], C. Cold[b], L. Wuest[b], H. Van Handel[b], B. Glenzinski[b], C. Milestone[b], and C. Kopacek[b]
Ground	M. Carlisle[b], J. Carstens[b], N. Christel[b], J. Christian[b], C. Cole[b], G. Dahl[b], B. Folley[b], E. Grossman[b], B. Groth[b], H. Halverson[b], T. Hermann[b], B. Hill[b], J. Huff[b], D. Matheys[b], R. McDonough[b], C. Mogen[b], K. Morgan[b], J. Pritzl[b], J. Robaidek[b], M. Schmidt[b], B. Seiser[b], G. Vande Vrede[b], R. Weide[b], S. Williams[b], T. Zawacki[b], P. Charland, J. Lutes, R. Mockler, S. Otto, S. Papon, and J. Ruwaldt, T. Moore[d], C. Todea[d], and T. Walters[d]

Habitat information was provided by U.S. Fish and Wildlife Service and Canadian Wildlife Service biologists.

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

Appendix B: Individuals that supplied information on the status of geese and swans.

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

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

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

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

Atlantic Flyway Resident Population of 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. Klimstra, J. Osenkowski[b], R. Raftovich, and E. Robinson[b]

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

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

Mississippi Flyway Population Giant Canada Geese: K. Abraham[b], D. Graber[b], M. Gillespie[b], R. Helm[b], J. Hopper[b], J. Hughes[a], D. Luukkonen[b], R. Marshalla[b], S. Maxson[b], A. Phelps[b], R. Pritchert[b], M. Shieldcastle[b], K. Van Horn[b], and G. Zenner[b]

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

Western Prairie and Great Plains Populations of Canada Geese: M. Johnson[b], R. King, F. McNew[b], D. Nieman[a], M. O'Meilia[b], F. Roetker, J. Solberg, P. Thorpe, S. Vaa[b], M. Vritiska[b]

Tall Grass Prairie Population of Canada Geese: R. Alisauskas[a] , G. Gilchrist[a], and K. Warner[a]

Short Grass Prairie Population of Canada Geese: R. Alisauskas[a], J-F. Dufour[a], C. Ferguson, D. Groves, J. Hines[a], and E. Mallek

Hi-Line Population of Canada Geese: R. Bentley, J. Dubovsky, J. Gammonley[b], J. Hansen[b], E. Huggins, D. Nieman[a], L. Roberts[b], and P. Thorpe

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

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

Dusky Canada Geese: B. Eldridge, B. Larned, D. Logan[d], P. Meyers[d], M. Petrula[b], R. Stehn, and T. Rothe[b]

Lesser and Taverner's Canada Geese: K. Bollinger, C. Dau, B. Larned, E. Mallek, and R. Platte

Cackling Canada Geese: M. Anthony[d], K. Bollinger, C. Dau, B. Eldridge, and J. Fischer

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

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

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

Western Central Flyway Population Light Geese: R. Alisauskas[a], J. Hines[a], K. Kraai[a], and P. Thorpe

Western Arctic/Wrangel Island Population of Lesser Snow Geese: V. Baranuk[d], J. Hines[a], and D. Kraege[b]

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

Pacific Population White-Fronted Geese: C. Dau, B. Eldridge, D. Groves, and R. Platte

Mid-continent Population White-fronted Geese: R. Alisauskas[a], J-F Dufour[a], D. Groves, J. Hines[a], S. Kovach, B. Larned, D. Lobpries[b], N. Lyman[b], E. Mallek, D. Nieman[a], F. Roetker, J. Smith[a], J. Solberg, M. Spindler, R. Walters[b], and K. Warner[a]

Pacific Brant: M. Anthony[d], B. Eldridge, R. King, B. Larned, and H. Wilson

Atlantic Brant: I. Butler[d] and G. Gilchrist[a]

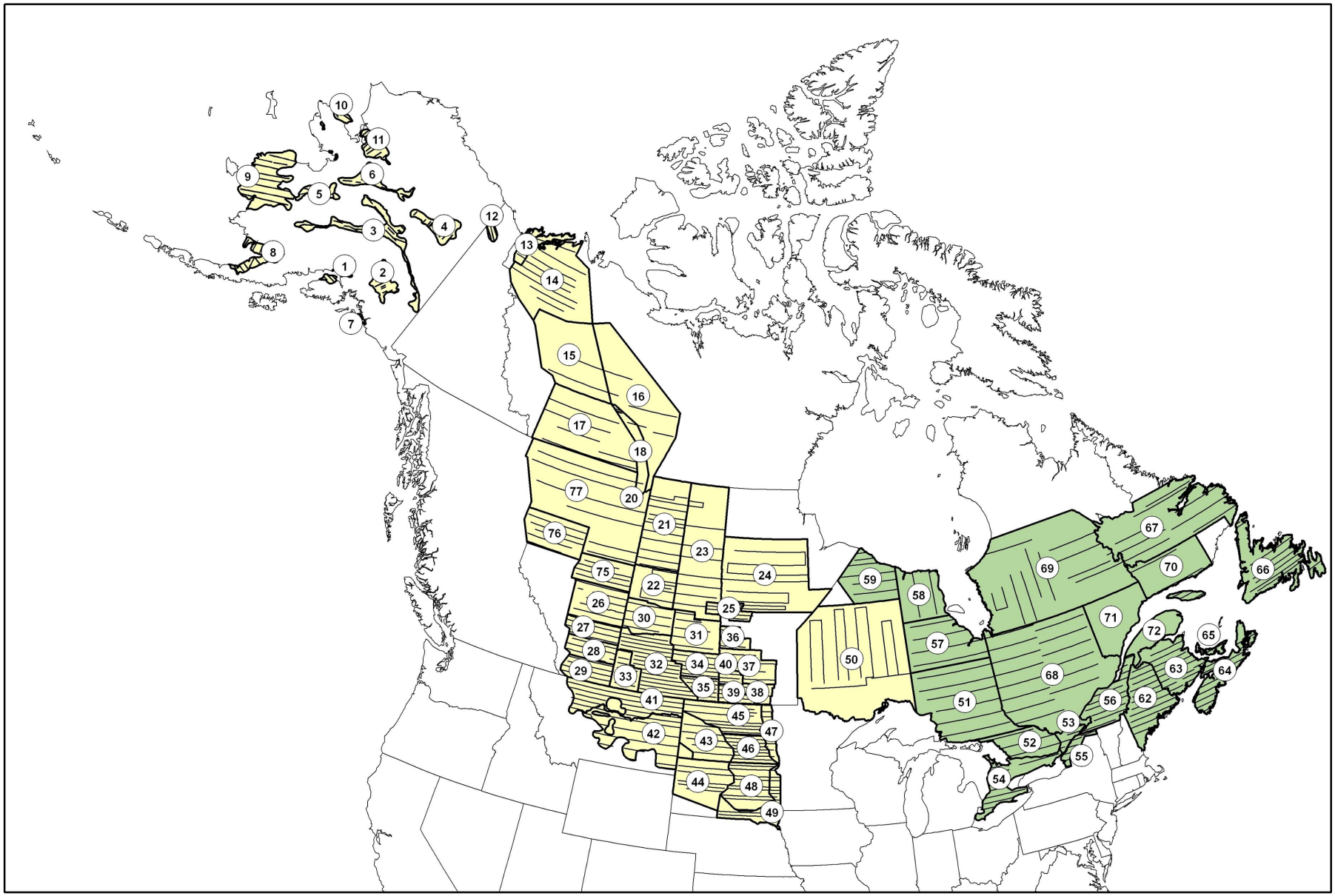
Western High Arctic Brant: D. Kraege[b]

Emperor Geese: C. Dau, B. Eldridge, R. King, and E. Mallek

Western Population of Tundra Swans: C. Dau and B. Eldridge

Eastern Population of Tundra Swans: C. Dau, J. Hines[a], B. Larned, and E. Mallek

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



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

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

	Prairie Canada		Northcentral U.S.[a]		Total	
Year	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$
1961	1,977.2	165.4				
1962	2,369.1	184.6				
1963	2,482.0	129.3				
1964	3,370.7	173.0				
1965	4,378.8	212.2				
1966	4,554.5	229.3				
1967	4,691.2	272.1				
1968	1,985.7	120.2				
1969	3,547.6	221.9				
1970	4,875.0	251.2				
1971	4,053.4	200.4				
1972	4,009.2	250.9				
1973	2,949.5	197.6				
1974	6,390.1	308.3	1,840.8	197.2	8,230.9	366.0
1975	5,320.1	271.3	1,910.8	116.1	7,230.9	295.1
1976	4,598.8	197.1	1,391.5	99.2	5,990.3	220.7
1977	2,277.9	120.7	771.1	51.1	3,049.1	131.1
1978	3,622.1	158.0	1,590.4	81.7	5,212.4	177.9
1979	4,858.9	252.0	1,522.2	70.9	6,381.1	261.8
1980	2,140.9	107.7	761.4	35.8	2,902.3	113.5
1981	1,443.0	75.3	682.8	34.0	2,125.8	82.6
1982	3,184.9	178.6	1,458.0	86.4	4,642.8	198.4
1983	3,905.7	208.2	1,259.2	68.7	5,164.9	219.2
1984	2,473.1	196.6	1,766.2	90.8	4,239.3	216.5
1985	4,283.1	244.1	1,326.9	74.0	5,610.0	255.1
1986	4,024.7	174.4	1,734.8	74.4	5,759.5	189.6
1987	2,523.7	131.0	1,347.8	46.8	3,871.5	139.1
1988	2,110.1	132.4	790.7	39.4	2,900.8	138.1
1989	1,692.7	89.1	1,289.9	61.7	2,982.7	108.4
1990	2,817.3	138.3	691.2	45.9	3,508.5	145.7
1991	2,493.9	110.2	706.1	33.6	3,200.0	115.2
1992	2,783.9	141.6	825.0	30.8	3,608.9	144.9
1993	2,261.1	94.0	1,350.6	57.1	3,611.7	110.0
1994	3,769.1	173.9	2,215.6	88.8	5,984.8	195.3
1995	3,892.5	223.8	2,442.9	106.8	6,335.4	248.0
1996	5,002.6	184.9	2,479.7	135.3	7,482.2	229.1
1997	5,061.0	180.3	2,397.2	94.4	7,458.2	203.5
1998	2,521.7	133.8	2,065.3	89.2	4,586.9	160.8
1999	3,862.0	157.2	2,842.2	256.8	6,704.3	301.2
2000	2,422.5	96.1	1,524.5	99.9	3,946.9	138.6
2001	2,747.2	115.6	1,893.2	91.5	4,640.4	147.4
2002	1,439.0	105.0	1,281.0	63.4	2,720.0	122.7
2003	3,522.3	151.8	1,667.8	67.4	5,190.1	166.1
2004	2,512.6	131.0	1,407.0	101.7	3,919.6	165.8
2005	3,920.5	196.7	1,460.7	79.7	5,381.2	212.2
2006	4,449.5	221.5	1,644.4	85.4	6,093.9	237.4
2007	5,040.2	261.8	1,962.5	102.5	7,002.7	281.2
2008	3,054.8	147.6	1,376.6	71.9	4,431.4	164.2

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

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

	British Columbia[b]		California		Michigan		Minnesota		Nebraska	
Year	Total ducks	Mallards	Total ducks	Mallards	Total ducks	Mallards	Total ducks	Mallards	Total ducks	Mallards
1955									101.5	32.0
1956									94.9	25.8
1957									154.8	26.8
1958									176.4	28.1
1959									99.7	12.1
1960									143.6	21.6
1961									141.8	43.3
1962									68.9	35.8
1963									114.9	37.4
1964									124.8	66.8
1965									52.9	20.8
1966									118.8	36.0
1967									96.2	27.6
1968							368.5	83.7	96.5	24.1
1969							345.3	88.8	100.6	26.7
1970							343.8	113.9	112.4	24.5
1971							286.9	78.5	96.0	22.3
1972							237.6	62.2	91.7	15.2
1973							415.6	99.8	85.5	19.0
1974							332.8	72.8	67.4	19.5
1975							503.3	175.8	62.6	14.8
1976							759.4	117.8	87.2	20.1
1977							536.6	134.2	152.4	24.1
1978							511.3	146.8	126.0	29.0
1979							901.4	158.7	143.8	33.6
1980							740.7	172.0	133.4	37.3
1981							515.2	154.8	66.2	19.4
1982							558.4	120.5	73.2	22.3
1983							394.2	155.8	141.6	32.2
1984							563.8	188.1	154.1	36.1
1985							580.3	216.9	75.4	28.4
1986							537.5	233.6	69.5	15.1
1987	2.7	0.2					614.9	192.3	120.5	41.7
1988	4.9	0.6					752.8	271.7	126.5	27.8
1989	4.6	0.5					1,021.6	273.0	136.7	18.7
1990	4.7	0.5					886.8	232.1	81.4	14.7
1991	5.9	0.6					868.2	225.0	126.3	26.0
1992	6.2	0.6	497.4	375.8	665.8	384.0	1,127.3	360.9	63.4	24.4
1993	5.7	0.5	666.7	359.0	813.5	454.3	875.9	305.8	92.8	23.8
1994	6.6	0.6	483.2	311.7	848.3	440.6	1,320.1	426.5	118.9	17.5
1995	6.5	0.8	589.7	368.5	812.6	559.8	912.2	319.4	142.9	42.0
1996	6.4	0.5	843.7	536.7	790.2	395.8	1,062.4	314.8	132.3	38.9
1997	5.7	0.5	824.3	511.3	886.3	489.3	953.0	407.4	128.3	26.1
1998	7.3	0.9	706.8	353.9	1,305.2	567.1	739.6	368.5	155.7	43.4
1999	8.5	0.9	851.0	560.1	824.8	494.3	716.5	316.4	251.2	81.1
2000	8.2	0.8	562.4	347.6	1,121.7	462.8	815.3	318.1	178.8	54.3
2001	7.8	0.8	413.5	302.2	673.5	358.2	761.3	320.6	225.3	69.2
2002	9.0	0.6	392.0	265.3	997.3	336.8	1,224.1	366.6	141.8	50.6
2003	8.6	0.6	533.7	337.1	587.2	294.1	748.9	280.5	96.7	32.9
2004	6.6	0.6	412.8	262.4	701.9	328.8	1,099.3	375.3	69.9	23.2
2005	5.6	0.5	615.2	317.9	442.6	238.5	681.3	238.5	117.1	29.3
2006	7.8	0.4	649.4	399.4	353.5	207.8	529.4	160.7		
2007			627.6	388.3	723.0	315.0	495.6	242.5		
2008			554.3	297.1	457.0	189.0	258.6	297.6		

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

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

Appendix E: Continued.

	Nevada		Northeastern U.S.[c]		Oregon		Washington		Wisconsin	
Year	Total ducks	Mallards	Total ducks	Mallards	Total ducks	Mallards	Total ducks	Mallards	Total ducks	Mallards
1955										
1956										
1957										
1958										
1959	14.2	2.1								
1960	14.1	2.1								
1961	13.5	2.0								
1962	13.8	1.7								
1963	23.8	2.2								
1964	23.5	3.0								
1965	29.3	3.5								
1966	25.7	3.4								
1967	11.4	1.5								
1968	10.5	1.2								
1969	18.2	1.4								
1970	19.6	1.5								
1971	18.3	1.1								
1972	19.0	0.9								
1973	20.7	0.7							412.7	107.0
1974	17.1	0.7							435.2	94.3
1975	14.5	0.6							426.9	120.5
1976	13.6	0.6							379.5	109.9
1977	16.5	1.0							323.3	91.7
1978	11.1	0.6							271.3	61.6
1979	12.8	0.6					98.6	32.1	265.7	78.6
1980	16.6	0.9					113.7	34.1	248.1	116.5
1981	26.9	1.6					148.3	41.8	505.0	142.8
1982	21.0	1.1					146.4	49.8	218.7	89.5
1983	24.3	1.5					149.5	47.6	202.3	119.5
1984	24.0	1.4					196.3	59.3	210.0	104.8
1985	24.9	1.5					216.2	63.1	192.8	73.9
1986	26.4	1.3					203.8	60.8	262.0	110.8
1987	33.4	1.5					183.6	58.3	389.8	136.9
1988	31.7	1.3					241.8	67.2	287.1	148.9
1989	18.8	1.3					162.3	49.8	462.5	180.7
1990	22.2	1.3					168.9	56.9	328.6	151.4
1991	14.6	1.4					140.8	43.7	435.8	172.4
1992	12.4	0.9					116.3	41.0	683.8	249.7
1993	14.1	1.2	1,158.1	686.6			149.8	55.0	379.4	174.5
1994	19.2	1.4	1,297.3	856.3	336.7	125.0	123.9	52.7	571.2	283.4
1995	17.9	1.0	1,408.5	864.1	227.5	85.6	147.3	58.9	592.4	242.2
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	1,392.1	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	1,197.2	619.1	239.9	84.3	120.9	50.6	626.9	188.4

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

Appendix F: Breeding population estimates and standard errors (in thousands) for 10 species of ducks from the traditional survey area (strata 1–18, 20–50, 75–77).

	Mallard		Gadwall		American wigeon		Green-winged teal		Blue-winged teal	
Year	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$
1955	8,777.3	457.1	651.5	149.5	3,216.8	297.8	1,807.2	291.5	5,305.2	567.6
1956	10,452.7	461.8	772.6	142.4	3,145.0	227.8	1,525.3	236.2	4,997.6	527.6
1957	9,296.9	443.5	666.8	148.2	2,919.8	291.5	1,102.9	161.2	4,299.5	467.3
1958	11,234.2	555.6	502.0	89.6	2,551.7	177.9	1,347.4	212.2	5,456.6	483.7
1959	9,024.3	466.6	590.0	72.7	3,787.7	339.2	2,653.4	459.3	5,099.3	332.7
1960	7,371.7	354.1	784.1	68.4	2,987.6	407.0	1,426.9	311.0	4,293.0	294.3
1961	7,330.0	510.5	654.8	77.5	3,048.3	319.9	1,729.3	251.5	3,655.3	298.7
1962	5,535.9	426.9	905.1	87.0	1,958.7	145.4	722.9	117.6	3,011.1	209.8
1963	6,748.8	326.8	1,055.3	89.5	1,830.8	169.9	1,242.3	226.9	3,723.6	323.0
1964	6,063.9	385.3	873.4	73.7	2,589.6	259.7	1,561.3	244.7	4,020.6	320.4
1965	5,131.7	274.8	1,260.3	114.8	2,301.1	189.4	1,282.0	151.0	3,594.5	270.4
1966	6,731.9	311.4	1,680.4	132.4	2,318.4	139.2	1,617.3	173.6	3,733.2	233.6
1967	7,509.5	338.2	1,384.6	97.8	2,325.5	136.2	1,593.7	165.7	4,491.5	305.7
1968	7,089.2	340.8	1,949.0	213.9	2,298.6	156.1	1,430.9	146.6	3,462.5	389.1
1969	7,531.6	280.2	1,573.4	100.2	2,941.4	168.6	1,491.0	103.5	4,138.6	239.5
1970	9,985.9	617.2	1,608.1	123.5	3,469.9	318.5	2,182.5	137.7	4,861.8	372.3
1971	9,416.4	459.5	1,605.6	123.0	3,272.9	186.2	1,889.3	132.9	4,610.2	322.8
1972	9,265.5	363.9	1,622.9	120.1	3,200.1	194.1	1,948.2	185.8	4,278.5	230.5
1973	8,079.2	377.5	1,245.6	90.3	2,877.9	197.4	1,949.2	131.9	3,332.5	220.3
1974	6,880.2	351.8	1,592.4	128.2	2,672.0	159.3	1,864.5	131.2	4,976.2	394.6
1975	7,726.9	344.1	1,643.9	109.0	2,778.3	192.0	1,664.8	148.1	5,885.4	337.4
1976	7,933.6	337.4	1,244.8	85.7	2,505.2	152.7	1,547.5	134.0	4,744.7	294.5
1977	7,397.1	381.8	1,299.0	126.4	2,575.1	185.9	1,285.8	87.9	4,462.8	328.4
1978	7,425.0	307.0	1,558.0	92.2	3,282.4	208.0	2,174.2	219.1	4,498.6	293.3
1979	7,883.4	327.0	1,757.9	121.0	3,106.5	198.2	2,071.7	198.5	4,875.9	297.6
1980	7,706.5	307.2	1,392.9	98.8	3,595.5	213.2	2,049.9	140.7	4,895.1	295.6
1981	6,409.7	308.4	1,395.4	120.0	2,946.0	173.0	1,910.5	141.7	3,720.6	242.1
1982	6,408.5	302.2	1,633.8	126.2	2,458.7	167.3	1,535.7	140.2	3,657.6	203.7
1983	6,456.0	286.9	1,519.2	144.3	2,636.2	181.4	1,875.0	148.0	3,366.5	197.2
1984	5,415.3	258.4	1,515.0	125.0	3,002.2	174.2	1,408.2	91.5	3,979.3	267.6
1985	4,960.9	234.7	1,303.0	98.2	2,050.7	143.7	1,475.4	100.3	3,502.4	246.3
1986	6,124.2	241.6	1,547.1	107.5	1,736.5	109.9	1,674.9	136.1	4,478.8	237.1
1987	5,789.8	217.9	1,305.6	97.1	2,012.5	134.3	2,006.2	180.4	3,528.7	220.2
1988	6,369.3	310.3	1,349.9	121.1	2,211.1	139.1	2,060.8	188.3	4,011.1	290.4
1989	5,645.4	244.1	1,414.6	106.6	1,972.9	106.0	1,841.7	166.4	3,125.3	229.8
1990	5,452.4	238.6	1,672.1	135.8	1,860.1	108.3	1,789.5	172.7	2,776.4	178.7
1991	5,444.6	205.6	1,583.7	111.8	2,254.0	139.5	1,557.8	111.3	3,763.7	270.8
1992	5,976.1	241.0	2,032.8	143.4	2,208.4	131.9	1,773.1	123.7	4,333.1	263.2
1993	5,708.3	208.9	1,755.2	107.9	2,053.0	109.3	1,694.5	112.7	3,192.9	205.6
1994	6,980.1	282.8	2,318.3	145.2	2,382.2	130.3	2,108.4	152.2	4,616.2	259.2
1995	8,269.4	287.5	2,835.7	187.5	2,614.5	136.3	2,300.6	140.3	5,140.0	253.3
1996	7,941.3	262.9	2,984.0	152.5	2,271.7	125.4	2,499.5	153.4	6,407.4	353.9
1997	9,939.7	308.5	3,897.2	264.9	3,117.6	161.6	2,506.6	142.5	6,124.3	330.7
1998	9,640.4	301.6	3,742.2	205.6	2,857.7	145.3	2,087.3	138.9	6,398.8	332.3
1999	10,805.7	344.5	3,235.5	163.8	2,920.1	185.5	2,631.0	174.6	7,149.5	364.5
2000	9,470.2	290.2	3,158.4	200.7	2,733.1	138.8	3,193.5	200.1	7,431.4	425.0
2001	7,904.0	226.9	2,679.2	136.1	2,493.5	149.6	2,508.7	156.4	5,757.0	288.8
2002	7,503.7	246.5	2,235.4	135.4	2,334.4	137.9	2,333.5	143.8	4,206.5	227.9
2003	7,949.7	267.3	2,549.0	169.9	2,551.4	156.9	2,678.5	199.7	5,518.2	312.7
2004	7,425.3	282.0	2,589.6	165.6	1,981.3	114.9	2,460.8	145.2	4,073.0	238.0
2005	6,755.3	280.8	2,179.1	131.0	2,225.1	139.2	2,156.9	125.8	4,585.5	236.3
2006	7,276.5	223.7	2,824.7	174.2	2,171.2	115.7	2,587.2	155.3	5,859.6	303.5
2007	8,307.3	285.8	3,355.9	206.2	2,806.8	152.0	2,890.3	196.1	6,707.6	362.2
2008	7,723.8	256.8	2,727.7	158.9	2,486.6	151.3	2,979.7	194.4	6,640.1	337.3

Appendix F: Continued.

	Northern shoveler		Northern pintail		Redhead		Canvasback		Scaup	
Year	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$
1955	1,642.8	218.7	9,775.1	656.1	539.9	98.9	589.3	87.8	5,620.1	582.1
1956	1,781.4	196.4	10,372.8	694.4	757.3	119.3	698.5	93.3	5,994.1	434.0
1957	1,476.1	181.8	6,606.9	493.4	509.1	95.7	626.1	94.7	5,766.9	411.7
1958	1,383.8	185.1	6,037.9	447.9	457.1	66.2	746.8	96.1	5,350.4	355.1
1959	1,577.6	301.1	5,872.7	371.6	498.8	55.5	488.7	50.6	7,037.6	492.3
1960	1,824.5	130.1	5,722.2	323.2	497.8	67.0	605.7	82.4	4,868.6	362.5
1961	1,383.0	166.5	4,218.2	496.2	323.3	38.8	435.3	65.7	5,380.0	442.2
1962	1,269.0	113.9	3,623.5	243.1	507.5	60.0	360.2	43.8	5,286.1	426.4
1963	1,398.4	143.8	3,846.0	255.6	413.4	61.9	506.2	74.9	5,438.4	357.9
1964	1,718.3	240.3	3,291.2	239.4	528.1	67.3	643.6	126.9	5,131.8	386.1
1965	1,423.7	114.1	3,591.9	221.9	599.3	77.7	522.1	52.8	4,640.0	411.2
1966	2,147.0	163.9	4,811.9	265.6	713.1	77.6	663.1	78.0	4,439.2	356.2
1967	2,314.7	154.6	5,277.7	341.9	735.7	79.0	502.6	45.4	4,927.7	456.1
1968	1,684.5	176.8	3,489.4	244.6	499.4	53.6	563.7	101.3	4,412.7	351.8
1969	2,156.8	117.2	5,903.9	296.2	633.2	53.6	503.5	53.7	5,139.8	378.5
1970	2,230.4	117.4	6,392.0	396.7	622.3	64.3	580.1	90.4	5,662.5	391.4
1971	2,011.4	122.7	5,847.2	368.1	534.4	57.0	450.7	55.2	5,143.3	333.8
1972	2,466.5	182.8	6,979.0	364.5	550.9	49.4	425.9	46.0	7,997.0	718.0
1973	1,619.0	112.2	4,356.2	267.0	500.8	57.7	620.5	89.1	6,257.4	523.1
1974	2,011.3	129.9	6,598.2	345.8	626.3	70.8	512.8	56.8	5,780.5	409.8
1975	1,980.8	106.7	5,900.4	267.3	831.9	93.5	595.1	56.1	6,460.0	486.0
1976	1,748.1	106.9	5,475.6	299.2	665.9	66.3	614.4	70.1	5,818.7	348.7
1977	1,451.8	82.1	3,926.1	246.8	634.0	79.9	664.0	74.9	6,260.2	362.8
1978	1,975.3	115.6	5,108.2	267.8	724.6	62.2	373.2	41.5	5,984.4	403.0
1979	2,406.5	135.6	5,376.1	274.4	697.5	63.8	582.0	59.8	7,657.9	548.6
1980	1,908.2	119.9	4,508.1	228.6	728.4	116.7	734.6	83.8	6,381.7	421.2
1981	2,333.6	177.4	3,479.5	260.5	594.9	62.0	620.8	59.1	5,990.9	414.2
1982	2,147.6	121.7	3,708.8	226.6	616.9	74.2	513.3	50.9	5,532.0	380.9
1983	1,875.7	105.3	3,510.6	178.1	711.9	83.3	526.6	58.9	7,173.8	494.9
1984	1,618.2	91.9	2,964.8	166.8	671.3	72.0	530.1	60.1	7,024.3	484.7
1985	1,702.1	125.7	2,515.5	143.0	578.2	67.1	375.9	42.9	5,098.0	333.1
1986	2,128.2	112.0	2,739.7	152.1	559.6	60.5	438.3	41.5	5,235.3	355.5
1987	1,950.2	118.4	2,628.3	159.4	502.4	54.9	450.1	77.9	4,862.7	303.8
1988	1,680.9	210.4	2,005.5	164.0	441.9	66.2	435.0	40.2	4,671.4	309.5
1989	1,538.3	95.9	2,111.9	181.3	510.7	58.5	477.4	48.4	4,342.1	291.3
1990	1,759.3	118.6	2,256.6	183.3	480.9	48.2	539.3	60.3	4,293.1	264.9
1991	1,716.2	104.6	1,803.4	131.3	445.6	42.1	491.2	66.4	5,254.9	364.9
1992	1,954.4	132.1	2,098.1	161.0	595.6	69.7	481.5	97.3	4,639.2	291.9
1993	2,046.5	114.3	2,053.4	124.2	485.4	53.1	472.1	67.6	4,080.1	249.4
1994	2,912.0	141.4	2,972.3	188.0	653.5	66.7	525.6	71.1	4,529.0	253.6
1995	2,854.9	150.3	2,757.9	177.6	888.5	90.6	770.6	92.2	4,446.4	277.6
1996	3,449.0	165.7	2,735.9	147.5	834.2	83.1	848.5	118.3	4,217.4	234.5
1997	4,120.4	194.0	3,558.0	194.2	918.3	77.2	688.8	57.2	4,112.3	224.2
1998	3,183.2	156.5	2,520.6	136.8	1,005.1	122.9	685.9	63.8	3,471.9	191.2
1999	3,889.5	202.1	3,057.9	230.5	973.4	69.5	716.0	79.1	4,411.7	227.9
2000	3,520.7	197.9	2,907.6	170.5	926.3	78.1	706.8	81.0	4,026.3	205.3
2001	3,313.5	166.8	3,296.0	266.6	712.0	70.2	579.8	52.7	3,694.0	214.9
2002	2,318.2	125.6	1,789.7	125.2	564.8	69.0	486.6	43.8	3,524.1	210.3
2003	3,619.6	221.4	2,558.2	174.8	636.8	56.6	557.6	48.0	3,734.4	225.5
2004	2,810.4	163.9	2,184.6	155.2	605.3	51.5	617.2	64.6	3,807.2	202.3
2005	3,591.5	178.6	2,560.5	146.8	592.3	51.7	520.6	52.9	3,386.9	196.4
2006	3,680.2	236.5	3,386.4	198.7	916.3	86.1	691.0	69.6	3,246.7	166.9
2007	4,552.8	247.5	3,335.3	160.4	1,009.0	84.7	864.9	86.2	3,452.2	195.3
2008	3,507.8	168.4	2,612.8	143.0	1,056.0	120.4	488.7	45.4	3,738.3	220.1

Appendix G: Total breeding duck estimates for the traditional survey area, in thousands.

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

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

Appendix H: Breeding population estimates and 90% confidence intervals or credibility intervals (CIs; in thousands) for the 10 most abundant species of ducks in the eastern survey area, 1990–2008[a].

	Mergansers[b]		Mallard		American black duck		American wigeon		Green-winged teal	
Year	$\hat{N}$	90% CI	$\hat{N}$	90% CI	$\hat{N}$	90% CI	$\hat{N}$	90% CI	$\hat{N}$	90% CI
1990	351.4	(299.2, 421.8)	340.0	(219.3, 575.6)	437.7	(388.0, 498.0)	13.5	(1.4, 25.7)	233.9	(182.5, 307.1)
1991	428.4	(358.7, 524.1)	385.1	(248.9, 639.9)	440.1	(385.9, 508.7)	15.2	(2.1, 28.3)	222.6	(174.0, 294.1)
1992	427.7	(356.8, 536.8)	385.1	(247.5, 648.9)	418.5	(368.5, 479.9)	5.1	(0.5, 9.7)	215.5	(166.9, 285.8)
1993	397.3	(331.3, 490.9)	390.6	(251.6, 655.6)	417.9	(366.2, 480.5)	10.4	(3.4, 17.5)	195.5	(149.9, 261.4)
1994	422.5	(340.7, 555.1)	405.4	(260.2, 678.5)	384.4	(335.6, 443.6)	10.2	(2.4, 18.1)	203.6	(156.4, 273.1)
1995	449.5	(367.5, 569.9)	339.5	(216.4, 580.3)	436.8	(380.9, 504.7)	9.5	(0.0, 21.4)	207.6	(159.6, 278.6)
1996	388.8	(330.8, 466.0)	363.9	(234.0, 616.3)	502.0	(447.8, 566.9)	10.0	(3.8, 16.3)	269.8	(212.8, 350.7)
1997	405.6	(343.4, 490.2)	387.6	(247.4, 652.2)	455.3	(407.8, 511.9)	18.2	(10.2, 26.2)	210.2	(165.0, 274.4)
1998	327.5	(279.3, 393.5)	426.8	(276.9, 702.5)	487.9	(436.8, 547.1)	58.1	(21.8, 94.5)	201.1	(158.7, 261.1)
1999	386.9	(327.6, 467.7)	434.7	(283.6, 712.4)	544.5	(487.2, 612.5)	14.1	(10.1, 18.1)	241.5	(189.8, 314.8)
2000	398.5	(337.9, 482.7)	390.3	(254.4, 650.2)	507.1	(454.1, 569.3)	38.1	(6.0, 70.2)	263.7	(210.1, 339.2)
2001	381.5	(325.4, 458.5)	425.0	(279.6, 702.6)	477.0	(426.9, 535.7)	43.9	(24.5, 63.3)	217.8	(171.8, 281.7)
2002	501.5	(427.3, 600.6)	418.7	(274.7, 688.4)	527.9	(473.3, 592.4)	13.1	(4.7, 21.4)	255.6	(201.8, 334.7)
2003	442.6	(374.9, 537.7)	433.9	(282.5, 717.6)	477.6	(427.2, 535.7)	11.6	(3.4, 19.8)	246.1	(194.1, 321.6)
2004	468.3	(400.1, 557.7)	457.1	(300.6, 745.8)	491.4	(439.3, 552.6)	22.8	(11.0, 34.5)	285.1	(224.8, 373.8)
2005	435.4	(369.3, 527.4)	445.1	(288.7, 736.7)	478.0	(427.3, 539.2)	31.1	(17.6, 44.7)	228.2	(180.3, 296.3)
2006	398.3	(341.0, 478.2)	413.4	(272.0, 682.3)	500.7	(448.2, 562.2)	11.5	(5.2, 17.8)	230.8	(181.6, 299.7)
2007	429.3	(364.3, 520.6)	452.8	(295.9, 748.5)	571.2	(508.8, 647.1)	14.0	(5.0, 23.0)	260.1	(205.4, 336.4)
2008	411.9	(350.9, 492.0)	450.1	(296.1, 736.7)	495.8	(444.1, 558.0)	8.4	(2.5, 14.4)	261.2	(204.6, 344.2)

	Scaup[c]		Ring-necked duck		Goldeneyes[d]		Bufflehead		Scoters[e]	
Year	$\hat{N}$	90% CI	$\hat{N}$	90% CI	$\hat{N}$	90% CI	$\hat{N}$	90% CI	$\hat{N}$	90% CI
1990	50.9	(4.2, 97.6)	548.9	(432.3, 716.8)	364.0	(285.1, 480.8)	35.5	(23.4, 47.6)	99.5	(0.1, 199.5)
1991	38.8	(17.0, 60.6)	480.8	(381.9, 625.3)	376.6	(296.2, 496.2)	28.4	(14.9, 41.9)	89.8	(24.7, 154.9)
1992	36.9	(3.9, 69.8)	492.4	(388.8, 635.1)	391.1	(305.9, 516.2)	45.3	(27.3, 63.2)	85.2	(0.1, 190.7)
1993	12.0	(3.1, 21.0)	446.6	(353.3, 576.7)	377.0	(293.7, 499.2)	6.6	(3.0, 10.3)	104.4	(18.3, 190.5)
1994	36.7	(6.4, 66.9)	463.2	(363.6, 603.3)	388.9	(303.4, 514.1)	24.3	(7.5, 41.2)	162.2	(38.6, 285.9)
1995	16.5	(0.0, 34.6)	479.0	(376.5, 626.9)	343.1	(266.3, 457.0)	10.3	(4.2, 16.4)	25.9	(7.8, 44.1)
1996	20.4	(2.4, 38.4)	583.8	(464.3, 750.7)	401.5	(314.2, 529.9)	36.1	(23.1, 49.1)	31.6	(16.2, 47.0)
1997	37.4	(5.5, 69.3)	526.5	(420.2, 673.9)	400.9	(314.7, 527.6)	15.3	(8.1, 22.5)	52.6	(28.7, 76.5)
1998	15.6	(1.0, 30.1)	463.2	(368.5, 595.7)	362.4	(284.7, 475.8)	26.8	(19.3, 34.3)	58.9	(35.3, 82.6)
1999	22.3	(2.2, 42.4)	537.1	(428.7, 686.8)	436.6	(338.6, 581.7)	15.0	(9.4, 20.7)	24.2	(8.7, 39.7)
2000	37.9	(18.4, 57.4)	570.7	(455.6, 732.9)	423.0	(330.3, 559.7)	15.9	(9.4, 22.4)	51.7	(28.9, 74.4)
2001	137.9	(0.3, 286.3)	518.6	(414.4, 665.8)	488.8	(380.6, 649.1)	40.4	(24.4, 56.5)	57.1	(28.5, 85.7)
2002	68.8	(0.3, 150.8)	523.2	(413.9, 679.9)	571.9	(432.0, 788.9)	53.2	(35.9, 70.4)	202.1	(0.6, 469.6)
2003	38.8	(12.1, 65.4)	539.4	(431.1, 689.6)	422.8	(331.5, 558.4)	18.9	(11.9, 26.0)	73.4	(27.3, 119.5)
2004	22.8	(10.3, 35.3)	580.8	(462.6, 750.8)	407.7	(322.6, 532.7)	17.3	(10.1, 24.6)	103.3	(57.3, 149.2)
2005	30.0	(14.0, 46.0)	541.4	(435.4, 691.5)	382.0	(301.8, 501.0)	18.8	(8.9, 28.8)	74.8	(45.6, 104.1)
2006	36.9	(18.9, 54.9)	557.9	(446.0, 716.8)	388.0	(306.0, 506.8)	15.1	(9.1, 21.1)	78.8	(27.6, 130.1)
2007	31.3	(18.6, 43.9)	664.0	(529.7, 855.9)	454.6	(356.5, 601.9)	15.7	(8.8, 22.6)	103.2	(40.7, 165.7)
2008	32.5	(21.3, 43.6)	551.2	(441.3, 705.0)	423.8	(332.6, 558.9)	30.2	(19.5, 40.9)	85.6	(56.0, 115.2)

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

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

[c] Greater and lesser.

[d] Common and Barrow's.

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

Appendix I: Abundance indices (in thousands) for North American Canada goose populations, 1969–2008.

Year	North Atlantic[a,b]	Atlantic[a,b]	Atlantic Flyway Resident[a]	Southern James Bay[a]	Miss. Valley[a]	Miss. Flyway Giant[a,b]	Eastern Prairie[a]	W. Prairie & Great Plains[c]	Tall Grass Prairie[c,d]	Short Grass Prairie[e]	Hi-line[e]	Rocky Mountain[a]	Dusky[f]	Cackling[g]	Aleutian[f]
1969/70										151.2	44.2				
1970/71									131.1	148.5	40.5	43.9			
1971/72							95.0		159.6	160.9	31.4	30.5			
1972/73							116.6		147.2	259.4	35.6	34.4			
1973/74							96.7		158.5	153.6	24.5	38.3			0.8
1974/75							121.5		125.6	123.7	41.2	38.1			0.9
1975/76							168.4		201.5	242.5	55.6	25.4			1.3
1976/77							110.8		167.9	210.0	67.6	29.6			1.5
1977/78							111.2		211.3	134.0	65.1	43.0			1.6
1978/79							72.8		180.5	163.7	33.8	58.8		64.1	1.7
1979/80									155.2	213.0	67.3	36.4		127.4	2.0
1980/81							78.9		244.9	168.2	94.4	59.9		87.1	2.7
1981/82							96.4	175.0	268.6	156.0	81.9	65.8		54.1	3.5
1982/83							92.8	242.0	165.5	173.2	75.9	49.5		26.2	3.8
1983/84							112.0	150.0	260.7	143.5	39.5	48.1		25.8	4.2
1984/85							105.6	230.0	197.3	179.1	76.4	49.8		32.1	4.3
1985/86							126.4	115.0	189.4	181.0	69.8	68.3	17.1	51.4	5.0
1986/87							145.9	324.0	159.0	190.9	98.1	70.1	15.8	54.8	5.4
1987/88		118.0					137.0	272.1	306.1	139.1	66.8	107.0	16.0	69.9	5.8
1988/89					380.0		132.1	330.3	213.0	284.8	100.1	95.0	17.4	76.8	6.3
1989/90				92.1	494.0		163.4	271.0	146.5	378.1	105.9	90.6	16.3	110.2	7.0
1990/91				72.4	237.0		167.4	390.0	305.1	508.5	116.6	85.5	10.7	104.6	7.7
1991/92				73.0	414.2		158.4	341.9	276.3	620.2	140.5	102.2	17.8	149.3	11.7
1992/93		91.3		50.7	402.4	810.9	136.2	318.0	235.3	328.2	118.5	116.5	16.5	164.3	15.7
1993/94		40.1		45.7	390.0	1002.9	136.2	272.5	224.2	434.1	164.3	138.3	16.3	152.5	19.2
1994/95		29.3		74.1	375.3	1030.6	139.0	352.5	245.0	697.8	174.4	146.6	12.1	161.4	21.4
1995/96	99.6	46.1		71.1	350.5	1132.4	141.0	403.3	264.0	561.2	167.5	145.3	12.0	134.6	21.3
1996/97	64.4	63.2		87.0	414.7	1038.7	130.5	453.4	262.9	460.7	148.5	103.0	13.5	205.1	20.2
1997/98	53.9	42.2		70.3	297.5	1212.7	99.3	482.3	331.8	440.6	191.0	145.2	14.5	148.6	32.3
1998/99	96.8	77.5		108.1	454.0	1234.1	139.5	467.2	548.2	403.2	119.5	164.3	10.5	169.6	35.8
1999/00	58.0	93.2		78.7	345.0	1497.4	130.0	594.7	295.7	200.0	270.7	181.3	10.3	175.0	34.3
2000/01	57.8	146.7		68.4	329.0	1371.3	122.2	682.7	149.1	164.1	252.9	177.5	11.1	176.2	
2001/02	62.0	164.8		55.2	286.5	1612.3	152.0	710.3	504.7	160.9	217.1	150.0	12.4	127.9	
2002/03	60.8	156.9	1126.7	90.2	360.1	1633.0	122.4	561.0	611.9	156.7	205.9	147.6	9.8	165.2	74.7
2003/04	67.8	174.8	1048.7	75.2	276.3	1600.7	145.5	622.1	458.7	203.6	215.6	164.2	11.2	130.2	115.0
2004/05	51.3	162.4	1167.1	42.2	344.9	1583.1	161.6	415.1	400.8	177.2	207.4	165.7	16.1	156.9	89.0
2005/06	49.2	160.2	1144.0	128.9	384.4	1729.6	134.8	444.4	499.8	234.7	247.3	146.0	12.1	169.3	101.6
2006/07	69.9	195.7	1128.0	64.8	402.6	1648.5	153.4	446.0	680.3	190.5	180.2	151.2	10.2[a]	173.4	108.9
2007/08	41.9	169.7	1024.9	92.3	305.2	1700.5	161.1	669.5	402.7	212.4	269.3	210.4	9.1[a]	193.3	114.0

[a] Surveys conducted in spring.

[b] Number of breeding pairs.

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

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

[e] Surveys conducted in January.

[f] Indirect or preliminary estimate.

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

Appendix J: Abundance indices for light goose, white-fronted, and emperor goose populations.

	Light geese				White-fronted geese		Emperor geese[a]
Year	Greater snow geese[a]	Mid-continent[b]	Western Central Flyway[c]	Western Arctic & Wrangel[d]	Mid-continent[d]	Pacific[e]	
1969/70	89.6	777.0	6.9				
1970/71	123.3	1070.2	11.1				
1971/72	134.8	1313.4	13.0				
1972/73	143.0	1025.3	11.6				
1973/74	165.0	1189.8	16.2				
1974/75	153.8	1096.6	26.4				
1975/76	165.6	1562.4	23.2				
1976/77	160.0	1150.3	33.6				
1977/78	192.6	1966.4	31.1				
1978/79	170.1	1285.7	28.2			73.1	
1979/80	180.0	1398.1	30.4	528.1		93.5	
1980/81	170.8	1406.7	37.6	204.2		116.5	93.3
1981/82	163.0	1794.1	50.0	759.9		91.7	100.6
1982/83	185.0	1755.5	76.1	354.1		112.9	79.2
1983/84	225.4	1494.5	43.0	547.6		100.2	71.2
1984/85	260.0	1973.0	62.9	466.3		93.8	58.8
1985/86	303.5	1449.4	96.6	549.8		107.1	42.0
1986/87	255.0	1913.8	63.5	521.7		130.6	51.7
1987/88		1750.7	46.2	525.3		161.5	53.8
1988/89	363.2	1956.2	67.6	441.0		218.8	45.8
1989/90	368.3	1724.3	38.7	463.9		240.8	67.6
1990/91	352.6	2135.8	104.6	708.5		236.5	71.0
1991/92	448.1	2021.9	87.9	690.1		230.9	71.3
1992/93	498.4	1744.1	45.1	639.3	622.9	295.1	52.5
1993/94	591.4	2200.8	84.9	569.2	676.3	324.8	57.3
1994/95	616.6	2725.1	80.1	478.2	727.3	277.5	51.2
1995/96	669.1	2398.1	93.1	501.9	1129.4	344.1	80.3
1996/97	657.5	2957.7	127.2	366.3	742.5	319.0	57.1
1997/98	836.6	3022.2	103.5	416.4	622.2	413.1	39.7
1998/99	803.4	2575.7	236.4	354.3	1058.3	393.4	54.6
1999/00	813.9	2397.3	137.5	579.0	963.1	352.7	62.6
2000/01	837.4	2341.3	105.8	656.8	1067.6	438.9	84.4
2001/02	639.3	2696.1	99.9	448.1	712.3	359.7	58.7
2002/03	678.0	2435.0	105.9	596.9	637.2	422.0	71.2
2003/04	957.6	2214.3	135.4	587.8	528.2	374.9	47.4
2004/05	814.6	2344.2	143.0	750.3	644.3	443.9	54.0
2005/06	1017.0	2221.7	140.6	710.7	522.8	509.3	76.0
2006/07	1019.0	2917.1	170.6	799.7	751.3	604.7	77.5
2007/08	1004.0	2455.1	188.5	1073.5	764.3	627.0	64.9

[a] Surveys conducted in spring.

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

[c] Surveys conducted in January.

[d] Surveys conducted in autumn.

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

[f] Incomplete or preliminary.

Appendix K: Abundance indices of North American brant and swan populations from January surveys, 1969–2008.

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

[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.

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