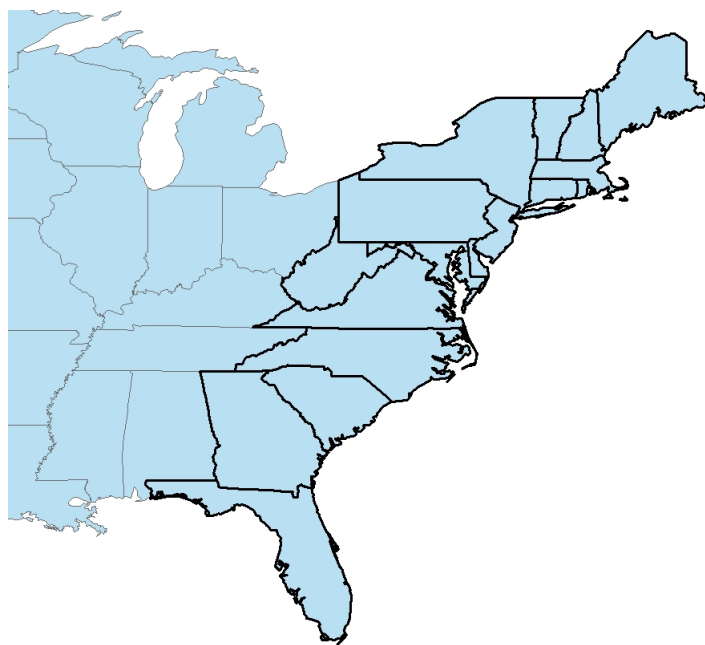# ATLANTIC FLYWAY BREEDING WATERFOWL PLOT SURVEY

Breeding Pair and Population Size Estimates Report

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Introduction/Methods

The Atlantic Flyway Northeast Plot survey became operational in 1993 and was initiated in an effort to collect information about locally breeding waterfowl. The intent was to collect data that would provide the basis for setting waterfowl hunting regulations in the Atlantic Flyway. Currently this effort involves 11 states from Virginia to New Hampshire in which cooperators survey randomly selected 1-km^2 plots (Figure 1) during the breeding season, typically April, May, and June. These data are then sent to the Atlantic Flyway office in the USFWS's Division of Migratory Bird Management for analysis. This analysis produces both population and breeding pairs estimates for selected species.

The purpose of this report is not to provide detail about the evolution of the survey. Rather, this report presents the results from the current year and compares them with the previous year and the long-term average. For a more in-depth understanding of the Northeast Plot survey (including rationale/justification, design, and implementation) please see the following:

Heusmann, H. W. and J. R. Sauer. 1997. A survey for mallard pairs in the Atlantic Flyway. Journal of Wildlife Management 61:1191-1198.

Heusmann, H. W. and J. R. Sauer. 2000. The northeastern states' waterfowl breeding population survey. Wildlife Society Bulletin 28:355-364.

Results

Across the survey area the waterfowl breeding season started early with warm temperatures in March. Colder temperatures returned in April resulting in a near average spring phenology. Many states reported unusual spring temperature flucuations. Lower than average snowfall across the survey area, and below normal early spring precipitation, contributed to average or below average water levels in most states.

In 2016, 2 population estimates are again presented for Canada geese. The first is based on the method of calculating total indicated birds (TIB) that was used from 1993 to 2002 (TIB = (2 x pairs) + singles + grouped birds). The newer method, more comparable with that used for duck species in this survey and for other goose surveys, calculates TIB as 2 x (pairs + singles) + grouped birds. As in years past stratum-within-state-, state-, stratum-, and survey-area-specific estimates (formerly printed as Appendix A) will be distributed in an Excel file. This will make these estimates more accessible to cooperators. Note that these estimates will also be uploaded to the USFWS Migratory Bird Data Center (https://migbirdapps.fws.gov). Breeding population and breeding pair estimates for this year are compared with estimates from 2015 and long-term (1993-2015) averages. Statistical comparisons were made with a 2-tailed z-test. The statistic was compared with the normal distribution and the z test statistic was calculated as:

$$z = \frac{Estimate_t - Estimate_{t-1}}{\sqrt{Var_t + Var_{t-1}}}$$

or

$$z = \frac{Estimate_t - Estimate_{LTA}}{\sqrt{Var_t + Var_{LTA}}}$$

The variance of the long term average was calculated as;

$$Var_{LTA} = \sum_{i=1}^{n} Var_i n^2$$

Where:

$i=$ survey year
$Var_i =$ estimated variance for year i
$n=$ number of years used in the long-term average

Comparisons of 2016 population and breeding pair estimates for mallards, black ducks, wood ducks, Canada geese, gadwall, green-winged and blue-winged teal, common and hooded mergansers, and mute swans were made with 2015 estimates and long-term averages (LTA). All comparisons were made at the 0.05 level and differences were considered significant when the *p*-value *(p)* was below the prespecified level.

The 2016 mallard population and breeding pair estimates were again at near record lows, but slightly higher than 2015. For mallards, both the population and breeding pair point estimates

increased from 2015 by 2.0 and 0.8 percent, respectively (Tables 1 and 2; Figures 2 and 3), but neither change was significant (p=0.86 and p=0.94 respectively). The differences from the LTA were large (24.2 and 25.3 percent lower, respectively) and significant (p<0.001 and p<0.001) for total birds and breeding pairs respectively. The population and pairs estimates for black ducks decreased from the 2015 estimates and have significant downward survey trends each with decreases from the LTA of greater than 34 percent (Tables 1 and 2; Figures 2 and 3). The wood duck population and pairs point estimates each increased from 2015 estimates (Tables 1 and 2; Figures 2 and 3), by about 6 and 8 percent, respectively. This increase contributed to wood duck population and pairs estimates gains of 13 percent and 15 percent over the LTA, respectively (Tables 1 and 2), though the increasing trend is not significant. Both the "Old" and "New" population estimates for Canada geese showed no significant change compared to 2015 (Table 1). The 2016 estimates were slightly below the LTA, but the differences were not significant (Table 1; Figure 2). The Canada goose population estimate remains well above the Atlantic Flyway's population goal of 700,000. The Canada goose pair estimate was also below the 2015 estimate by less than 1 percent, but slightly above the LTA (Table 2; Figure 3). Neither difference was significant.

Caution should be used in interpreting results for gadwall, green-winged and blue-winged teal, common and hooded mergansers, and mute swans as these estimates have large confidence intervals and estimates tend to fluctuate greatly from year to year. Changes in population or breeding pair estimates from the previous year may be seen in the data, but they are always insignificant. Differences from the LTA may show a significant trend, but the estimates still have large confidence intervals. Gadwall population estimates were significantly lower than the LTA by about 40 percent though breeding pair estimates were unchanged from the LTA (Tables 3 and 4). Both the population and pairs point estimates for green-winged teal were lower than in 2015 by over 20 percent (Tables 3 and 4). Likewise, the 2016 estimates for this species were lower than the LTA (Tables 3 and 4), though not significantly. The blue-winged teal population estimate was significantly lower than the LTA and the breeding pairs estimate was lower than the LTA, though not significantly. Common and hooded mergansers had population point estimates below 2015 but higher than the LTA. Mute swan population and pair estimates were slightly below 2015 estimates (0.5 and 3.8 percent respectively), and significantly below the LTA (33 and 26 percent respectively; Tables 3 and 4).

Table 1: Population estimates and standard errors for mallards, black ducks, wood ducks, and Canada geese from the Atlantic Flyway Breeding Waterfowl Plot Survey, 1993-2016, and percent change from 2015 to 2016 and from the long-term average to 2016.

Year	N	Mallards Estimate	Mallards SE	Black ducks Estimate	Black ducks SE	Wood ducks Estimate	Wood ducks SE	Canada geese Estimate	Canada geese SE	Canada geese Estimate	Canada geese SE
1993	1,475	686,562	49,870	80,158	11,033	311,924	32,660	647,509	111,770		
1994	1,468	856,313	62,774	60,930	8,667	323,285	34,730	648,684	72,971		
1995	1,465	864,120	70,395	72,507	13,169	367,019	35,473	780,027	98,816		
1996	1,469	848,645	61,074	77,316	17,521	344,659	32,139	932,656	107,423		
1997	1,472	795,176	49,596	65,578	9,050	385,644	33,863	1,013,324	132,539		
1998	1,474	775,213	49,718	81,689	20,458	382,778	28,585	970,092	115,663		
1999	1,491	879,953	60,173	82,421	14,392	402,170	34,542	999,517	120,811		
2000	1,480	762,555	48,701	87,009	15,421	376,212	35,008	1,022,299	101,930		
2001	1,485	809,438	51,572	69,627	11,263	388,204	37,891	1,016,629	89,337		
2002	1,487	833,514	56,235	68,637	12,211	420,000	37,804	965,657	86,932		
2003	1,495	731,907	47,025	64,898	11,357	341,945	29,497	1,040,474	89,820	1,126,731	94,540
2004	1,485	806,554	51,747	53,891	7,713	360,185	36,035	978,554	89,813	1,073,096	93,828
2005	1,488	753,622	53,619	49,745	8,469	413,558	38,981	1,064,696	96,415	1,167,075	102,279
2006	1,455	721,402	47,639	51,924	8,880	400,967	34,124	1,057,251	103,397	1,143,951	106,242
2007	1,485	687,578	46,724	62,355	11,608	420,574	36,086	1,046,067	90,513	1,127,987	94,528
2008	1,476	619,095	40,682	65,121	16,838	386,127	34,468	951,501	79,003	1,024,914	82,157
2009	1,445	666,752	45,695	39,523	6,228	367,998	34,312	943,274	72,554	1,006,133	75,112
2010	1,463	651,709	49,122	38,155	8,495	409,599	35,018	896,254	87,327	977,085	92,408
2011	1,471	586,089	41,561	38,717	6,919	382,736	32,978	941,359	82,828	1,015,076	86,473
2012	1,474	612,587	45,776	28,619	4,370	418,910	33,177	823,257	69,346	879,793	71,582
2013	1,327	604,157	42,755	49,735	8,041	361,156	28,918	883,578	75,510	951,936	79,106
2014	1,290	634,582	48,937	54,493	13,141	421,557	36,137	1,011,944	112,529	1,084,913	114,367
2015	1,310	540,087	45,546	42,429	14,573	406,178	37,759	891,123	79,660	963,809	81,744
2016	1,306	551,258	45,110	39,750	8,468	430,636	37,494	883,155	76,930	949,990	80,130
Long-term average (1993-2015)											
		727,287	10,681	60,238	2,491	382,321	7,186	935,901	19,944	1,045,688	25,277
Percent change from:		%	P	%	P	%	P	%	P	%	P
2015		2.07	0.8617	-6.31	0.8737	6.02	0.6458	-0.89	0.9426	-1.43	0.9039
LTA		-24.20	0.0001	-34.01	0.0203	12.64	0.2057	-5.64	0.0569	-9.15	0.2547

Table 2: Breeding pair estimates and standard errors for mallards, black ducks, wood ducks, and Canada geese from the Atlantic Flyway Breeding Waterfowl Plot Survey, 1993-2016, and percent change from 2015 to 2016 and from the long-term average to 2016.

		Mallards		Black ducks		Wood ducks		Canada geese	
Year	N	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
1993	1,475	324,020	23,075	39,464	5,485	140,506	14,229		
1994	1,468	427,254	31,354	29,472	4,255	148,298	14,448	202,281	19,827
1995	1,465	404,837	30,111	32,670	5,919	172,944	16,949	245,233	23,023
1996	1,469	403,919	28,367	31,674	5,042	156,201	14,023	277,608	25,468
1997	1,472	383,296	23,653	29,792	4,079	186,127	16,610	326,982	40,080
1998	1,474	374,612	24,079	31,833	4,885	184,725	13,938	324,648	29,188
1999	1,491	421,492	28,771	38,693	6,620	195,197	16,512	379,479	38,088
2000	1,480	359,398	22,288	36,006	4,902	174,417	15,066	339,936	26,316
2001	1,485	385,824	23,400	31,942	4,544	187,322	18,336	392,055	27,777
2002	1,487	400,730	26,599	29,026	3,645	202,090	18,298	405,898	32,094
2003	1,495	347,309	22,299	28,863	4,186	167,135	14,664	389,793	28,280
2004	1,485	387,141	25,135	25,028	3,499	173,292	16,971	394,626	28,065
2005	1,488	358,214	25,213	21,471	3,127	195,916	17,690	410,544	30,402
2006	1,455	345,742	22,568	24,907	4,225	194,578	16,713	384,715	27,397
2007	1,485	332,549	22,778	24,714	4,253	196,717	15,616	390,630	27,454
2008	1,476	301,700	19,728	24,204	4,360	185,867	16,642	377,762	26,780
2009	1,445	321,830	22,256	17,823	2,933	173,898	15,767	329,638	22,291
2010	1,463	300,558	22,346	15,431	2,736	198,490	17,247	359,627	26,875
2011	1,471	277,354	18,157	18,146	3,348	184,559	15,817	363,841	25,776
2012	1,474	292,799	21,529	13,407	2,093	200,618	15,832	312,766	21,763
2013	1,327	289,552	19,233	23,426	3,832	177,710	13,958	341,100	26,154
2014	1,290	301,699	22,353	20,907	4,569	209,525	17,806	357,492	27,215
2015	1,310	258,762	21,075	20,756	7,278	194,915	16,440	357,219	28,348
2016	1,306	260,793	19,638	15,214	2,417	210,335	18,447	354,215	25,953
Long-term average (1993-2015)									
		347,852	5,001	26,507	938	182,654	3,363	348,358	5,978
Percent change									
from:		%	P	%	P	%	P	%	P
	2015	0.79	0.9438	-26.70	0.4699	7.91	0.5326	-0.84	0.9377
	LTA	-25.03	0.0000	-42.60	0.0000	15.16	0.1399	1.68	0.8259

Table 3: Population estimates and standard errors for gadwall, green-winged teal, blue-winged teal, common merganser, hooded merganser, and mute swans from the Atlantic Flyway Breeding Waterfowl Plot Survey, 2003-2016, and percent change from 2015 to 2016 and from the long-term average to 2016.

Year	N	Gadwall		Green-winged teal		Blue-winged teal		Common merganser		Hooded merganser		Mute swan	
		Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Esitmate	SE	Estimate	SE
2003	1,495	8,933	3,494	60,173	13,237	33,948	11,397	45,653	8,306	28,878	5,518	14,368	2,999
2004	1,485	11,247	5,272	55,016	13,356	39,344	11,862	49,163	14,923	44,143	11,366	22,706	8,653
2005	1,488	16,062	14,012	36,321	9,097	19,066	6,467	40,420	7,027	43,035	8,921	12,614	3,051
2006	1,455	7,199	3,320	64,402	17,330	8,988	5,556	43,214	12,409	34,355	9,931	24,902	6,825
2007	1,485	6,230	2,321	55,108	11,019	42,505	19,342	49,230	9,710	43,121	9,356	17,064	3,591
2008	1,476	8,438	6,540	43,995	12,720	15,116	8,203	39,515	7,084	31,197	6,878	21,251	7,893
2009	1,445	14,551	6,165	67,003	12,629	23,143	8,881	40,615	7,704	25,019	5,671	21,859	5,816
2010	1,463	3,821	2,681	70,763	22,638	35,834	25,829	43,340	12,490	20,187	4,979	18,243	3,517
2011	1,472	6,078	2,650	61,412	20,495	8,761	3,364	52,232	9,302	28,078	6,185	24,972	8,588
2012	1,474	5,557	3,726	60,028	13,751	13,224	4,325	50,128	9,106	34,092	7,544	30,606	9,728
2013	1,327	13,746	7,923	70,486	21,009	20,744	8,938	55,550	10,064	45,344	8,651	24,468	11,050
2014	1,290	25,361	11,879	48,367	14,975	25,205	8,798	57,219	9,645	42,340	11,806	17,375	3,672
2015	1,310	8,328	3,399	67,063	25,336	11,821	4,043	59,936	16,856	51,567	8,919	13,758	3,057
2016	1,306	6,292	2,411	49,674	11,794	13,846	4,819	53,692	9,360	37,225	6,603	13,685	3,057
Long-term average (1993-2015)													
		10,427	2,002	58,472	5,006	22,900	3,470	48,170	3,230	36,258	2,526	20,322	1,997
Percent change from:		%	P	%	P	%	P	%	P	%	P	%	P
	2015	-24.44	0.5493	-25.93	0.4925	17.13	0.6165	-10.42	0.7111	-27.81	0.1078	-0.53	0.9808
	LTA	-39.65	0.0389	-15.05	0.0788	-39.53	0.0091	11.46	0.0874	2.67	0.7018	-32.66	0.0009

Table 4: Breeding pair estimates and standard errors for gadwall, green-winged teal, blue-winged teal, common merganser, hooded merganser, and mute swans from the Atlantic Flyway Breeding Waterfowl Plot Survey, 2003-2016, and percent change from 2015 to 2016 and from the long-term average to 2016.

|		Gadwall		Green-winged teal		Blue-winged teal		Common merganser		Hooded merganser		Mute swan	
Year	N	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Esitmate	SE	Estimate	SE
2003	1,495	4,466	1,747	12,622	3,510	7,445	2,891	19,561	3,432	12,783	2,555	7,184	1,499
2004	1,485	3,259	1,265	8,690	2,743	16,342	5,024	19,544	6,891	20,158	5,514	9,267	2,538
2005	1,488	1,071	897	7,389	2,106	7,251	2,110	17,369	2,961	20,051	4,130	6,031	1,508
2006	1,455	1,754	839	13,665	4,194	4,494	2,778	17,233	5,117	11,563	2,463	10,184	2,938
2007	1,485	3,115	1,160	13,155	3,851	13,444	6,211	17,620	3,119	18,673	4,069	8,023	1,649
2008	1,476	971	430	12,172	4,315	7,041	4,070	18,520	3,329	14,361	3,322	10,001	3,898
2009	1,445	3,108	1,231	17,022	4,232	11,494	4,439	16,619	3,189	10,804	2,717	9,562	2,487
2010	1,463	630	404	10,308	3,624	5,032	2,271	16,088	5,514	8,081	2,245	9,514	1,846
2011	1,472	2,880	1,320	15,207	7,153	3,637	1,509	23,169	4,062	13,323	3,024	8,524	1,752
2012	1,474	934	430	16,631	4,670	6,496	2,158	20,620	3,528	15,998	3,624	8,481	1,834
2013	1,327	3,078	1,155	15,974	4,238	10,372	4,469	22,886	3,834	18,432	3,506	9,245	4,164
2014	1,290	3,606	1,621	8,791	2,578	10,676	3,963	24,787	4,164	16,851	4,987	8,688	1,836
2015	1,310	2,717	1,100	14,529	4,163	5,911	2,022	25,589	8,056	23,237	4,100	6,564	1,513
2016	1,306	2,481	1,103	11,393	2,877	6,923	2,409	23,539	4,198	16,273	2,964	6,318	1,474
Long-term average (1993-2015)													
		2,430	338	12,781	1,240	8,433	1,094	19,970	1,398	15,717	1,107	8,559	729
Percent change from:		%	P	%	P	%	P	%	P	%	P	%	P
	2015	-8.69	0.8300	-21.58	0.4513	17.13	0.6165	-8.01	0.7991	-29.97	0.0894	-3.75	0.8706
	LTA	2.10	0.8800	-10.86	0.2629	-17.91	0.1676	17.87	0.0107	3.54	0.6151	-26.18	0.0021
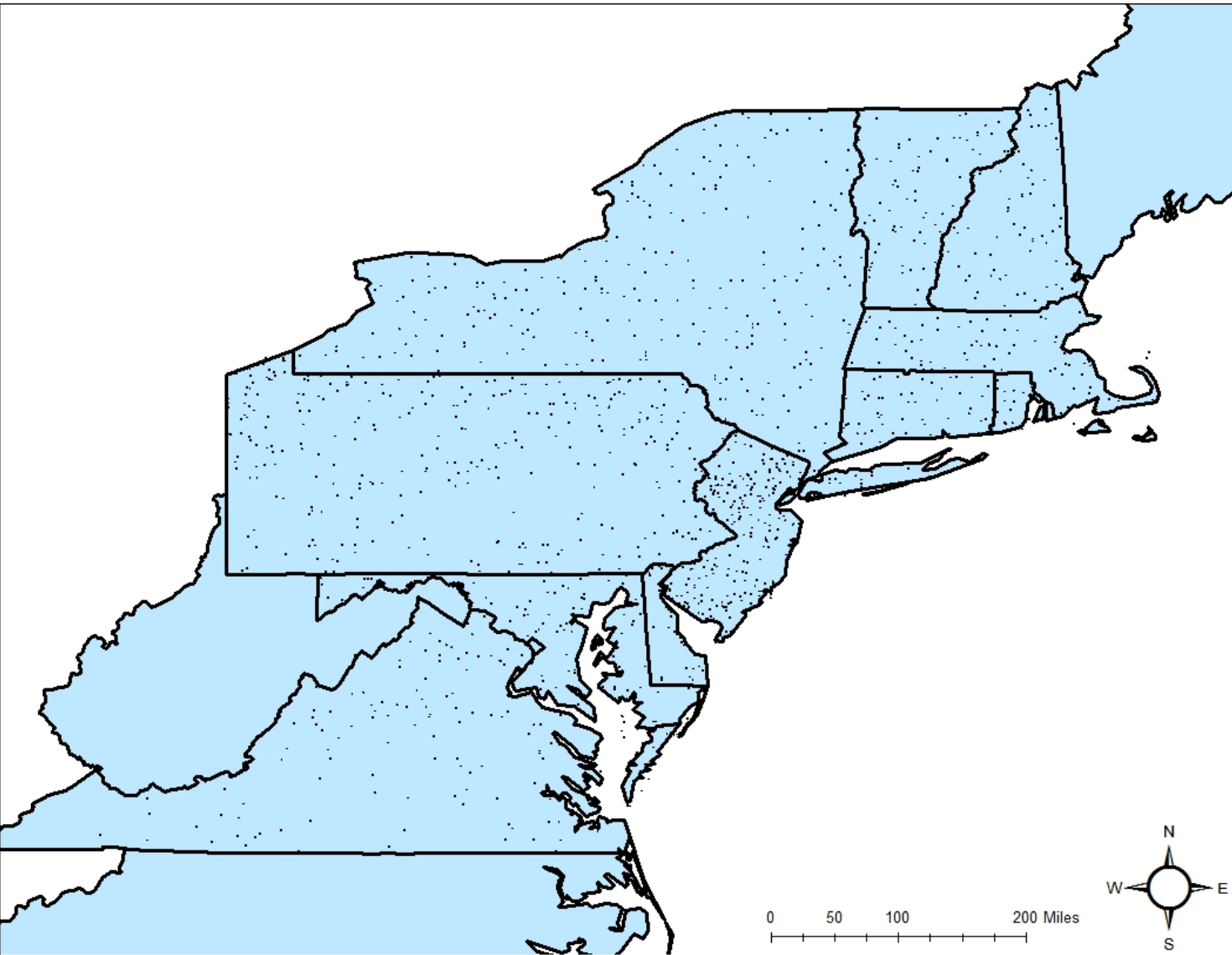
Figure 1: Map of 1-km^2 plots in the Atlantic Flyway breeding plot survey, Virginia to New Hampshire, distributed across Breeding Bird Strata relative to the amount of a stratum in a state.
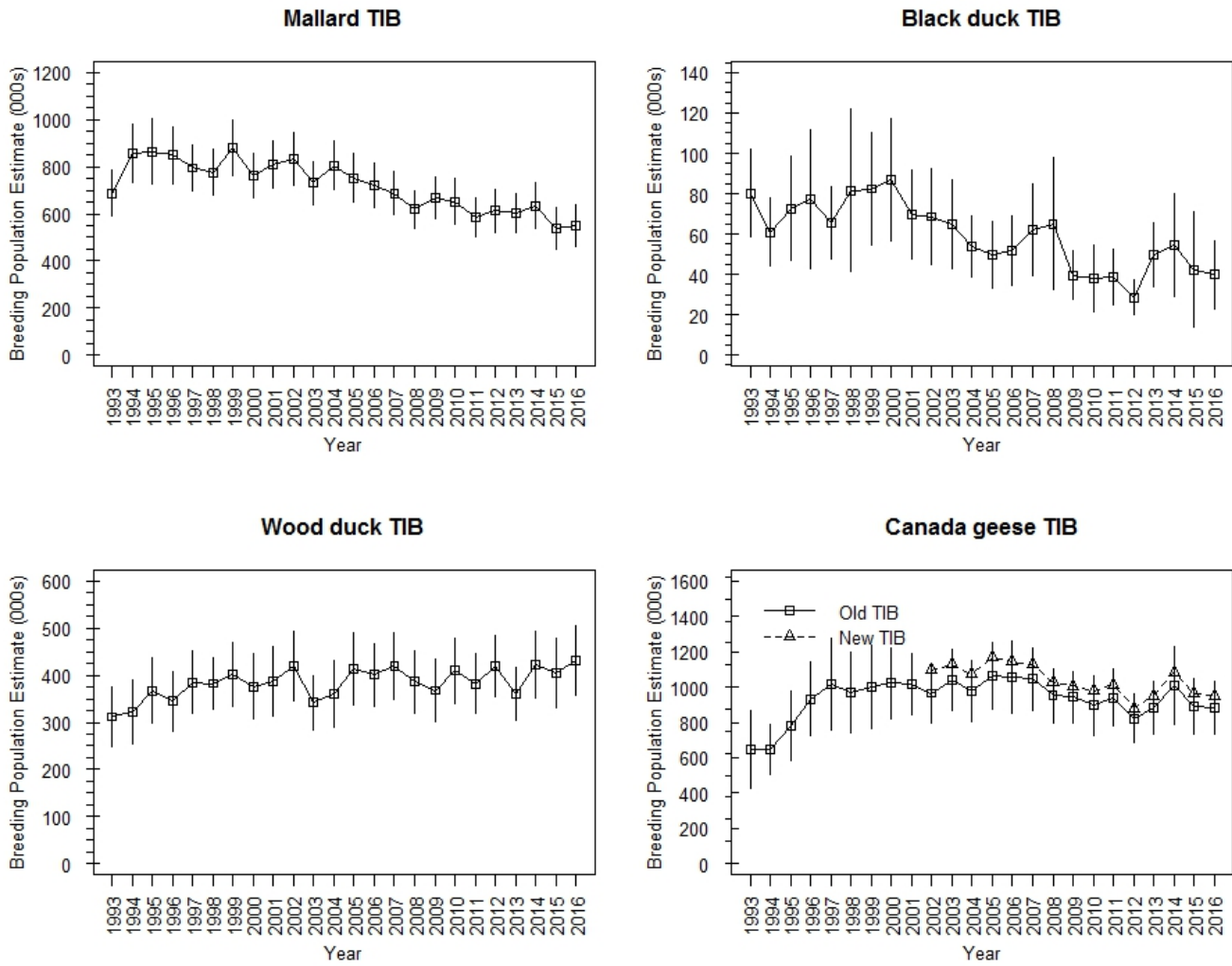
Figure 2: Population estimates and 95% confidence intervals for mallards, black ducks, wood ducks, and Canada geese, 1993-2015.
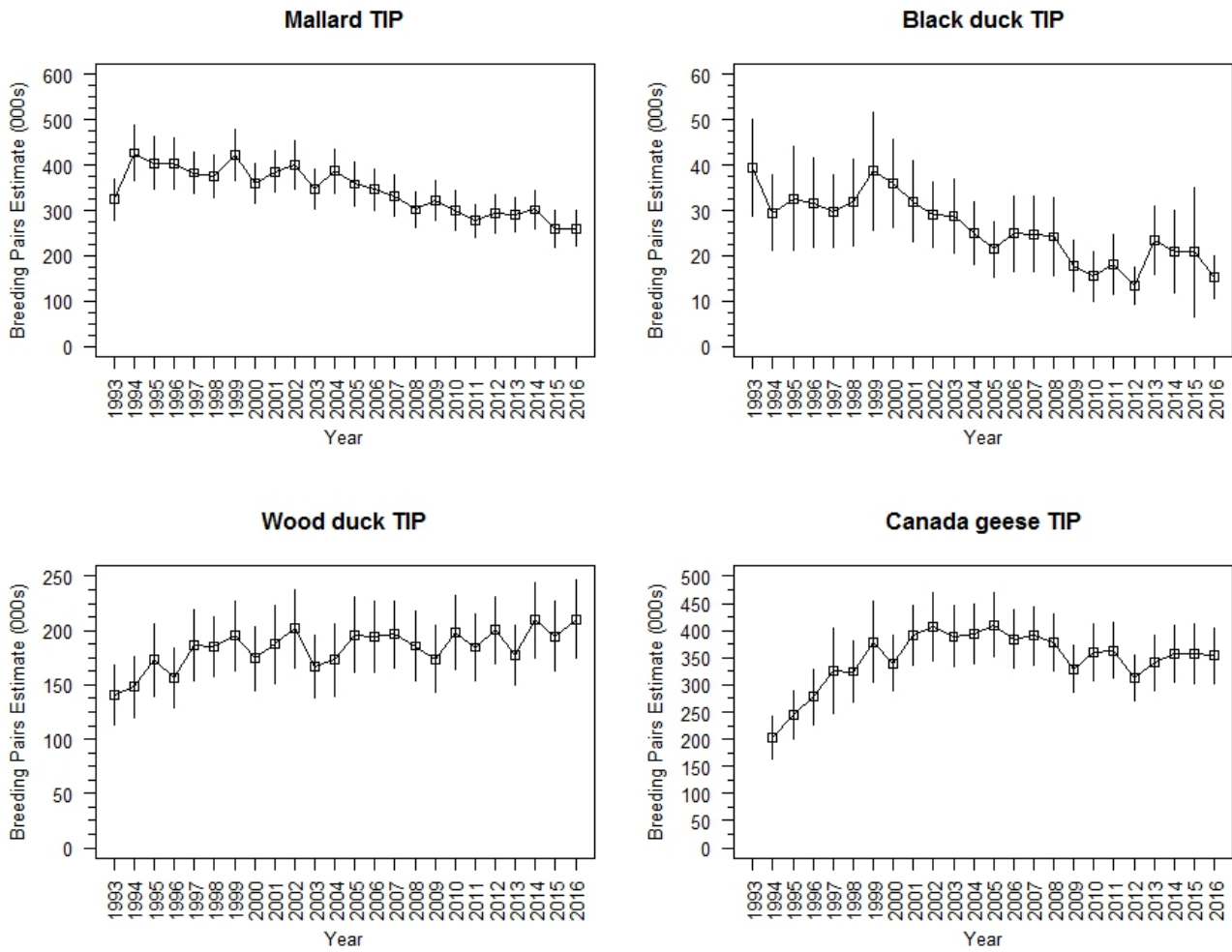
Figure 3: Breeding pair estimates and 95% confidence intervals for mallards, black ducks, wood ducks, and Canada geese, 1993-2015.