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Trends in Duck Breeding Populations, 1955-2008

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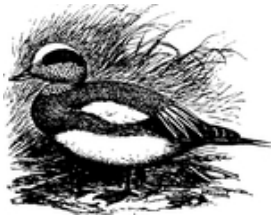

This report summarizes information about the status of duck populations and wetland habitats during spring 2008, focusing on areas encompassed by the U.S. Fish and Wildlife (USFWS) and Canadian Wildlife Services' (CWS) Waterfowl Breeding Population and Habitat Survey. This report does not include information from surveys conducted by state or provincial agencies. In the traditional survey area, which includes strata 1-18, 20-50, and 75-77 (Figure 1), the total duck population estimate (excluding scoters [*Melanitta* spp.], eiders [*Somateria* and *Polysticta* spp.], long-tailed ducks [*Clangula hyemalis*], mergansers [*Mergus* and *Lophodytes* spp.], and wood ducks [*Aix sponsa*]) was 37.3 ± 0.6 [SE] million birds. This estimate represents a 9% decline over last year's estimate of 41.2 ± 0.7 million birds, but remains 11% above the 1955-2007 long-term average[a] (Table 1). Estimated mallard (*Anas platyrhynchos*) abundance was 7.7 ± 0.3 million birds, which was similar to last year's estimate of 8.3 ± 0.3 million birds and the long-term average (Table 2). Blue-winged teal (*A. discors*) abundance was 6.6 ± 0.3 million birds. This value is 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 below 2007 estimates (-19% and -23%, respectively) but remain well above their long-term averages (+56% and +56%, respectively). 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 and were >50% above their long-term averages. Estimates of canvasbacks (*A. valisineria*; 0.5 ± 0.05 million) were 44% below the 2007 estimate (0.9 ± 0.09 million) and 14% below the long-term average. The estimate for Northern pintails (*Anas acuta*) was 2.6 ± 0.1 million, which was 22% below the 2007 estimate of 3.3 ± 0.2 million, and 36% below the long-term average. The scaup estimate (*Aythya affinis* and *A. marila* combined; 3.7 ± 0.2 million) was similar to 2007, and remained 27% below the long-term average of 5.1 ± 0.2 million.

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

[a]Populations are considered to have changed from the previous year or long-term average if observed significance value associated with change is ≤ 0.10. Actual p-values are presented in tables.

many 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 12, Figure 2). 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 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 condition in this area was considered fair to poor, with the exceptions being 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; conditions were good in both of these areas. The 2008 pond estimate for the north-central U.S. of 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 likely will ease drought conditions and may improve habitat conditions for late nesters or improve the success of re-nesting attempts.

In the bush regions of the traditional survey area (Alaska,Yukon, Northwest Territories, northern Manitoba, northern Saskatchewan, western Ontario) spring break-up was later in 2008 than in recent years with locally variable snowfall and, consequently, variable runoff that 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 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 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 2005, the USFWS and CWS began to integrate two previously independent waterfowl surveys conducted in eastern North America. Consequently, a new analytical method, hierarchical modeling, was used to generate composite estimates from USFWS and CWS survey data, total indicated bird definitions for American black ducks were modified to provide a common index across the surveys, and adjustments were made to the geographic stratification of eastern North America. Additional refinements to analytical methods are incorporated in the estimates presented in this report. For these reasons, population estimates presented in this report for the eastern survey area (that encompasses strata 51-72) are not directly comparable with estimates presented in reports presented prior to 2006. Specifically, composite estimates are presented for only a portion of the eastern survey area and include data from strata 51, 52, 63, 64, 66, 67, 68, 70, 71, and 72. These strata were chosen for composite estimation because at least one survey (i.e., that is either the CWS or USFWS survey) was conducted

for each of these strata for the full period of record of the eastern survey (1990-2008). In cases where the USFWS has traditionally not recorded observations to the species level, composite estimates are provided only for multiple-species groupings (i.e., scoters, mergansers, goldeneyes, scaup). Analytical methods applied to eastern survey area data and results will be presented in greater detail in the 2008 Waterfowl Status Report. We anticipate additional refinements to composite estimates for the eastern survey area in the coming years as the USFWS and CWS work toward a final integrated survey design and analytical approach. Population estimates for the 10 most abundant species surveyed in the eastern survey area were similar to last year and to their 1990-2007 averages (Table 13, Figures 6-7, Appendix B).

The data in this report were contributed by the following individuals:

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. Yackupzak

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

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]

[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

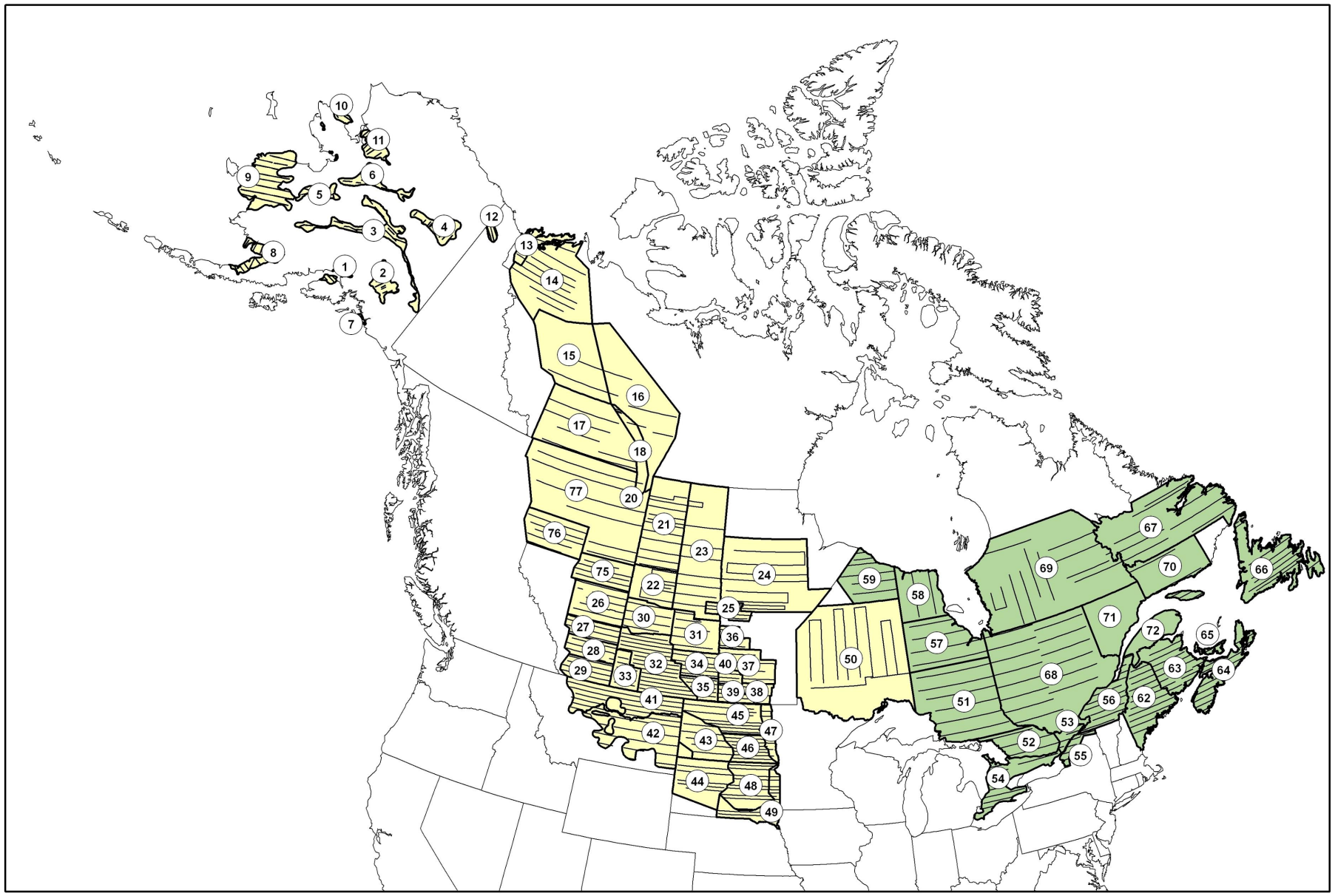

Figure 1: Strata and transects of the of the Waterfowl Breeding Population and Habitat Survey (Yellow = traditional survey area, green = eastern survey area).

Table 1: Total duck breeding population estimates (in thousands) for regions in the traditional survey area.

		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

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

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

Table 2: Mallard 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	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

Table 3: 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 4: 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 5: 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 6: 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 7: 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 8: 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 9: 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 10: 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 11: 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

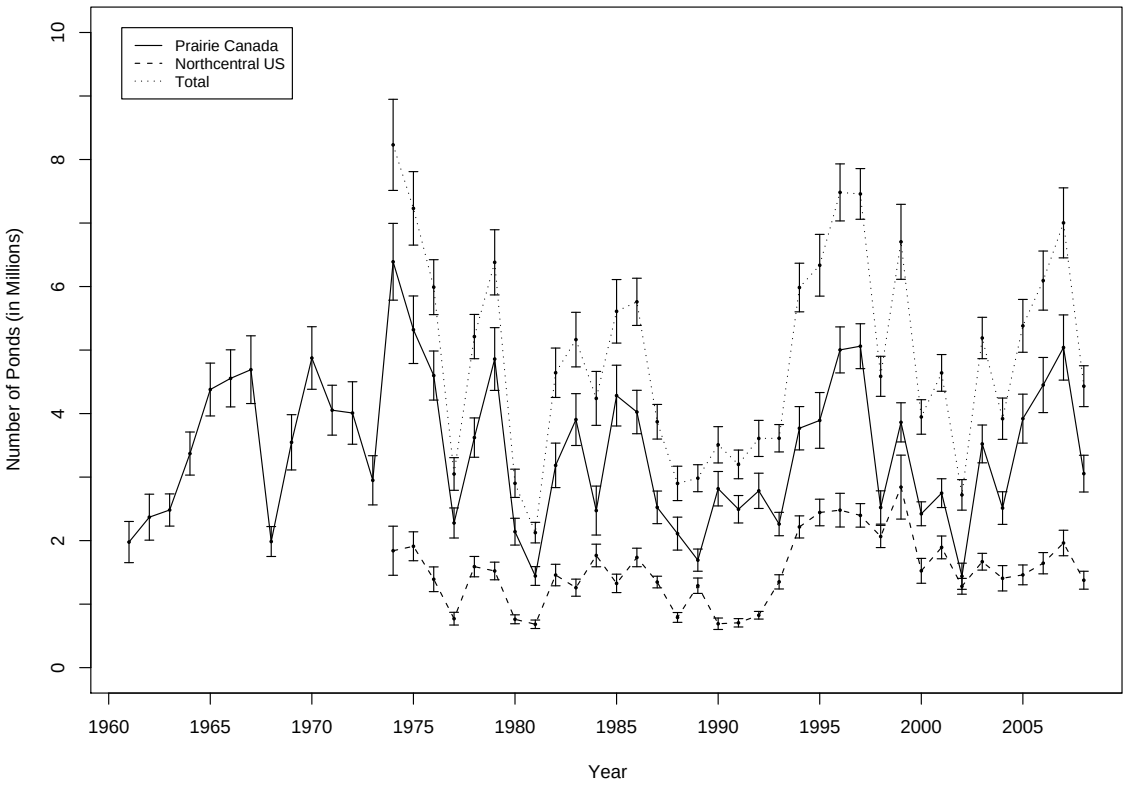

Figure 2: Number of ponds in May and 90% confidence intervals in prairie Canada and the northcentral U.S.

Table 12: Estimated number (in thousands) of 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	1,377	1,963	-30	<0.001	1,538	-11	0.028
Total	4,431	7,003	-37	<0.001	4,931	-10	0.003

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
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] Indicates significant change. Significance (P <0.10) determined by non-overlap of Bayesian credibility intervals or confidence intervals.

[d] Rounded values mask change in estimates.

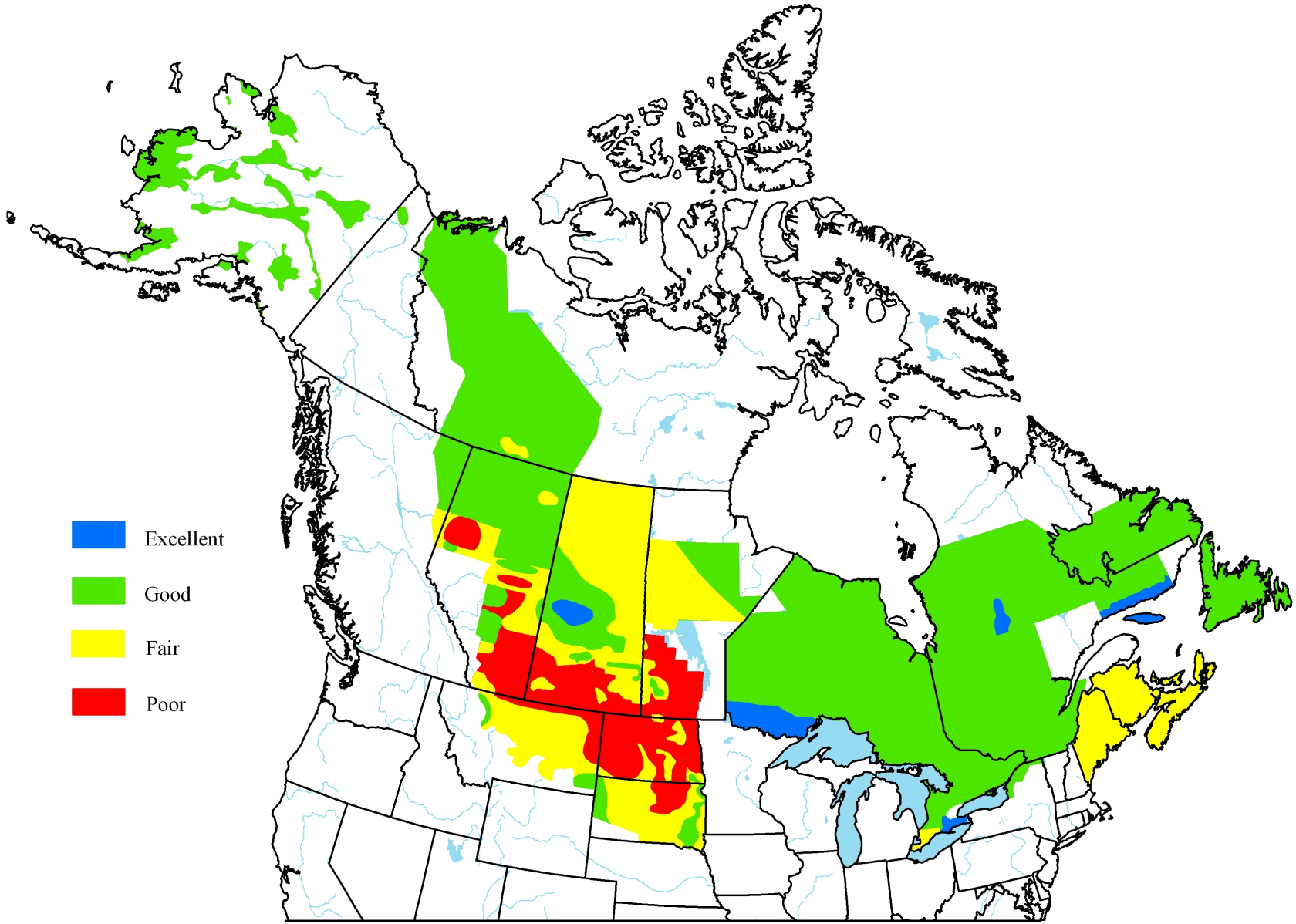

Figure 3: Breeding waterfowl habitat conditions during the 2008 Watefowl Breeding Population and Habitat Survey, as judged by U.S. Fish and Wildlife Service Flyway Biologists.

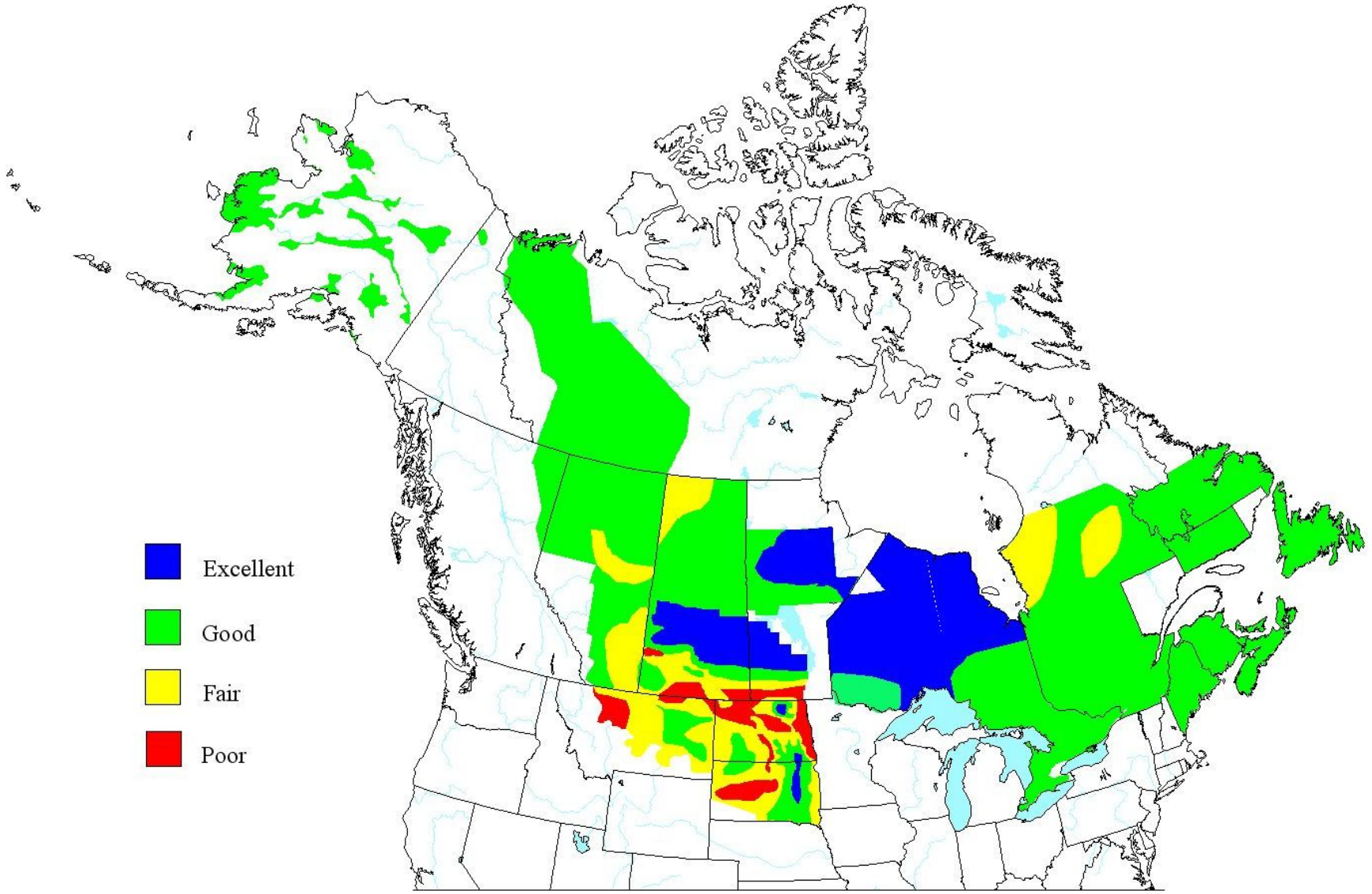

Figure 4: Breeding waterfowl habitat conditions during the 2007 Watefowl Breeding Population and Habitat Survey, as judged by U.S. Fish and Wildlife Service Flyway Biologists.

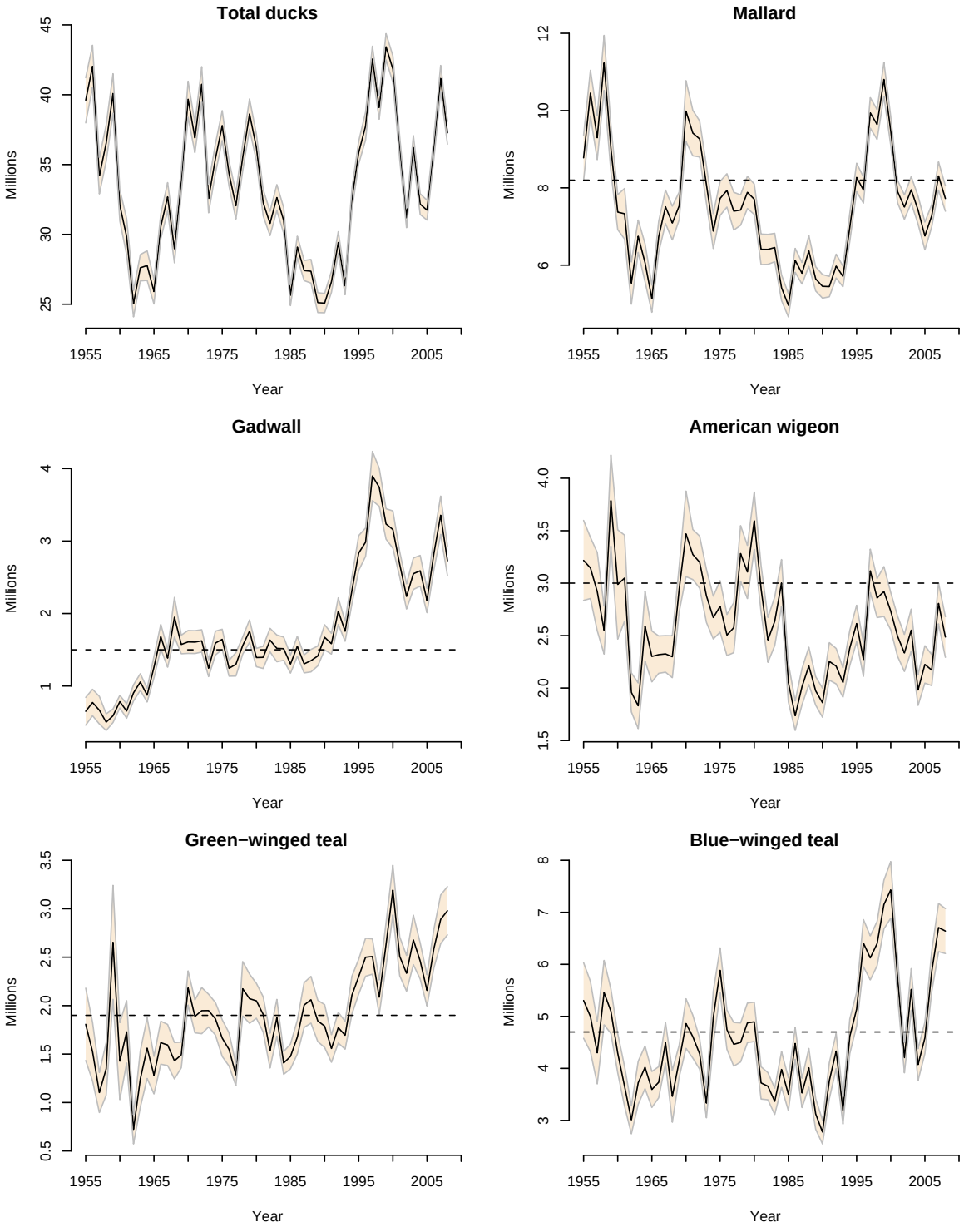

Figure 5: Breeding population estimates, 95% confidence intervals, and North American Waterfowl Management Plan population goal (dashed line) for selected species in the traditional survey area (strata 1-18, 20-50, 75-77).

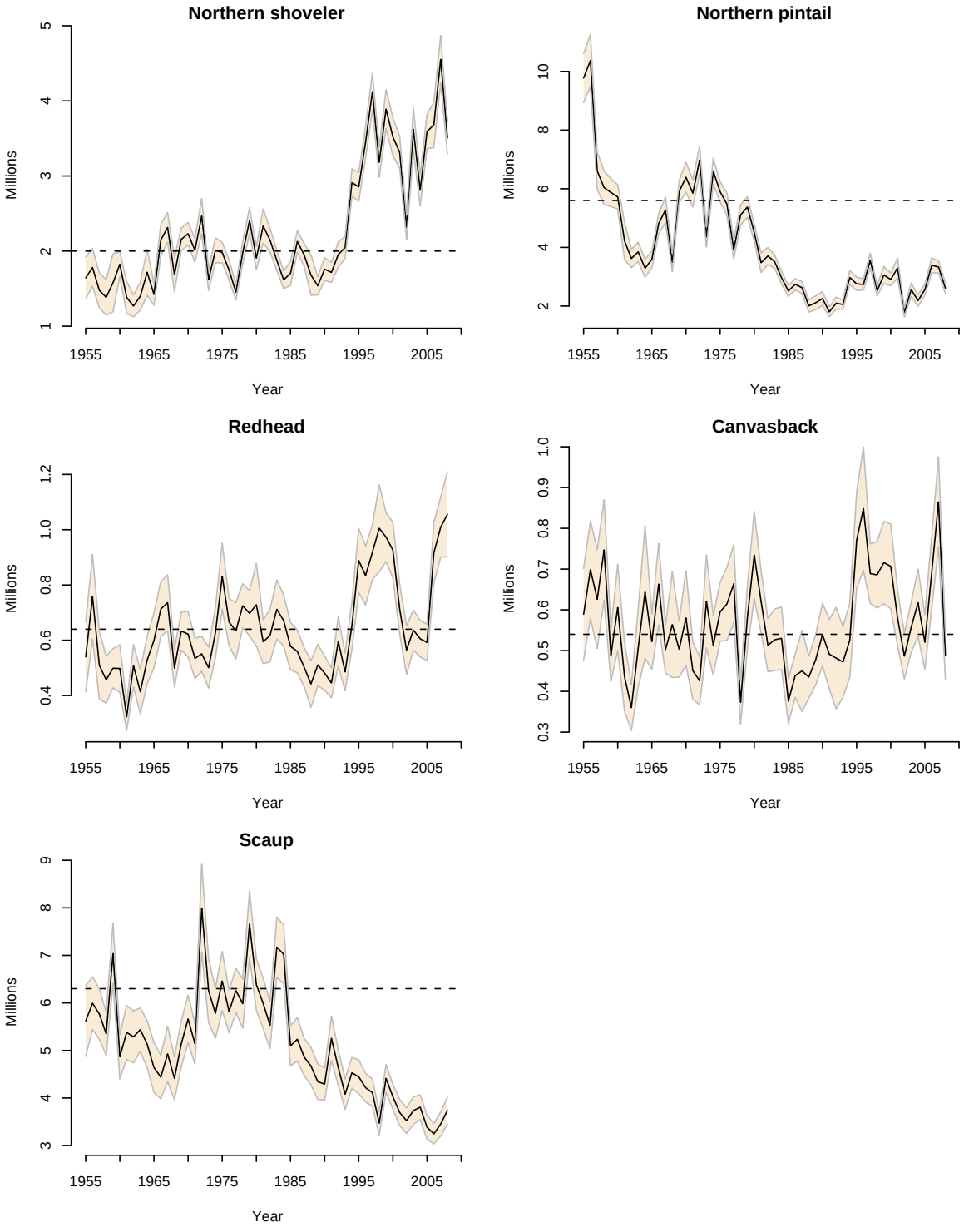

Figure 5: Continued.

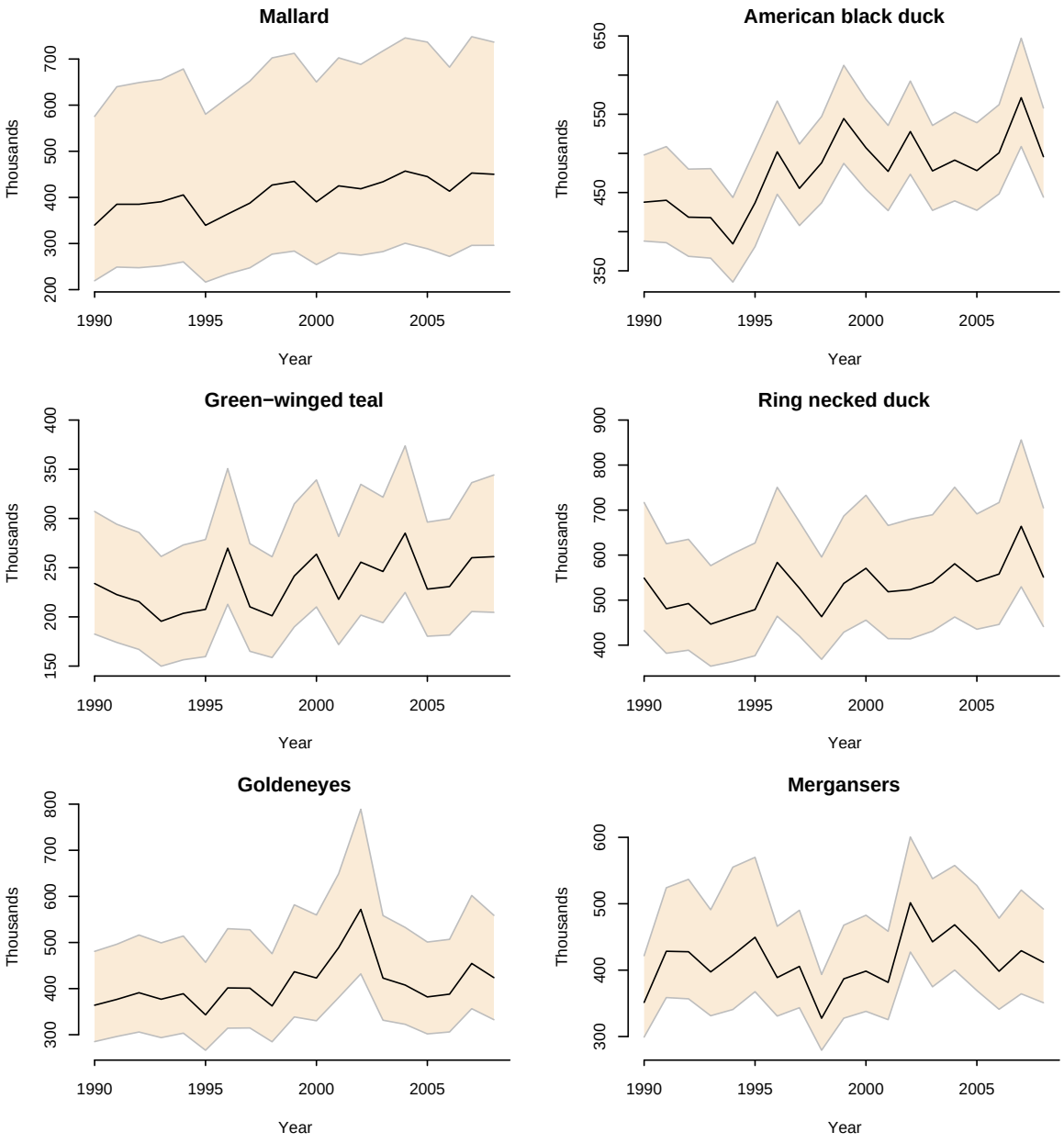

Figure 6: Breeding population estimates (from Bayesian hierarchical models) and 90% credibility intervals for selected species in the eastern survey area (strata 51, 52, 63, 64, 66-68, 70-72).

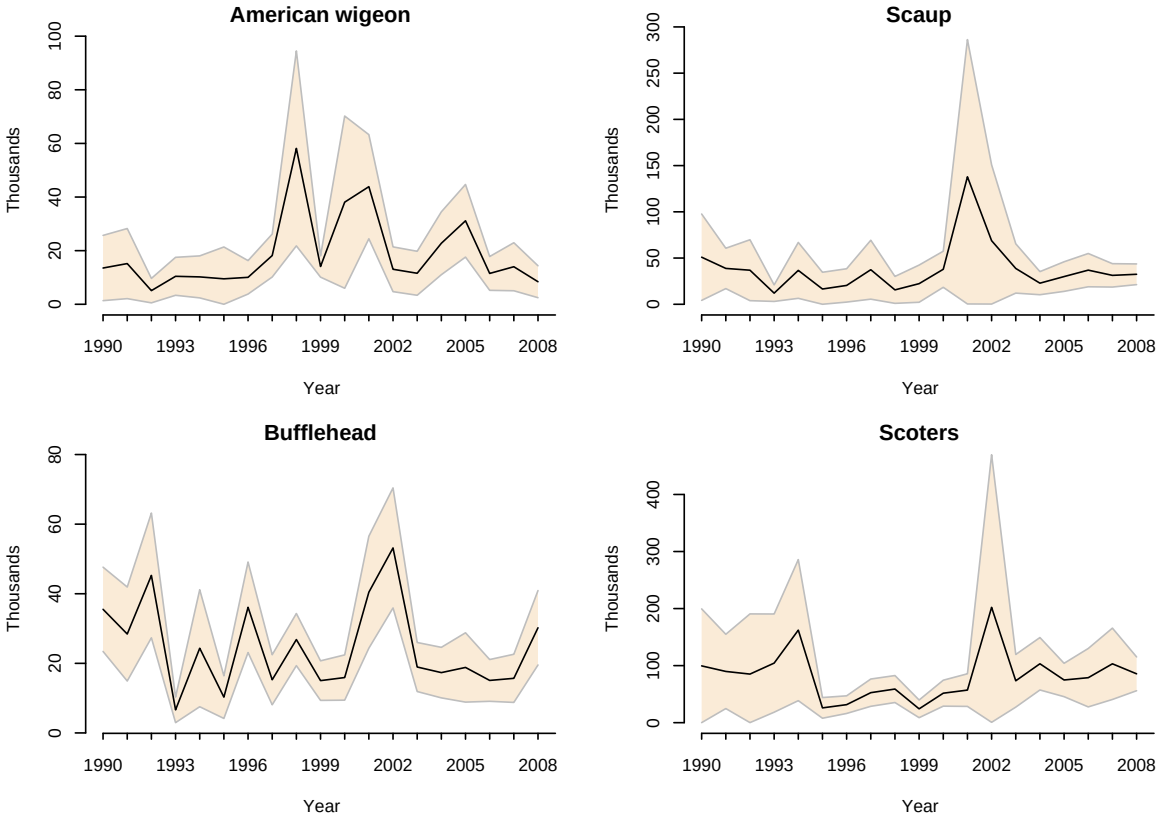

Figure 7: Breeding population estimates (variance-weighted means) and 90% confidence intervals for selected species in the eastern survey area (strata 51, 52, 63, 64, 66-68, 70-72).

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

	Mallard		Gadwall		American wigeon		Green-winged teal		Blue-winged teal	
Year	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$
1955	8777.3	457.1	651.5	149.5	3216.8	297.8	1807.2	291.5	5305.2	567.6
1956	10452.7	461.8	772.6	142.4	3145.0	227.8	1525.3	236.2	4997.6	527.6
1957	9296.9	443.5	666.8	148.2	2919.8	291.5	1102.9	161.2	4299.5	467.3
1958	11234.2	555.6	502.0	89.6	2551.7	177.9	1347.4	212.2	5456.6	483.7
1959	9024.3	466.6	590.0	72.7	3787.7	339.2	2653.4	459.3	5099.3	332.7
1960	7371.7	354.1	784.1	68.4	2987.6	407.0	1426.9	311.0	4293.0	294.3
1961	7330.0	510.5	654.8	77.5	3048.3	319.9	1729.3	251.5	3655.3	298.7
1962	5535.9	426.9	905.1	87.0	1958.7	145.4	722.9	117.6	3011.1	209.8
1963	6748.8	326.8	1055.3	89.5	1830.8	169.9	1242.3	226.9	3723.6	323.0
1964	6063.9	385.3	873.4	73.7	2589.6	259.7	1561.3	244.7	4020.6	320.4
1965	5131.7	274.8	1260.3	114.8	2301.1	189.4	1282.0	151.0	3594.5	270.4
1966	6731.9	311.4	1680.4	132.4	2318.4	139.2	1617.3	173.6	3733.2	233.6
1967	7509.5	338.2	1384.6	97.8	2325.5	136.2	1593.7	165.7	4491.5	305.7
1968	7089.2	340.8	1949.0	213.9	2298.6	156.1	1430.9	146.6	3462.5	389.1
1969	7531.6	280.2	1573.4	100.2	2941.4	168.6	1491.0	103.5	4138.6	239.5
1970	9985.9	617.2	1608.1	123.5	3469.9	318.5	2182.5	137.7	4861.8	372.3
1971	9416.4	459.5	1605.6	123.0	3272.9	186.2	1889.3	132.9	4610.2	322.8
1972	9265.5	363.9	1622.9	120.1	3200.1	194.1	1948.2	185.8	4278.5	230.5
1973	8079.2	377.5	1245.6	90.3	2877.9	197.4	1949.2	131.9	3332.5	220.3
1974	6880.2	351.8	1592.4	128.2	2672.0	159.3	1864.5	131.2	4976.2	394.6
1975	7726.9	344.1	1643.9	109.0	2778.3	192.0	1664.8	148.1	5885.4	337.4
1976	7933.6	337.4	1244.8	85.7	2505.2	152.7	1547.5	134.0	4744.7	294.5
1977	7397.1	381.8	1299.0	126.4	2575.1	185.9	1285.8	87.9	4462.8	328.4
1978	7425.0	307.0	1558.0	92.2	3282.4	208.0	2174.2	219.1	4498.6	293.3
1979	7883.4	327.0	1757.9	121.0	3106.5	198.2	2071.7	198.5	4875.9	297.6
1980	7706.5	307.2	1392.9	98.8	3595.5	213.2	2049.9	140.7	4895.1	295.6
1981	6409.7	308.4	1395.4	120.0	2946.0	173.0	1910.5	141.7	3720.6	242.1
1982	6408.5	302.2	1633.8	126.2	2458.7	167.3	1535.7	140.2	3657.6	203.7
1983	6456.0	286.9	1519.2	144.3	2636.2	181.4	1875.0	148.0	3366.5	197.2
1984	5415.3	258.4	1515.0	125.0	3002.2	174.2	1408.2	91.5	3979.3	267.6
1985	4960.9	234.7	1303.0	98.2	2050.7	143.7	1475.4	100.3	3502.4	246.3
1986	6124.2	241.6	1547.1	107.5	1736.5	109.9	1674.9	136.1	4478.8	237.1
1987	5789.8	217.9	1305.6	97.1	2012.5	134.3	2006.2	180.4	3528.7	220.2
1988	6369.3	310.3	1349.9	121.1	2211.1	139.1	2060.8	188.3	4011.1	290.4
1989	5645.4	244.1	1414.6	106.6	1972.9	106.0	1841.7	166.4	3125.3	229.8

Appendix A: Continued.

	Mallard		Gadwall		American wigeon		Green-winged teal		Blue-winged teal	
Year	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$
1990	5452.4	238.6	1672.1	135.8	1860.1	108.3	1789.5	172.7	2776.4	178.7
1991	5444.6	205.6	1583.7	111.8	2254.0	139.5	1557.8	111.3	3763.7	270.8
1992	5976.1	241.0	2032.8	143.4	2208.4	131.9	1773.1	123.7	4333.1	263.2
1993	5708.3	208.9	1755.2	107.9	2053.0	109.3	1694.5	112.7	3192.9	205.6
1994	6980.1	282.8	2318.3	145.2	2382.2	130.3	2108.4	152.2	4616.2	259.2
1995	8269.4	287.5	2835.7	187.5	2614.5	136.3	2300.6	140.3	5140.0	253.3
1996	7941.3	262.9	2984.0	152.5	2271.7	125.4	2499.5	153.4	6407.4	353.9
1997	9939.7	308.5	3897.2	264.9	3117.6	161.6	2506.6	142.5	6124.3	330.7
1998	9640.4	301.6	3742.2	205.6	2857.7	145.3	2087.3	138.9	6398.8	332.3
1999	10805.7	344.5	3235.5	163.8	2920.1	185.5	2631.0	174.6	7149.5	364.5
2000	9470.2	290.2	3158.4	200.7	2733.1	138.8	3193.5	200.1	7431.4	425.0
2001	7904.0	226.9	2679.2	136.1	2493.5	149.6	2508.7	156.4	5757.0	288.8
2002	7503.7	246.5	2235.4	135.4	2334.4	137.9	2333.5	143.8	4206.5	227.9
2003	7949.7	267.3	2549.0	169.9	2551.4	156.9	2678.5	199.7	5518.2	312.7
2004	7425.3	282.0	2589.6	165.6	1981.3	114.9	2460.8	145.2	4073.0	238.0
2005	6755.3	280.8	2179.1	131.0	2225.1	139.2	2156.9	125.8	4585.5	236.3
2006	7276.5	223.7	2824.7	174.2	2171.2	115.7	2587.2	155.3	5859.6	303.5
2007	8307.3	285.8	3355.9	206.2	2806.8	152.0	2890.3	196.1	6707.6	362.2
2008	7723.8	256.8	2727.7	158.9	2486.6	151.3	2979.7	194.4	6640.1	337.3

Appendix A: Continued.

	Northern shoveler		Northern pintail		Redhead		Canvasback		Scaup	
Year	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$
1955	1642.8	218.7	9775.1	656.1	539.9	98.9	589.3	87.8	5620.1	582.1
1956	1781.4	196.4	10372.8	694.4	757.3	119.3	698.5	93.3	5994.1	434.0
1957	1476.1	181.8	6606.9	493.4	509.1	95.7	626.1	94.7	5766.9	411.7
1958	1383.8	185.1	6037.9	447.9	457.1	66.2	746.8	96.1	5350.4	355.1
1959	1577.6	301.1	5872.7	371.6	498.8	55.5	488.7	50.6	7037.6	492.3
1960	1824.5	130.1	5722.2	323.2	497.8	67.0	605.7	82.4	4868.6	362.5
1961	1383.0	166.5	4218.2	496.2	323.3	38.8	435.3	65.7	5380.0	442.2
1962	1269.0	113.9	3623.5	243.1	507.5	60.0	360.2	43.8	5286.1	426.4
1963	1398.4	143.8	3846.0	255.6	413.4	61.9	506.2	74.9	5438.4	357.9
1964	1718.3	240.3	3291.2	239.4	528.1	67.3	643.6	126.9	5131.8	386.1
1965	1423.7	114.1	3591.9	221.9	599.3	77.7	522.1	52.8	4640.0	411.2
1966	2147.0	163.9	4811.9	265.6	713.1	77.6	663.1	78.0	4439.2	356.2
1967	2314.7	154.6	5277.7	341.9	735.7	79.0	502.6	45.4	4927.7	456.1
1968	1684.5	176.8	3489.4	244.6	499.4	53.6	563.7	101.3	4412.7	351.8
1969	2156.8	117.2	5903.9	296.2	633.2	53.6	503.5	53.7	5139.8	378.5
1970	2230.4	117.4	6392.0	396.7	622.3	64.3	580.1	90.4	5662.5	391.4
1971	2011.4	122.7	5847.2	368.1	534.4	57.0	450.7	55.2	5143.3	333.8
1972	2466.5	182.8	6979.0	364.5	550.9	49.4	425.9	46.0	7997.0	718.0
1973	1619.0	112.2	4356.2	267.0	500.8	57.7	620.5	89.1	6257.4	523.1
1974	2011.3	129.9	6598.2	345.8	626.3	70.8	512.8	56.8	5780.5	409.8
1975	1980.8	106.7	5900.4	267.3	831.9	93.5	595.1	56.1	6460.0	486.0
1976	1748.1	106.9	5475.6	299.2	665.9	66.3	614.4	70.1	5818.7	348.7
1977	1451.8	82.1	3926.1	246.8	634.0	79.9	664.0	74.9	6260.2	362.8
1978	1975.3	115.6	5108.2	267.8	724.6	62.2	373.2	41.5	5984.4	403.0
1979	2406.5	135.6	5376.1	274.4	697.5	63.8	582.0	59.8	7657.9	548.6
1980	1908.2	119.9	4508.1	228.6	728.4	116.7	734.6	83.8	6381.7	421.2
1981	2333.6	177.4	3479.5	260.5	594.9	62.0	620.8	59.1	5990.9	414.2
1982	2147.6	121.7	3708.8	226.6	616.9	74.2	513.3	50.9	5532.0	380.9
1983	1875.7	105.3	3510.6	178.1	711.9	83.3	526.6	58.9	7173.8	494.9
1984	1618.2	91.9	2964.8	166.8	671.3	72.0	530.1	60.1	7024.3	484.7
1985	1702.1	125.7	2515.5	143.0	578.2	67.1	375.9	42.9	5098.0	333.1
1986	2128.2	112.0	2739.7	152.1	559.6	60.5	438.3	41.5	5235.3	355.5
1987	1950.2	118.4	2628.3	159.4	502.4	54.9	450.1	77.9	4862.7	303.8
1988	1680.9	210.4	2005.5	164.0	441.9	66.2	435.0	40.2	4671.4	309.5
1989	1538.3	95.9	2111.9	181.3	510.7	58.5	477.4	48.4	4342.1	291.3
1990	1759.3	118.6	2256.6	183.3	480.9	48.2	539.3	60.3	4293.1	264.9

Appendix A: Continued.

	Northern Shoveler		Northern Pintail		Redhead		Canvasback		Scaup	
Year	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$	$\widehat{N}$	$\widehat{SE}$
1991	1716.2	104.6	1803.4	131.3	445.6	42.1	491.2	66.4	5254.9	364.9
1992	1954.4	132.1	2098.1	161.0	595.6	69.7	481.5	97.3	4639.2	291.9
1993	2046.5	114.3	2053.4	124.2	485.4	53.1	472.1	67.6	4080.1	249.4
1994	2912.0	141.4	2972.3	188.0	653.5	66.7	525.6	71.1	4529.0	253.6
1995	2854.9	150.3	2757.9	177.6	888.5	90.6	770.6	92.2	4446.4	277.6
1996	3449.0	165.7	2735.9	147.5	834.2	83.1	848.5	118.3	4217.4	234.5
1997	4120.4	194.0	3558.0	194.2	918.3	77.2	688.8	57.2	4112.3	224.2
1998	3183.2	156.5	2520.6	136.8	1005.1	122.9	685.9	63.8	3471.9	191.2
1999	3889.5	202.1	3057.9	230.5	973.4	69.5	716.0	79.1	4411.7	227.9
2000	3520.7	197.9	2907.6	170.5	926.3	78.1	706.8	81.0	4026.3	205.3
2001	3313.5	166.8	3296.0	266.6	712.0	70.2	579.8	52.7	3694.0	214.9
2002	2318.2	125.6	1789.7	125.2	564.8	69.0	486.6	43.8	3524.1	210.3
2003	3619.6	221.4	2558.2	174.8	636.8	56.6	557.6	48.0	3734.4	225.5
2004	2810.4	163.9	2184.6	155.2	605.3	51.5	617.2	64.6	3807.2	202.3
2005	3591.5	178.6	2560.5	146.8	592.3	51.7	520.6	52.9	3386.9	196.4
2006	3680.2	236.5	3386.4	198.7	916.3	86.1	691.0	69.6	3246.7	166.9
2007	4552.8	247.5	3335.3	160.4	1009.0	84.7	864.9	86.2	3452.2	195.3
2008	3507.8	168.4	2612.8	143.0	1056.0	120.4	488.7	45.4	3738.3	220.1

Appendix B: 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, 1990-2007[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.