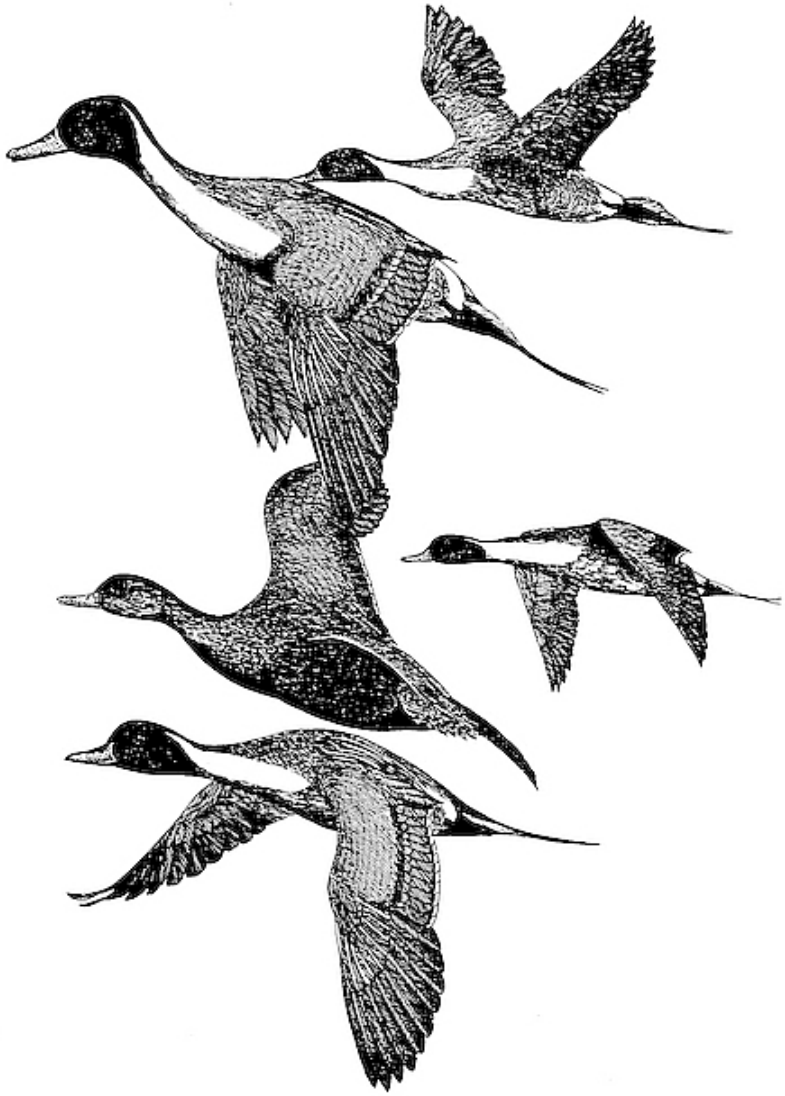
U.S. Fish and Wildlife Service

Trends in Duck Breeding Populations, 1955-2009

July 1, 2009



Trends in Duck Breeding Populations, 1955–2009

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Administrative Report – July 1, 2009

This report summarizes information about the status of duck populations and wetland habitats during spring 2009, focusing on areas encompassed by the U.S. Fish and Wildlife (USFWS) and Canadian Wildlife Services' (CWS) Waterfowl Breeding Population and Habitat Survey. We do 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* spp. and *Polysticta stelleri*], long-tailed ducks [*Clangula hyemalis*], mergansers [*Mergus* spp. and *Lophodytes cucullatus*], and wood ducks [*Aix sponsa*]) was 42.0 ± 0.7 [SE] million birds. This estimate represents a 13% increase over last year's estimate of 37.3± 0.6 million birds and was 25% above the long-term average[a] (1955–2008; Table 1). Estimated mallard (*Anas platyrhynchos*) abundance was 8.5 ± 0.2 million birds, which was a 10% increase over last year's estimate of 7.7 ± 0.3 million birds and 13% above the long-term average (Table 2). Estimated abundance of gadwall (*A. strepera*; 3.1 ± 0.2 million) was similar to the 2008 estimate and 73% above the long-term average (Table 3). Estimated American wigeon abundance (*A. americana*) was similar to 2008 and the long-term average (−1% and −5%, respectively; Table 4). Estimated abundances of green-winged teal (*A. crecca*; 3.4 ± 0.2 million; Table 5) and blue-winged teal (*A. discors*; 7.4 ± 0.4 million; Table 6) were similar to last year's estimates and well above their long-term averages (+79% and +60%, respectively). Northern shovelers (*A. clypeata*; 4.4 ± 0.2 million) were 25% above the 2008 estimate and remain well above their long-term average (+92%; Table 7). The estimate for northern pintails (*A. acuta*) was 3.2 ± 0.2 million, which was 23% above the 2008 estimate of 2.6 ± 0.1 million, and 20% below the long-term average (Table 8). Estimated abundance of redheads (*Aythya americana*; 1.0 ± 0.1 million) was similar to last year and 62% above the long-term average (Table 9). The canvasback estimate (*A. valisineria*; 0.7 ± 0.06 million) was 35% above the 2008 estimate (0.5 ± 0.05 million) and similar to the long-term average (Table 10). The scaup estimate (*A. affinis* and *A. marila* combined; 4.2 ± 0.2 million) was similar to that of 2008 and 18% below the long-term average of 5.1 ± 0.05 million (Table 11).

Habitat conditions during the 2009 Waterfowl Breeding Population and Habitat Survey were characterized by above-average moisture across the southern portions of the traditional survey area, good habitat in the eastern survey area, and late spring conditions across northern survey areas. The total pond estimate (Prairie Canada and U.S. combined) was 6.4 ± 0.2 million (Table 12, Figure 2). This

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

was 45% above last year's estimate of 4.4 ± 0.2 million ponds and 31% above the long-term average of 4.9 ± 0.03 million ponds.

Conditions across the Canadian prairies improved in 2009, with the exception of southern Alberta. The 2009 estimate of ponds in Prairie Canada was 3.6 ± 0.1 million. This was a 17% increase from last year's estimate (3.1 ± 0.1 million) and was similar to the 1955–2008 average (3.4 ± 0.03 million). The prairie parklands received below-normal precipitation but waterfowl habitat in this area continued to benefit from above-normal precipitation received in 2007 and was classified as fair to good.

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

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

The boreal forest of the eastern survey area was generally in good condition this spring, although northern survey areas in Ontario, Quebec, and Labrador experienced a very late spring. Above-average snowfall was recorded from Maine to the Maritimes, but average spring temperatures prevented the flooding that was experienced in 2008, resulting in good-to-excellent waterfowl habitat in 2009. Good-to-excellent waterfowl habitat existed through New York and much of Quebec and Ontario. Although overall habitat conditions were good in the eastern survey area, flooding from a series of major storms in southwestern Ontario during mid May and persistent winter conditions in the James and Hudson Bay Lowlands may have reduced habitat quality in those areas.

In 2005, the USFWS and CWS began to integrate two previously independent waterfowl surveys conducted in eastern North America into a single composite estimate using hierarchical models. Consequently, 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 issued 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, and 70. Further, we present model-based population estimates for strata 71 and 72 based on CWS data only. These 10 strata were chosen for presentation 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 (1990–2009). 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, or scaup). Analytical methods applied to eastern survey area data and results will be presented in greater detail in the 2009 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 1990–2008 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 F. Roetker and C. Ferguson[e]

Northern Saskatchewan and Northern Manitoba (Strata 21–24)

Air W. Rhodes and J. Goldsberry[e]

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

Air J. Bredy and D. Fronczak

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

Southern Saskatchewan (Strata 30–33)

Air P. Thorpe and P. Devers

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

Southern Manitoba (Strata 25, 34–40)

Air T. Liddick and D. Benning[e]

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

Montana and Western Dakotas (Strata 41–44)

Air R. Bentley and P. Fastbender

Ground K. Fleming and J. Kilmstra

Eastern Dakotas (Strata 45–49)

Air J. Solberg and T. Lewis

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

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

Air J. Wortham and G. Boomer

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

Air M. Koneff and G. Zimmerman

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

Air J. Rayfield and E. Huggins

Maine and Maritimes (Strata 62–67)

Air J. Bidwell and D. Forsell

Canadian Wildlife Service helicopter plot survey

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

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

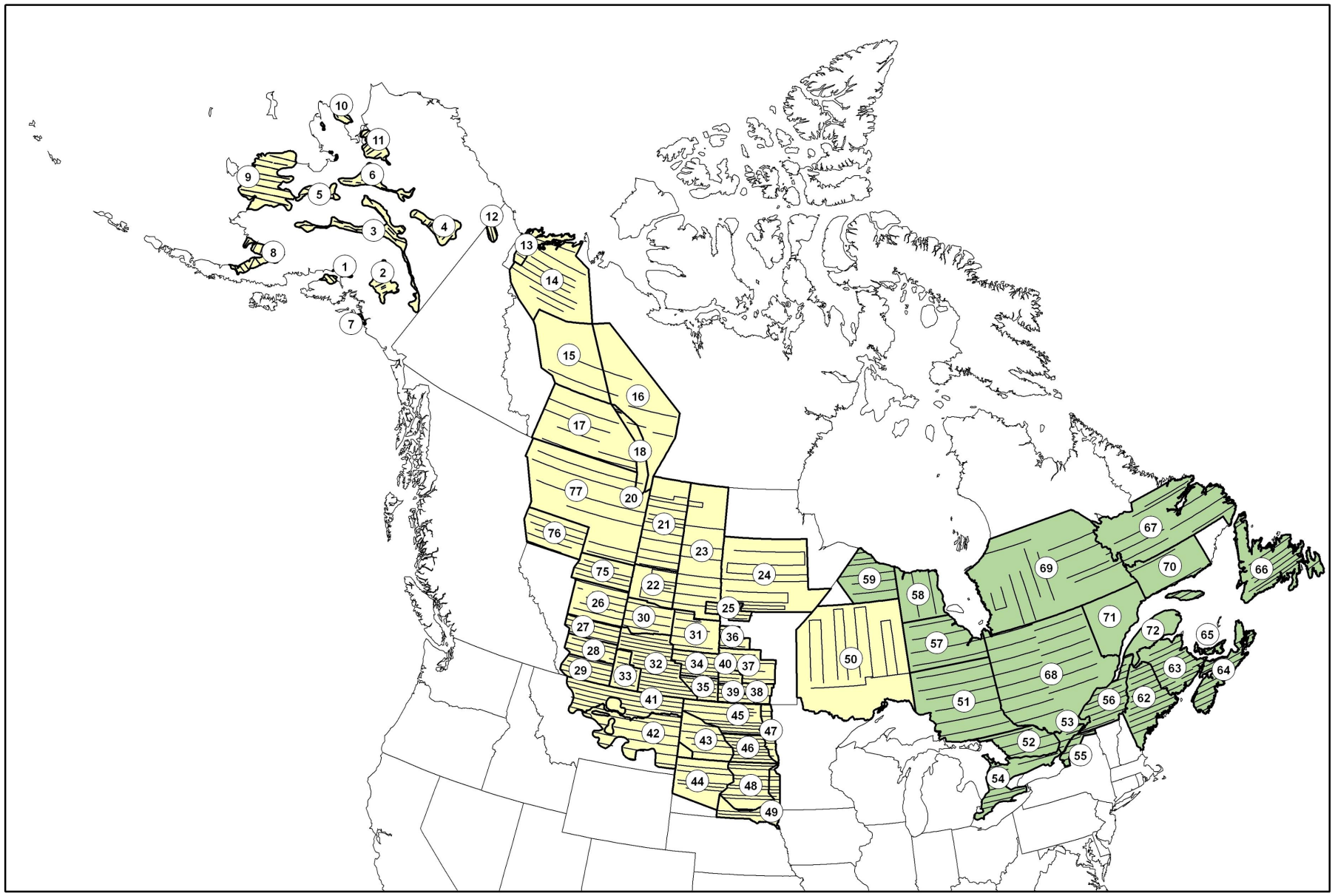

Figure 1: Strata and transects of the of the Waterfowl Breeding Population and Habitat Survey (Yellow = traditional survey area, Green = eastern survey area).

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

			Change from 2008			Change from LTA	
Region	2009	2008	%	P	LTA[b]	%	P
Alaska-Yukon Territory—Old Crow Flats	4,345	5,123	−15	0.003	3,641	+19	<0.001
C. & N. Alberta—N.E. British Columbia—NWT	6,934	6,934	+0	0.999	7,093	−2	0.610
N. Saskatchewan —N. Manitoba—W. Ontario	3,813	3,162	+21	0.014	3,528	+8	0.154
S. Alberta	3,288	4,199	−22	<0.001	4,287	−23	<0.001
S. Saskatchewan	8,053	8,949	−10	0.083	7,497	+7	0.102
S. Manitoba	1,371	1,223	+12	0.118	1,539	−11	0.022
Montana & Western Dakotas	2,468	1,139	+117	<0.001	1,610	+53	<0.001
Eastern Dakotas	11,733	6,546	+79	<0.001	4,330	+171	<0.001
Total	42,005	37,276	+13	<0.001	33,526	+25	<0.001

[a] 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.

[b] Long-term average, 1955–2008

Table 2: Mallard breeding population estimates (in thousands) for regions in the traditional survey area.

			Change from 2008			Change from LTA	
Region	2009	2008	%	P	LTA[a]	%	P
Alaska-Yukon Territory—Old Crow Flats	503	532	−6	0.650	368	+37	0.003
C. & N. Alberta—N.E. British Columbia—NWT	1,080	1,079	+0	0.997	1,072	+1	0.939
N. Saskatchewan —N. Manitoba—W. Ontario	930	1,046	−11	0.437	1,142	−19	0.032
S. Alberta	754	875	−14	0.099	1,086	−31	<0.001
S. Saskatchewan	1,867	1,907	−2	0.838	2,066	−10	0.088
S. Manitoba	417	381	+10	0.397	381	+10	0.227
Montana & Western Dakotas	444	354	+26	0.071	501	−11	0.166
Eastern Dakotas	2,517	1,549	+62	<0.001	895	+181	<0.001
Total	8,512	7,724	+10	0.027	7,511	+13	<0.001

[a] Long-term average, 1955–2008

Table 3: Gadwall breeding population estimates (in thousands) for regions in the traditional survey area.

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

[a] Long-term average, 1955–2008

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

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

[a] Long-term average, 1955–2008

Table 5: Green-winged teal breeding population estimates (in thousands) for regions in the traditional survey area.

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

[a] Long-term average, 1955–2008

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

			Change from 2008			Change from LTA	
Region	2009	2008	%	P	LTA[a]	%	P
Alaska-Yukon Territory—Old Crow Flats	0	0	+0		1	−100	<0.001
C. & N. Alberta—N.E. British Columbia—NWT	248	393	−37	0.125	275	−10	0.697
N. Saskatchewan —N. Manitoba—W. Ontario	116	87	+34	0.486	256	−55	<0.001
S. Alberta	480	818	−41	0.004	618	−22	0.026
S. Saskatchewan	1,740	2,318	−25	0.098	1,278	+36	0.036
S. Manitoba	303	265	+14	0.523	379	−20	0.120
Montana & Western Dakotas	345	235	+47	0.116	265	+30	0.214
Eastern Dakotas	4,152	2,525	+64	<0.001	1,534	+171	<0.001
Total	7,384	6,640	+11	0.153	4,607	+60	<0.001

[a] Long-term average, 1955–2008

Table 7: Northern shoveler breeding population estimates (in thousands) for regions in the traditional survey area.

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

[a] Long-term average, 1955–2008

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

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

[a] Long-term average, 1955–2008

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

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

[a] Long-term average, 1955–2008

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

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

[a] Long-term average, 1955–2008

Table 11: Scaup (greater and lesser combined) breeding population estimates (in thousands) for regions in the traditional survey area.

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

[a] Long-term average, 1955–2008

Table 12: Estimated number (in thousands) of May ponds in portions of prairie and parkland Canada and the north-central U.S.

			Change from 2008			Change from LTA	
Region	2009	2008	%	P	LTA[a]	%	P
Prairie Canada							
S. Alberta	687	849	−19	0.067	741	−7	0.343
S. Saskatchewan	2,210	1,608	+37	0.001	1,993	+11	0.109
S. Manitoba	671	598	+12	0.154	676	−1	0.874
Subtotal	3,568	3,055	+17	0.014	3,410	+5	0.292
North-central U.S.							
Montana & Western Dakotas	1,034	531	+95	<0.001	537	+93	<0.001
Eastern Dakotas	1,832	845	+117	<0.001	997	+84	<0.001
Subtotal	2,866	1,377	+108	<0.001	1,534	+87	<0.001
Total	6,434	4,431	+45	<0.001	4,917	+31	<0.001

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

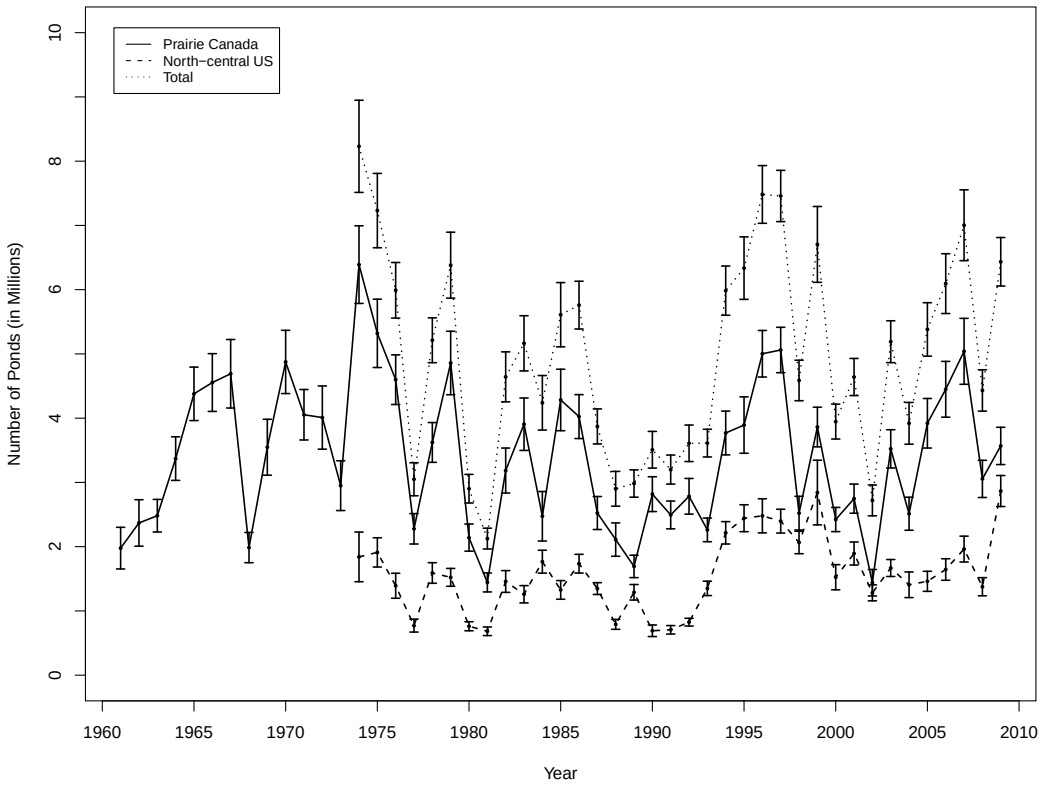

Figure 2: Number of ponds in May and 90% confidence intervals in prairie Canada and the North-central U.S.

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

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

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

[b] Average for 1990–2008.

[c] 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

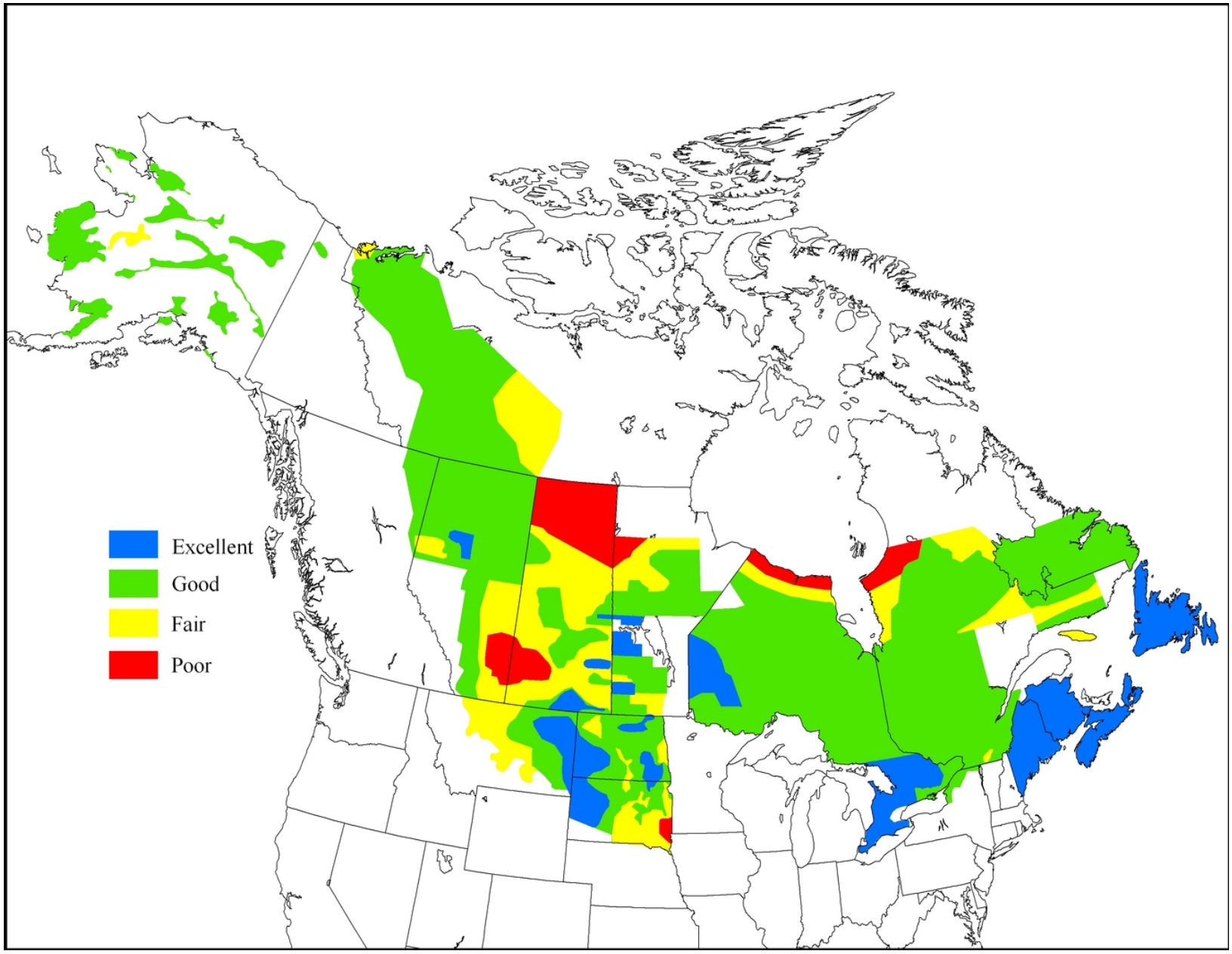

Figure 3: Breeding waterfowl habitat conditions during the 2009 Waterfowl Breeding Population and Habitat Survey, as judged by U.S. Fish and Wildlife Service Flyway Biologists.

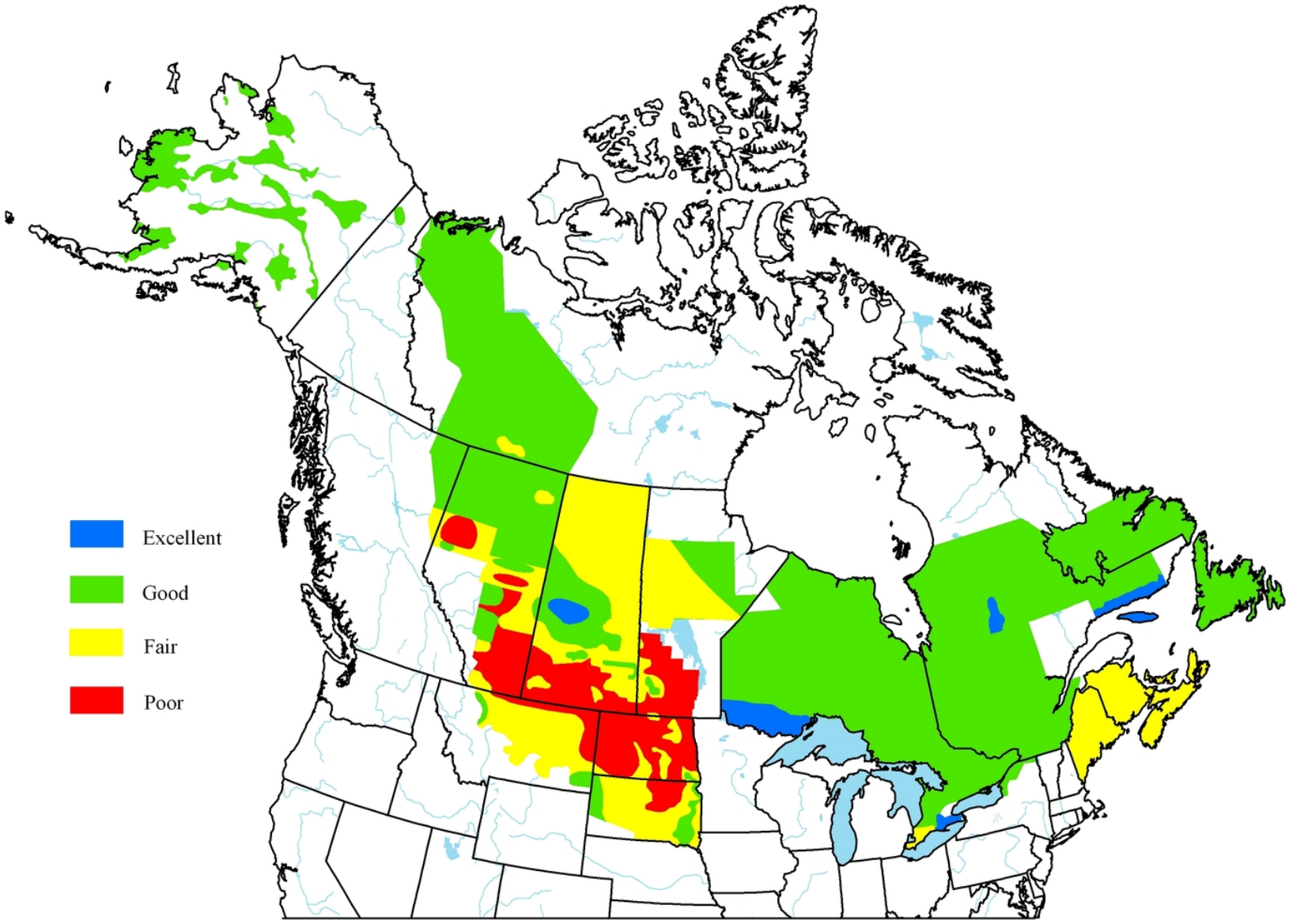

Figure 4: Breeding waterfowl habitat conditions during the 2008 Waterfowl Breeding Population and Habitat Survey, as judged by U.S. Fish and Wildlife Service Flyway Biologists.

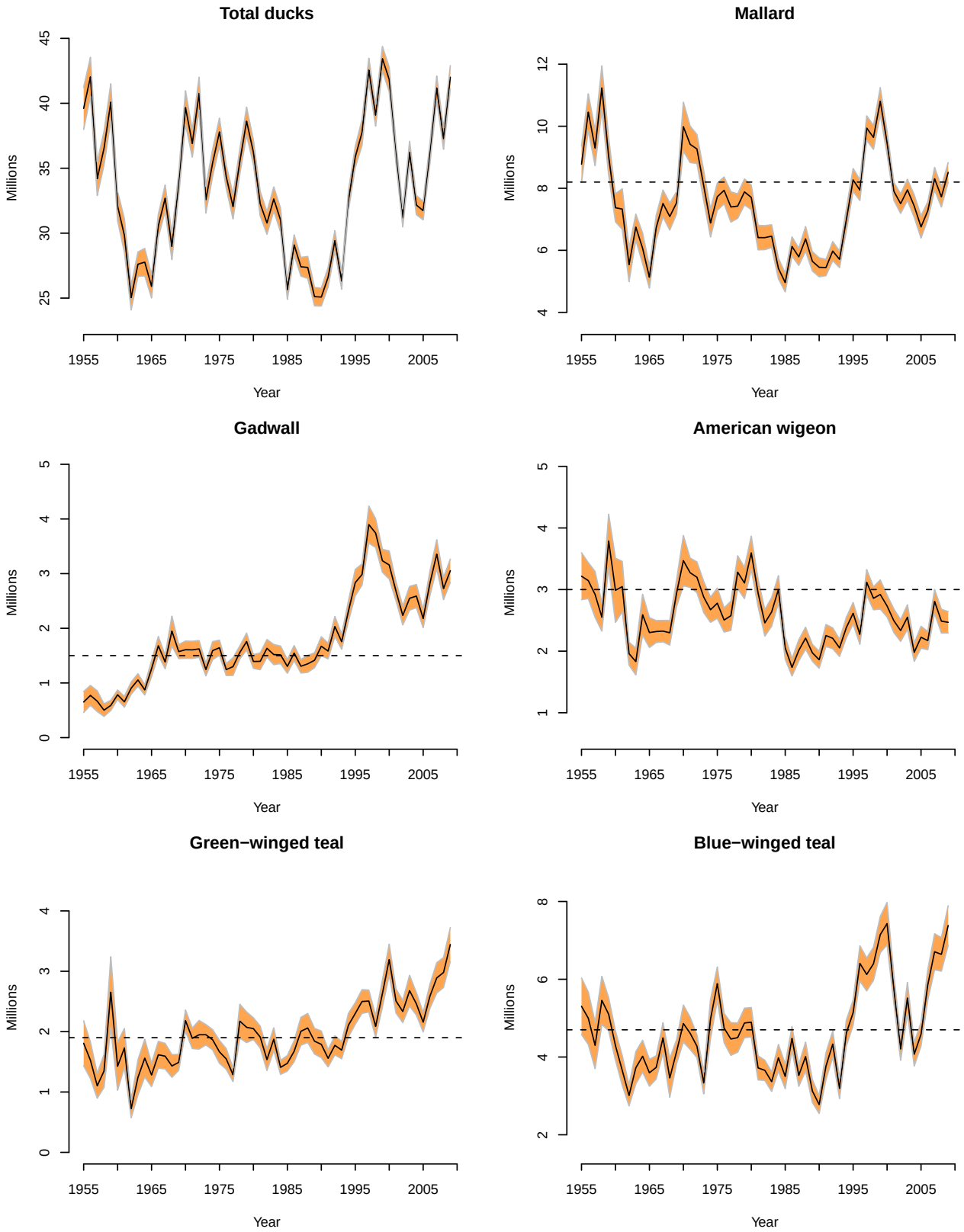

Figure 5: Breeding population estimates, 95% confidence intervals, and North American Waterfowl Management Plan population goal (dashed line) for selected species in the traditional survey area (strata 1–18, 20–50, 75–77).

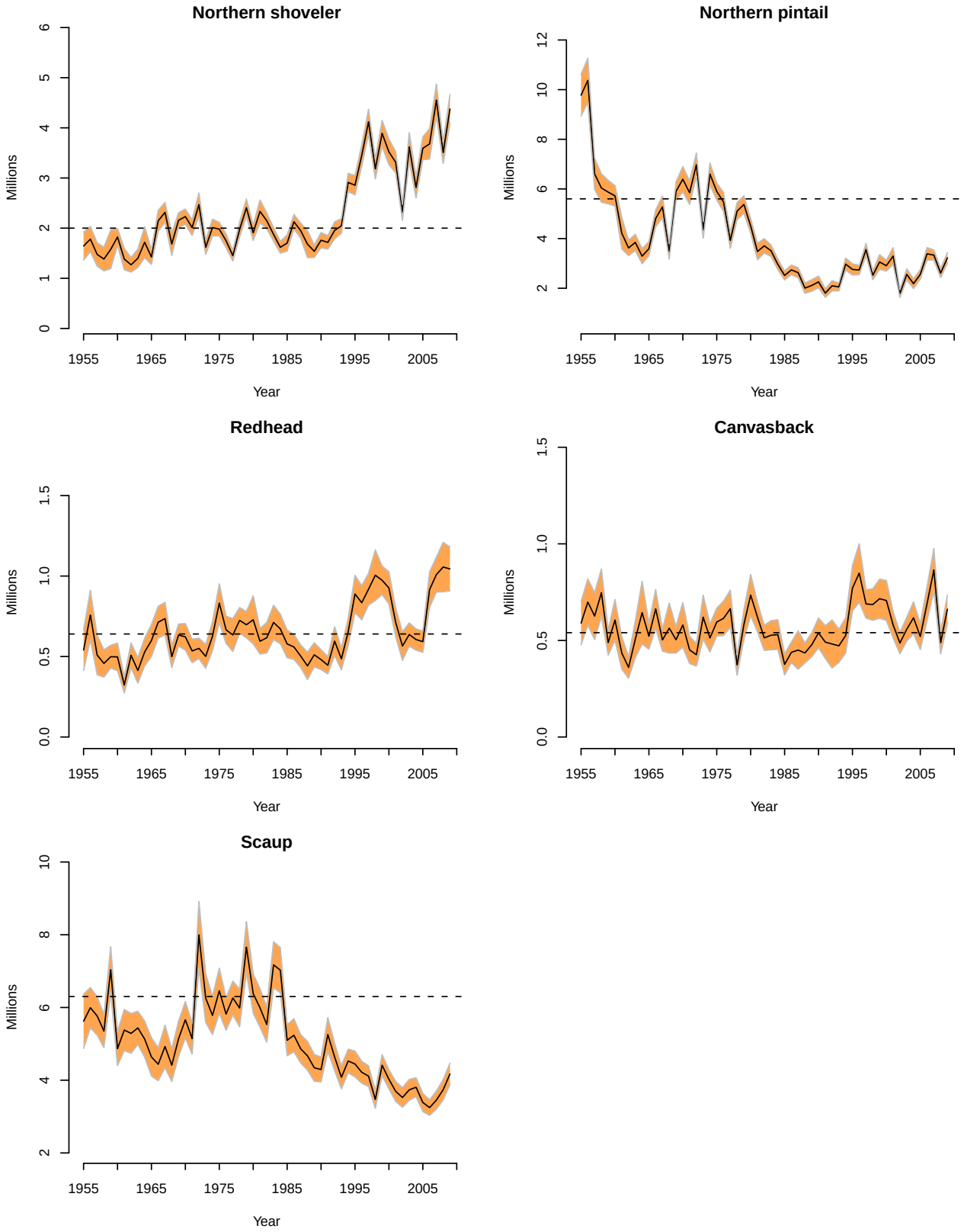

Figure 5: Continued.

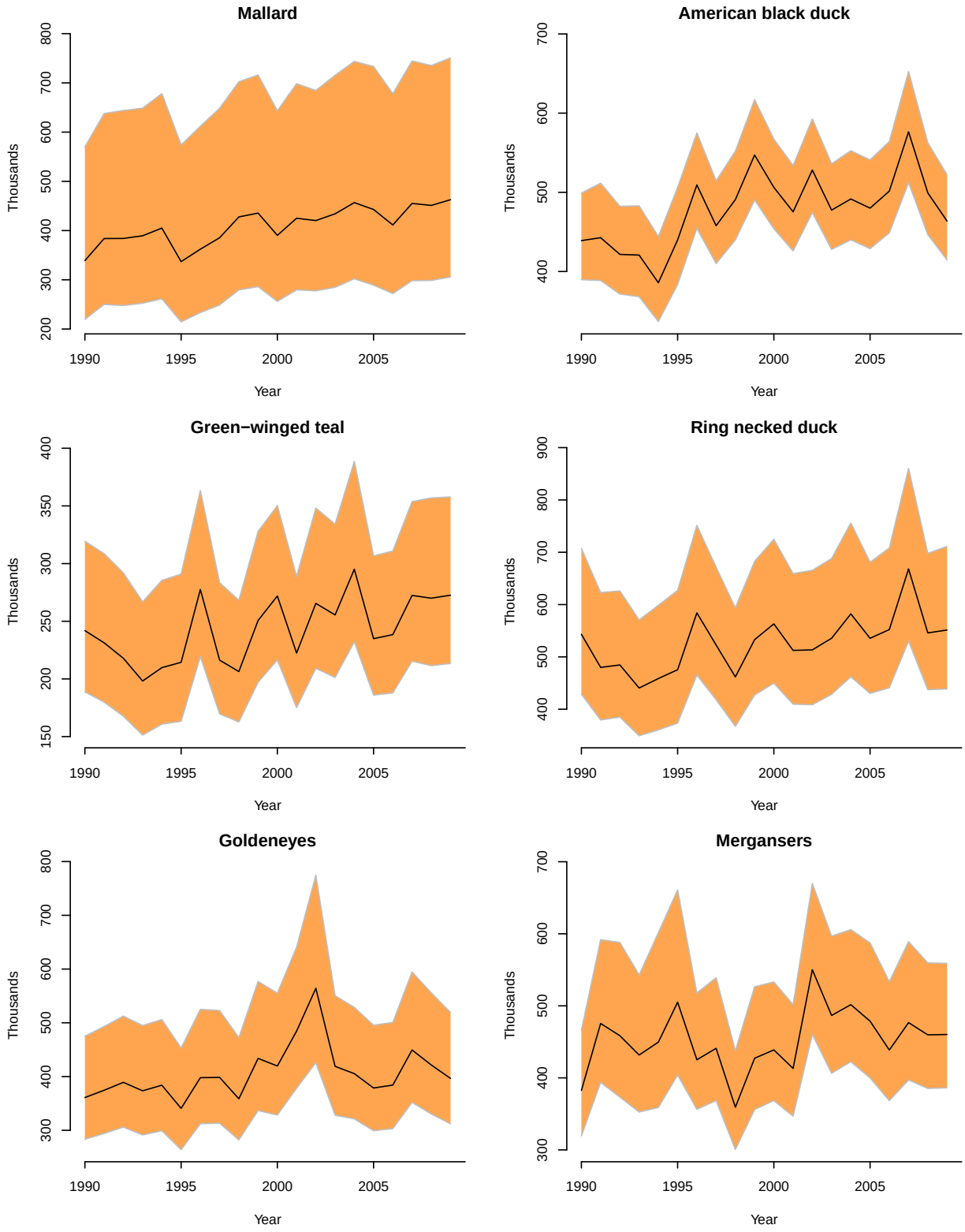

Figure 6: Breeding population estimates (from Bayesian hierarchical models) and 90% credibility intervals for selected species in the eastern survey area (strata 51, 52, 63, 64, 66–68, 70–72).

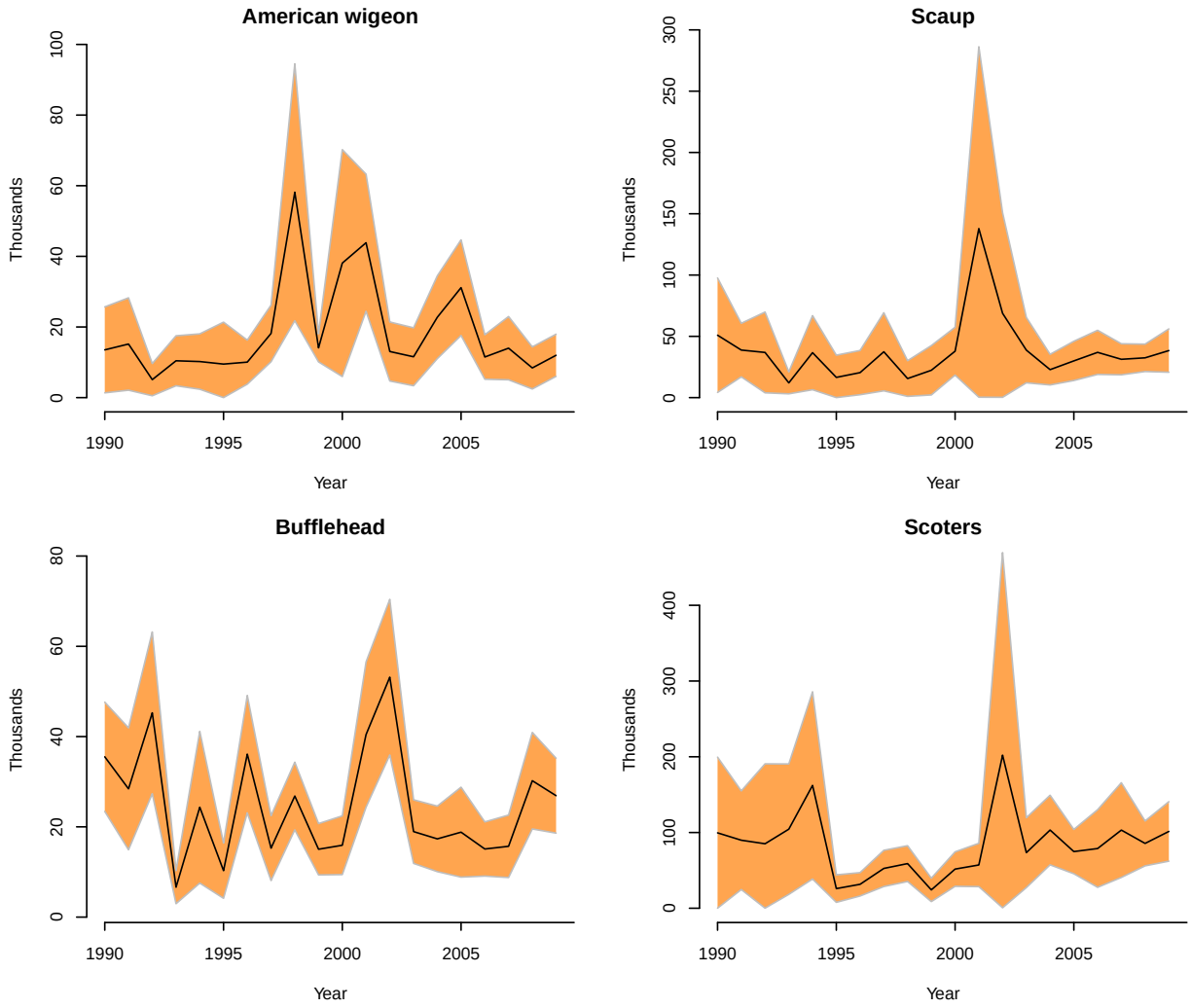

Figure 7: Breeding population estimates (variance-weighted means) and 90% confidence intervals for selected species in the eastern survey area (strata 51, 52, 63, 64, 66–68, 70–72).

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
2009	8512.4	248.3	3053.5	166.3	2468.6	135.4	3443.6	219.9	7383.8	396.8

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
2009	4376.3	224.1	3225.0	166.9	1044.1	106.3	662.1	57.4	4172.1	232.3

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

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

[b] Common, red-breasted, and hooded

Appendix B: Continued

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

[c] Greater and lesser

[d] Common and Barrow's

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