

**PENNSYLVANIA GAME COMMISSION
BUREAU OF WILDLIFE MANAGEMENT
PROJECT ANNUAL JOB REPORT**

PROJECT CODE NO: 06510

TITLE: Waterfowl Research/Management

JOB CODE NO.: 51004

TITLE: Waterfowl Population Monitoring

PERIOD COVERED: 1 July 2015 to 30 June 2016

COOPERATING AGENCIES: U. S. Fish and Wildlife Service, Division of Migratory Bird Management; Cooperating Atlantic Flyway States

WORK LOCATION(S): Statewide

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DATE: 25 August 2016

ABSTRACT The objectives of this project are to monitor the status of breeding and wintering populations of waterfowl in Pennsylvania and the Atlantic Flyway (AF), and to assess the effects of harvest regulation changes on the waterfowl resource. Pennsylvania duck hunting seasons for both 2014-15 and 2015-16 were 60 days with a daily bag limit of 6 birds, similar to those offered in 2013-14, except that canvasback bag limits decreased from 2 to 1 in 2014 and increased to 2 again in 2015. U.S. Fish and Wildlife Service (USFWS) Harvest Information Program estimated active duck and goose hunters in Pennsylvania during 2014-15 were 17,300 and 20,900, down 37% and 40% respectively from the 1999 to 2014 averages. Pennsylvania's 2014-15 total duck harvest estimate was 72,800, down 50% from average. Pennsylvania's 2014-15 estimated Canada goose harvest was 106,900, down 36% from average. Canada goose harvest timing was 29% during September and 71% during the regular season. Pennsylvania's estimated regular season snow goose harvest of 2,300 in 2014-15 was down 72% from average. In the 2016 light goose conservation season, a minimum of 1,953 snow geese were harvested in Pennsylvania. During the 2016 AF Midwinter Waterfowl Survey conducted in January, 39,235 waterfowl were recorded in Pennsylvania and 1,070,859 in the entire flyway; because this survey is transitioning to a narrower geographic and species focus, the 2016 results are not directly comparable to previous years. In the Pennsylvania portion of the 2016 AF Breeding Waterfowl Survey, mallard pairs (61,721) were down 30% from the 1993-2015 average of 88,419. There were 55,247 wood duck breeding pairs estimated in 2016 which was near average. Estimates of total hooded mergansers (8,962) and common merganser (23,503) were 37% and 26% above average respectively. The Canada goose breeding pair (97,738) and total spring population (234,959) estimates were near average. For the Northeast U.S. survey area, total population estimate for mallards (551,258) was 24% below

average and for American black ducks (39,750) was 34% below average. The estimates for wood ducks (430,636) and Atlantic Flyway Resident Population Canada geese (949,000) were similar to average. For 2015, waterfowl populations in the Eastern survey area of Canada were near average for mallards, 13% below average for black ducks, 14% below average for green-winged teal, and 15% below average for goldeneye. Ring-necked ducks were similar to the LTA. Habitat conditions on the traditional survey area during 2015 were similar to or poorer than 2014. Breeding duck populations on the traditional survey area in the mid-continent of North America were significantly above (43%) the long-term average. Pond counts and habitat conditions in the U.S. and Canadian prairies were above average and should be favorable for production. Spring 2015 production was average for Atlantic Population and Southern James Bay Population Canada geese. For greater snow geese, good production and an average fall flight were expected in 2015.

OBJECTIVE

To determine the status of breeding and wintering waterfowl populations in Pennsylvania and the Atlantic Flyway, and assess the effects of hunting regulation changes on the waterfowl resource.

METHODS

Hunter activity and total waterfowl harvest are estimated from the U.S. Fish and Wildlife Service (USFWS) Harvest Information Program (HIP) (Raftovich et al. 2015). The species, age, sex, geographical, and temporal distribution of the total harvest are obtained from the USFWS Parts Collection Survey (PCS). This survey samples a number of HIP-registered migratory bird hunters who record the date and location for each bird they harvest, and send in a wing from each duck and a tail fan and primary tips from each goose from which species, sex, and age are determined.

To estimate harvest and hunter participation during the 2016 light goose conservation season, hunters were required to obtain a free Snow Goose Conservation Permit either online or by mail. Along with the permit, hunters were required to possess a general hunting license, migratory game bird license and a federal duck stamp (for those 16 or older). Mandatory reporting of harvest and hunter activity was required of all hunters even if they did not hunt, and harvest reports were due within 30 days of the close of the snow goose conservation season. In an effort to boost reporting rates, which had been declining from 2009-2012, we have used e-mail reminders since 2013. In 2016, a single reminder was sent in late May to those permit holders for whom we had an e-mail address on file and who had not responded as required within the 30-day reporting period following the close of the season. Flyway-level conservation season data is obtained from the Snow Goose, Brant, and Swan Committee of the Atlantic Flyway Migratory Game Bird Technical Section.

Historically, data on the population size and distribution of wintering waterfowl was obtained through the Atlantic Flyway Midwinter Waterfowl Survey (MWS). Because population estimates used to set most waterfowl hunting seasons are now obtained from breeding ground surveys, the MWS is being reduced in scope to prioritize collection of data for tundra swans and Atlantic brant, the 2 species for which MWS counts are still the primary metric to inform harvest

management. 2016 represented a transition year to the reduced survey, with some Atlantic Flyway states conducting a full-fledged MWS comparable to previous coverage, some conducting a reduced survey of all waterfowl species, some recording tundra swans and brant only, and some not conducting a winter survey. For Pennsylvania, most historic survey segments were covered, but some only partially and all by ground counts, whereas previous year surveys included a mix of aerial and ground surveys. Thus, 2016 results are not directly comparable to previous years. In 2017 the Pennsylvania Game Commission will shift to a survey of tundra swans only, on segments where this species has historically occurred (Atlantic brant do not commonly occur in Pennsylvania).

Information on breeding population size of mallards, black ducks, wood ducks, Canada geese, and other waterfowl was obtained from the Atlantic Flyway (AF) Breeding Waterfowl Plot Survey. This survey has been conducted annually since 1989 in Pennsylvania and other AF states from Virginia to New Hampshire. Survey participants included biologists from the Game Management and Wildlife Diversity Divisions of the Bureau of Wildlife Management and Game Commission Region biologists and Wildlife Management Supervisors. A total of 346 1-km² plots were part of this survey across six physiographic regions (Fig. 1) of Pennsylvania using a stratified random design. Of these, 90 plots were not field checked because they did not contain habitat for breeding waterfowl. Surveys were conducted from 13 April to 5 May 2016. Breeding pair units are determined from the presence of pairs, lone drakes, and groups of drakes. Total population estimates presented for Canada geese utilize an equation initiated in 2003 that accounts for geese observed as singles, but assumed to be part of a breeding pair. These estimates averaged 8% higher each year from 2003 to 2010 than the old method of calculating total population. Breeding pair estimates show large 95% confidence intervals on the state level; the survey is designed to yield $\leq 20\%$ coefficient of variation on the mean over the entire Northeast United States region. Therefore, breeding pair trends over several years are more useful to follow than individual year estimates for Pennsylvania. Breeding population and breeding pair estimates for this year were compared with estimates from the long-term (1993-2015) averages. Additional breeding survey data for areas not covered by the AF Breeding Waterfowl Plot Survey is provided by the USFWS.

RESULTS

Hunter Activity and Harvest

Duck season length in both 2014-15 and 2015-16 was 60 days with outside framework dates of the Saturday nearest to 24 September (27 September in 2014 and 26 September in 2015) and the last Sunday in January (25 January in 2015 and 30 January in 2016). Duck seasons selected for Pennsylvania in both years included split seasons in 3 of 4 zones with the first split opening in October and the second split closing in early to mid-January; and non-split seasons opening in late October and closing in early January for the Lake Erie zone (Appendices 1 and 2). The aggregate daily duck bag limit remained at 6 birds. The daily bag limit for individual species regulations remained the same in 2014-15 and 2015-16 as in 2013-14, except canvasback daily bag limit was decreased from 2 to 1 per day in 2014-15 and then increased back to 2 daily in 2015-16.

Boundaries of Pennsylvania's 3 Canada goose harvest zones (Resident Canada Goose [RP], Southern James Bay Population [SJB], and Atlantic Population [AP]) are presented in Appendices 1 and 2. An early Canada goose season (1-25 September) was again held statewide in both 2014 and 2015, except for State Game Land (SGL) 214 (Pymatuning Wildlife Management

Area [WMA]) in Crawford County and SGL 46, the Middle Creek WMA in Lebanon and Lancaster counties. The daily bag limit was again 8 birds, 24 in possession statewide except the SJBZ zone (3 per day) and the areas surrounding Pymatuning WMA and Middle Creek WMA (see Appendices 1 and 2; daily bag limit of 1 bird in these areas to limit harvest on the resident flocks at each WMA). Regular Canada goose season lengths (AP Zone - 50 days, SJBZ Zone - 78 days, RP Zone - 80 days), daily bag limits (AP and SJBZ Zones - 3, RP Zone - 5), and framework dates were the same as 2013-14 in all 3 zones for both 2014-15 and 2015-16.

At the time of preparation of this report, data was not yet available from the USFWS on hunter effort, total harvest, or harvest composition (species and age ratios) for the 2015-16 hunting season. For the 2014-15 season, the estimates (Roberts 2015) of active duck and goose hunters in Pennsylvania from HIP were 17,300 and 20,900 respectively and were fourth highest and highest, respectively in the AF (Table 1). However, these estimates were 37% and 40% below the 1999-2014 average and continue recent declines in participation among Pennsylvania waterfowlers. The HIP estimate of days hunted for ducks in 2014-15 was down 49% from the long-term average (LTA) while the number of goose hunter days was down 45% from average. These trends are related to the decline in hunter numbers noted above, but the reflected fewer days hunted are also likely related to budget and time constraints identified by hunters as reasons limiting waterfowl hunting participation (Jacobs et al. 2012). The 2014-15 HIP estimate of total Pennsylvania duck harvest (72,800) was down 50% from average. Harvest Information Program Canada goose harvest estimate in Pennsylvania for 2014-15 was 106,900 and was 36% below average. Pennsylvania ranked third in the AF for total Canada goose harvest after New York and Maryland. The September season continues to account for a substantial proportion (29%) of the Canada goose harvest while the regular season (early October to late February) harvest accounted for 71% of the total. Estimated snow goose harvest during the regular season in Pennsylvania was 2,300 birds, 72% below average.

We issued 2,000 permits to hunters to participate in the 2016 Light Goose Conservation Season. This included 66 nonresident hunters. We received 658 reports by 23 May (32.9% initial reporting rate), and an additional 142 reports following distribution of the e-mail reminder to non-respondents for a total of 800 harvest reports (40.0% overall reporting rate).

Of the 800 reports received, 501 (62.6% of respondents or 25.1% of all permit holders, if non-respondents were assumed to be non-participants) indicated hunting during the conservation season. Their grand total retrieved harvest was 1,953 (Table 2). Total hunter days were 1,311 and the number of geese bagged per hunter day was 1.49. Data on harvest attributable to additional hunting methods of extended hours, electronic calls, and electronic decoys was not collected, as this information is no longer required by the USFWS for states to participate in the conservation season. From 2009-15, electronic calls were used for approximately 34% of snow geese taken in the Pennsylvania conservation order and from 2012-15, electronic decoys were used for approximately 27% of geese taken. Extended hunting hours had less effect, with approximately 12% of the total geese taken after sunset between 2009-15. (It should be noted that these expanded methods categories are not mutually exclusive; for example, a goose taken after sunset while using both electronic calls and electronic decoys would be recorded as harvested under all 3 methods, although only counted once in the grand total retrieved harvest).

Analyses conducted in 2013 and 2014 of the per capita hunting activity and harvests of permit holders reporting after the distribution of reminders compared to those of earlier respondents showed that assuming non-respondents to be non-participants is probably inaccurate. However, we have not attempted to introduce correction factors. Thus, the overall percentage of permit holders participating in the season is likely somewhere between the calculations of 25% based on all permit holders and the 63% based on reports actually received, and the harvest totals presented herein should be considered minimum estimates that may not be completely comparable between years. We will continue to investigate options to improve our harvest estimates or revise previous estimates.

Flyway-level results for 2016 for the 7 states (Delaware, Maryland, New Jersey, New York, Pennsylvania, Virginia and Vermont) participating in the conservation season were not available at the time of preparation of this report. For the 2015 conservation season, an estimated 6,073 hunters harvested a total of 86,641 snow geese in the Atlantic Flyway; this is the highest harvest in the 9 years the conservation order has been in existence (Snow Goose, Brant, and Swan Committee of the Atlantic Flyway Council, unpublished data). The conservation season in the U.S. has been reasonably successful in providing additional harvest of greater snow geese (for example, estimates of average total snow goose harvest (HIP regular season estimate plus Pennsylvania Game Commission conservation season minimum estimate) in Pennsylvania for the first 7 years with a conservation season are 81% higher than those for the 7 years prior to initiation of the conservation season). Also, the lack of a statistically significant trend in spring estimates of greater snow goose abundance over the past 10 years suggests that increased harvests may be stabilizing this overabundant population (U.S. Fish and Wildlife Service 2015).

The 5 most commonly harvested duck and merganser species in Pennsylvania were mallard, wood duck, American black duck, American green-winged teal, and bufflehead (Table 3). The 2014-15 harvests of most major duck and merganser species were below the 1999-2014 average: mallard (-60%), wood duck (-46%), American black duck (-51%), American green-winged teal (-5%), bufflehead (+21%), lesser scaup (-18%), greater scaup (-13%), ring-necked duck (+30%), gadwall (-27%), common merganser (-76%) and hooded merganser (-24%). Bufflehead and ring-necked duck harvests were 21% and 30% above average, respectively. The below average harvest was most likely related to declines in hunter participation but also the relatively mild weather conditions experienced during the fall and winter 2014-15.

The number of juveniles per adult in the 2014-15 AF harvest (Table 4) was near the 1996-2014 average for mallard (+5%), green-wing teal (-2%), common merganser (+5%), and greater scaup (+4%). Above average were wood duck (11%), bufflehead (37%), hooded merganser (60%), gadwall (42%), lesser scaup (34%), ring-necked duck (17%) and greater snow goose (63%). Below average were black duck (-10%), American wigeon (-35%), and Canada goose (-25%).

Midwinter Waterfowl Survey

Overall, 39,235 waterfowl were recorded in the portions of the survey completed in Pennsylvania in 2016 (Table 5). This total included 5,103 dabbling ducks (mostly mallards and black ducks); 3,770 diving ducks; 7,789 mergansers; 21,205 geese (99% Canada geese and 1% snow geese); and 824 swans (98% tundra swans and 2% mute swans).

For the entire AF, 1,070,859 waterfowl (1,073,244 including coots) were recorded in the

2016 MWS (Appendix 3). As noted above, neither state-level nor flyway-level grand totals are directly comparable to any previous years. For tundra swans and Atlantic brant which are the future focus of this survey and for which 2016 species totals should be comparable to those from previous years, flyway counts were 86,619 and 157,899, respectively.

Long-term flyway MWS trends for major species are as follows: mallards, relatively stable from 1950's through 1980's with a slow but steady decline ongoing since the early 1990's showing some stabilization recently; black ducks, substantial decline from 1950's to 1980's, but relatively stable since that time; Canada geese, generally increasing from 1950's to a peak in the early 2000's, with a slight decrease since; snow geese, steady increase from 1950's to early 2000's with some stabilization recently; and tundra swans, steady increase from 1950's through 1980's and relatively stable since. This survey also documented a general northward shift in the wintering distribution of many waterfowl species over recent decades.

Breeding Waterfowl Surveys

Survey results from the Pennsylvania portion of the 2016 Atlantic Flyway Breeding Waterfowl Survey are presented in Tables 6 and 7. Please note that breeding pair estimates presented have large confidence intervals on the strata and state level; the survey is designed to yield $\leq 20\%$ coefficient of variation on the mean over the entire Northeast United States region. In most instances, breeding pair trends over several years are more useful to follow than individual year estimates. Table 7 summarizes complete 2016 survey results with comparison to the 1993 to 2015 long-term average (average) for ducks, mergansers and Canada goose pairs. The Canada goose total is averaged from 2003 to 2015 due to a methods change in recording and calculating total birds observed.

The number of mallard breeding pairs (61,721) was numerically 30% below the average of 88,419 pairs (Table 6). This is consistent with other indices of statewide mallard abundance (North American Breeding Bird Survey and the number of pre-season-banded mallards). Stratum 22 in southwestern Pennsylvania had the highest density of breeding mallards (1.1 pairs/km²). American black ducks were observed in strata 13 and 243, resulting in a statewide estimate of 925 pairs. Breeding black ducks have been observed at very low densities since the survey was initiated in 1989 and there is evidence of declining statewide abundance and distribution. Numbers of black ducks banded pre-season in Pennsylvania has been declining since the mid-1990s and results from the Pennsylvania Breeding Bird Atlas have confirmed the declining occurrence of statewide breeding black ducks. There were 55,247 wood duck breeding pairs estimated in 2016, which was similar to the average of 53,245 pairs. Trends in wood duck abundance have indicated slightly increasing populations across all years of the survey. Wood duck densities were highest in northwestern Pennsylvania with 1.31 pairs/km². The estimate of total blue-winged teal (2,827) was 49% below average in 2016, while the American green-winged teal estimate (1,556) was 72% below average. Annual teal estimates can vary widely by weather related effects on teal migration, and teal estimates are not indicative of true breeding populations of teal in Pennsylvania as many migrating teal are encountered during the survey period. The estimate of total hooded mergansers (8,962) was 37% above average, while common mergansers (23,503) were 26% above average. Populations of both breeding merganser species have increased significantly across Pennsylvania since 1993 and are confirmed by Breeding Bird Atlas results.

The 2016 Pennsylvania Canada goose breeding pairs was estimated at 97,738 which is statistically similar to the average of 92,406. Pair densities were highest in the southwest (1.9 pairs/km²), northwest (1.4 pairs/km²) and southeast (1.4 pairs/km²) portions of the Commonwealth. The 2016 total population estimate of 234,959 was similar to the recent 13-year average of 263,463 geese (Table 7). As expected, the highest densities of total geese were observed in northwestern (5.1 geese/km²), southwestern (4.0 geese/km²) and southeastern (3.5 geese/km²) portions of Pennsylvania. This population remains well above the Atlantic Flyway Resident Population management plan goal of 150,000 spring birds in the Commonwealth (Atlantic Flyway Council 2011). We continue to support harvest policies to achieve the management plan goal through reduced densities in southeastern and southwestern Pennsylvania, while maintaining stable populations in other portions of the Commonwealth.

Survey results for the entire AF Breeding Waterfowl Plot Survey for 2016 (U.S Fish and Wildlife Service 2016, Appendix 4) included a mallard total population estimate of 551,258, which was a slight increase from the record low of 540,087 in 2015, but still 24% below average (statistically significant). The American black duck estimate (39,750) was down 34% (statistically significant) from average. There has been a declining trend in mallard and black duck abundance over the last 15 years of this survey. The wood duck estimate (430,636) was similar to last year and the average. Wood duck trends appear stable over the long-term. The Atlantic Flyway Resident Population (AFRP) of Canada geese breeds locally throughout the AF extending into southern Ontario, Québec, and the maritime provinces. The total population estimate for AFRP Canada geese was 949,900, which was similar to 2015 and slightly below (but not statistically significant) the LTA. This population remains well above the Atlantic Flyway management goal of 700,000 birds (Atlantic Flyway Council 2011). Spring phenology in the northeast U.S. was near average, while lower than average snowfall and below normal early spring precipitation contributed to average or below average water levels in most states. In general, average waterfowl production is expected from breeding areas important to Pennsylvania.

At the time of preparation of this report, results for the 2016 breeding season were not available for the eastern surveyed areas of Canada and Maine, the traditional mid-continent survey area, or Arctic-nesting goose populations (Atlantic [AP] and Southern James Bay [SJBP] Populations of Canada geese, greater snow geese). Monitoring results for these populations from the 2015 breeding season were reported by the USFWS (2015) and are summarized below.

In the eastern surveyed areas of Canada and Maine, 2015 abundance estimates for mallards (406,000) and ring-necked ducks (505,000) were similar to 2014 and the respective LTA. American black ducks (541,000) were 13% below average. Abundance of green-winged teal (221,000) and goldeneyes (358,000) was similar to 2014 for both species, but they were statistically significantly below LTA (by 14% and 15%, respectively).

The number of ducks counted in the traditional mid-continent survey area in May 2015 was 49.5 million. This was 43% above the 1955-2014 LTA. Mallard abundance was 11.6 million birds, 51% above the LTA of 7.7 million. Blue-winged teal (8.5 million birds, 73% above LTA), green-winged teal (4.1 million, 98% above LTA), gadwall (3.8 million, 100% above LTA), American wigeon (3.0 million, 17% above LTA), northern shovelers (4.4 million, 75% above

LTA), redheads (1.2 million, 71% above LTA), and canvasbacks (0.8 million, 30% above LTA), were all above their LTA in 2015. Estimated abundance of combined greater and lesser scaup (4.4 million) and northern pintails (3.0 million) were 13% and 24% below the respective LTA. Habitat conditions during 2015 were similar to or poorer than 2014. With the exception of portions of southern Saskatchewan and central latitudes of eastern Canada, in many areas the decline in habitat conditions was due to average to below-average annual precipitation. However, the total pond estimate (prairie Canada and U.S. combined) was 6.3 million which remained 21% above the LTA of 5.2 million ponds and should favor production, particularly in prairie Canada. The projected mid-continent mallard fall flight index was 13.8 million birds.

Atlantic Population Canada geese nest across a broad area of Northern Québec with highest densities occurring in the Ungava Peninsula and along the Hudson Bay coast. The estimated number of breeding pairs in 2015 was 161,300, similar to the 2014 estimate. The total population estimate was 864,400, which was also similar to the 2014 estimate. Over the past 10 years, breeding pair estimates have been relatively stable while total populations have decreased approximately 5% per year. Late spring phenology was noted along some areas of the Hudson Bay coast, where most lakes and ponds remained frozen in mid-June. Overall an average fall flight of AP geese was expected. The SJBP is the predominant migratory goose population in northwest Pennsylvania, contributing approximately 5% of the overall harvest in the SJBP zone (the balance being resident geese). The total spring population index of 60,700 SJBP Canada geese was similar to the 2014 estimate; however, the total population index has decreased by 7% per year over the 2006-2015 time series. The timing of peak hatch at Akimiski Island was similar to LTA and an average fall flight was expected. Greater snow geese nest principally on Bylot, Axel Heiberg, Ellesmere, and Baffin Islands in the Canadian Arctic, and in Greenland. This population is monitored on spring staging areas near the St. Lawrence Valley in Québec. The preliminary 2015 estimate was 818,000 geese, similar to the 796,000 estimate in 2014. Greater snow goose estimates have shown no trend over the past 10 years. An average to above-average fall flight was expected for greater snow geese in 2015.

RECOMMENDATION

Continue waterfowl breeding and wintering survey efforts during Fiscal Year 2016-17 to provide annual information on waterfowl population status.

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Table 1. 2014-15 waterfowl hunting season activity and harvest in Pennsylvania and percentage change as estimated by U.S. Fish and Wildlife Service Harvest Information Program Survey (HIP).

	2014-15^a	2013-14	% Change from 2013-14	1999-2014 Average	% Change from Average
Ducks					
HIP Hunters	17,300	20,200	-14	27,273	-37
HIP Hunter Days	71,700	98,500	-27	140,773	-49
HIP Harvest	72,800	97,700	-25	146,967	-50
Canada goose					
HIP Hunters	20,900	21,800	-4	34,633	-40
HIP Hunter Days	102,300	114,200	-10	186,667	-45
HIP Harvest	106,900	103,900	3	166,640	-36
Snow goose					
HIP Harvest	2,300	5,300	-57	8,080	-72

^a Preliminary.

Table 2. Number of permits issued, reports received, hunter days and number of geese taken by hunting method during the 2009 to 2016 Light Goose Conservation Season in Pennsylvania.

Year	Permits Issued	No. Hunted	% Hunted based on all permits	% Hunted based on reports submitted	Days Hunted	Grand Total Geese Bagged	Grand Total Geese Lost	After Sunset	With e^a calls	With e^a decoys
2009 ^b	3,276	1,724	53	59	3,840	5,903	317	736	1,522	- ^f
2010 ^c	3,107	668	21	50	2,409	2,985	141	330	1,101	- ^f
2011 ^c	3,401	900	26	69	2,959	5,197	259	475	1,845	Unknown ^g
2012 ^c	2,649	568	21	62	2,123	3,420	134	542	1,356	1,091
2013 ^d	2,606	578	22	59	2,051	3,162	162	457	1,049	739
2014 ^e	2,741	773	28	66	2,011	3,433	155	521	1,336	1,027
2015 ^e	2,661	806	30	66	2,260	4,684	147	475	1,452	1,130
2016 ^d	2,000	501	25	63	1,311	1,953	78	Unknown ^g	Unknown ^g	Unknown ^g

^a e = electronic

^b Reporting reminder postcard sent; 89% reporting rate by permit holders

^c No reminders used; reporting rates by permit holders varied between 35-43%

^d Reporting reminder sent to non-respondents for whom we had an e-mail address; overall 38-40% reporting rate by permit holders

^e One reporting reminder sent to all permit holders for whom we had an e-mail address at the close of the season, and a second reporting reminder sent after the close of the mandatory reporting period to non-respondents for whom we had an e-mail address; overall 43-46% reporting rate by permit holders

^f Method prohibited by state regulation

^g No data collected on this method

Table 3. U.S. Fish and Wildlife Service Harvest Information Program Survey (USFWS HIP) harvest estimates for major duck and merganser species in Pennsylvania, 1999-2015.

Species	2014-15^a	2013-14	% Change from 2013-14	1999-2014 Average	% Change from Avg.
Mallard	28,700	38,500	-25	72,280	-60
Wood duck	19,000	22,500	-16	35,073	-46
Black duck	4,000	6,800	-41	8,207	-51
Green-winged teal	2,500	5,900	-58	7,087	-65
Bufflehead	5,400	3,600	50	4,447	21
Common merganser	800	2,900	-72	3,273	-76
Hooded merganser	2,100	2,700	-22	2,767	-24
Gadwall	1,400	3,600	-61	1,920	-27
Lesser scaup	1,700	2,000	-15	2,080	-18
Mallard/black Hybrid	100	900	-89	1,013	-90
Ring-necked duck	2,000	800	150	1,533	30
American wigeon	400	400	0	1,020	-61
Greater scaup	900	3,200	-72	1,033	-13

^a Preliminary.

Table 4. Age ratios (Immature/Adult) of the 10 most commonly harvested duck species, Canada geese and snow geese (as determined from wing and tail collections) during the 1999-2015 hunting seasons in the Atlantic Flyway.

Species	2014-15^a	2013-14	% Change from 2013-14	1999-2014 Average	% Change from Avg.
Mallard	1.33	1.37	-3	1.27	5
Wood duck	1.33	1.45	-8	1.20	11
Black duck	1.07	1.43	-25	1.19	-10
Green-winged teal	1.68	1.77	-5	1.71	-2
Bufflehead	1.15	1.21	-5	0.84	37
Common merganser	1.33	1.28	4	1.26	5
Hooded merganser	1.29	0.73	77	0.81	60
Gadwall	1.68	1.48	14	1.18	42
Lesser scaup	0.83	0.58	43	0.62	34
Ring-necked duck	1.59	1.86	-15	1.36	17
American wigeon	0.68	1.03	-34	1.05	-35
Greater scaup	1.15	1.85	-38	1.11	4
Greater snow goose	1.32	0.5	164	0.81	63
Canada goose	0.36	0.47	-23	0.48	-25

^a Preliminary.

Table 5. Number of waterfowl recorded in zones 1-3 during Pennsylvania's 2016 Midwinter Waterfowl Survey.

Species	Zone 1^a	Zone 2^b	Zone 3^c	PA Total
Canada Goose	10,418	1,345	9,334	21,097
Mallard	2,615	61	1,210	3,886
Black Duck	459	7	450	916
Gadwall	235	0	15	250
Wigeon	0	0	6	6
Green-winged Teal	0	0	5	5
Blue-winged Teal	0	0	0	0
Shoveler	1	0	35	36
Pintail	0	0	4	4
Wood Duck	0	0	0	0
Redhead	1,313	0	0	1,313
Canvasback	501	0	10	511
Scaup	757	8	2	767
Ring-necked Duck	410	0	2	412
Goldeneye	387	20	0	407
Bufflehead	102	0	3	105
Ruddy Duck	245	0	10	255
Long-tailed Duck	0	0	0	0
Scoters	0	0	0	0
Mergansers	4,513	24	3,252	7,789
Unidentified ducks	0	0	208	208
Brant	0	0	0	0
Snow Goose	0	0	108	108
White-fronted Goose	0	0	0	0
Tundra Swan	130	4	676	810
Mute Swan	0	1	13	14
Unidentified swans	0	0	0	0
Coot	330	0	6	336
TOTALS	22,416	1,470	15,349	39,235

^a Zone 1 - Crawford and Erie counties

^b Zone 2 - Susquehanna River (includes lower Juniata River) and nearby lakes and farmland

^c Zone 3 - Delaware and Schuylkill rivers, Middle Creek, and various lakes in southeastern Pennsylvania

Table 6. Estimates of 2016 Pennsylvania waterfowl breeding pairs and standard error by physiographic strata, entire state, 1993-2015 long-term average (LTA) and comparison of 2016 estimate to the LTA from the Atlantic Flyway Breeding Waterfowl Survey.

Stratum	Black duck		Green-winged teal		Blue-winged teal		Canada goose		Common merganser		Hooded merganser		Mallard		Wood duck	
	Pairs	SE	Pairs	SE	Pairs	SE	Pairs	SE	Pairs	SE	Pairs	SE	Pairs	SE	Pairs	SE
10	0	0	0	0	0	0	18,365	3,663	0	0	0	0	13,431	3,821	2,467	1,009
13	712	712	0	0	0	0	18,524	6,704	2,137	2,136	0	0	11,400	4,999	13,537	5,428
22	0	0	0	0	0	0	25,304	11,255	666	665	0	0	14,650	6,098	7,991	2,960
241	0	0	565	341	1,414	881	14,137	3,757	990	607	1,838	644	5,089	1,700	13,006	2,770
242	0	0	0	0	0	0	12,039	3,696	3,283	1,944	365	364	9,485	2,718	8,026	2,403
243	213	212	213	212	0	0	9,369	2,811	1,703	709	213	212	7,666	1,697	10,221	2,012
State	925	743	778	402	1,414	881	97,738	14,856	8,779	3107	2,416	769	61,721	9,484	55,247	7,532
LTA	843	^a	2,160	^a	2,680	^a	92,406	^a	7,904	^a	2,440	^a	88,419	^a	53,245	^a
% change	+10		-64		-47		+6		+11		+1		-30		+4	

^a Standard errors (SEs) on long-term averages not available at the time of preparation of this report

Table 7. Pennsylvania waterfowl population estimates from 2006 to 2016 and the 1993-2015 averages.

Species Estimate	1993-15												
	2016	average	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	
Mallard total	128,981	182,171	136,776	144,031	138,804	127,637	132,903	161,675	187,697	131,477	181,540	174,374	
Black duck total	1,850	1,686	-	716	4,278	-	852	537	1,278	537	3,433	-	
Wood duck total	116,167	111,939	111,322	122,310	121,256	141,261	107,045	114,797	128,060	87,924	127,848	128,009	
Canada goose total	234,959	263,463 ^a	249,218	241,735	278,862	219,611	245,061	231,780	289,879	246,499	255,924	245,689	
Bl-wing teal total	2,827	5,513 ^b	4,535	9,533	11,075	3,028	2,970	4,186	7,814	1,840	12,650	1,979	
Gr-wing teal total	1,556	5,553 ^b	4,725	5,908	6,279	7,528	3,869	2,064	5,569	1,979	5,064	7,172	
Hooded merg. Total	8,962	6,529 ^b	17,242	12,590	10,734	5,273	4,646	2,621	2,972	3,031	2,972	7,646	
Common merg. total	23,503	18,650 ^b	15,104	27,278	28,004	23,749	25,100	14,053	12,377	18,773	17,429	15,167	
Mute swan total	708	1,278	706	716	1,246	709	1,417	2,268	1,276	3,921	6,064	2,102	

- No black ducks observed.

^a Average from 2003 to 2015 using new formula for total. Total estimate calculated using new formula 2x(pairs + singles) + groups.

^b Average from 2003 to 2015.

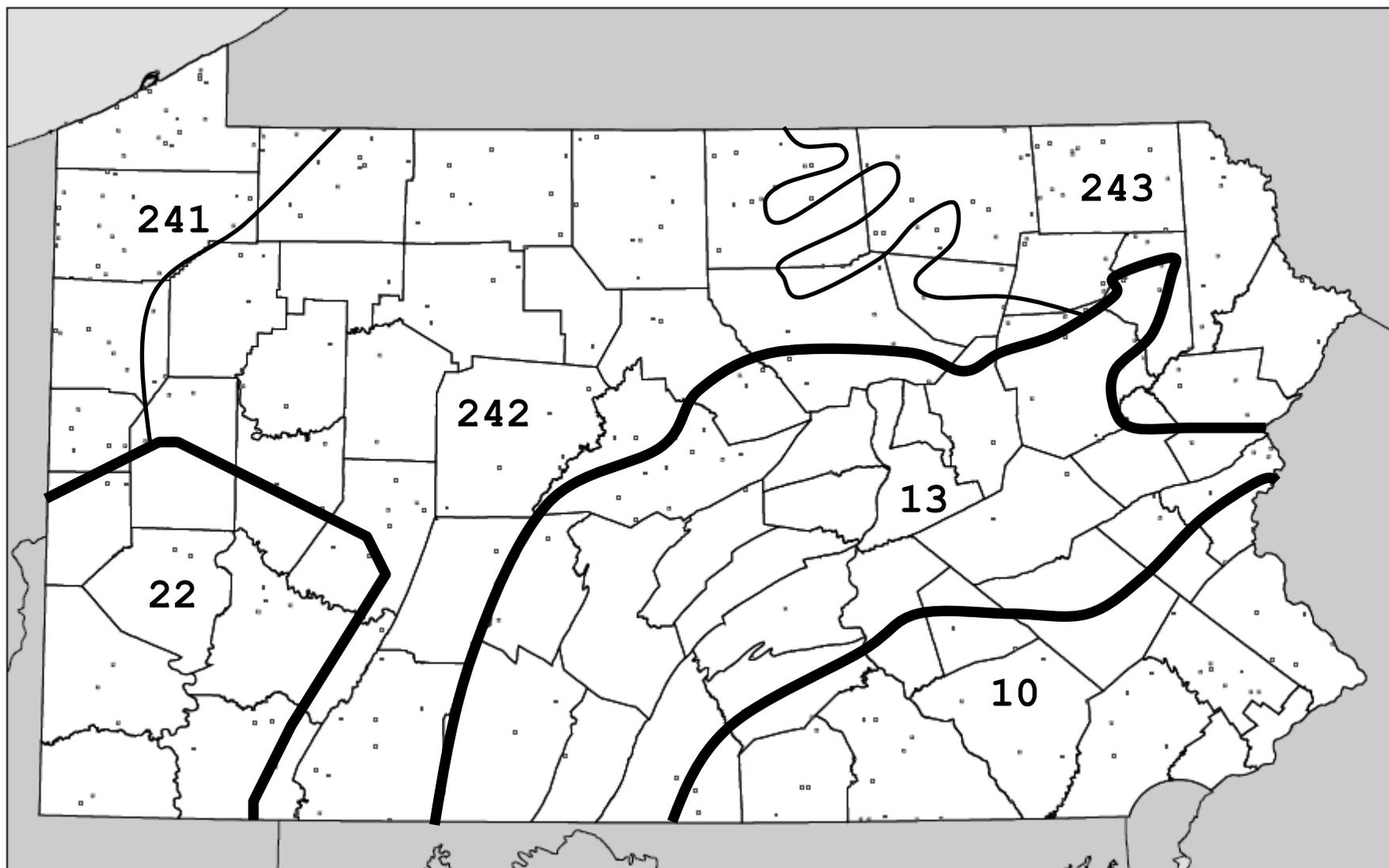


Figure 1. Location of Atlantic Flyway breeding waterfowl survey plots within major physiographic units in Pennsylvania. Physiographic Units are Piedmont (10), Ridge and Valley (13), Pittsburgh Plateau (22), Glaciated Northwestern Plateau (241), Allegheny Mountain/Plateau (242), and Pocono/Low Plateau (243).

Appendix 1. Proposed 2014/2015 waterfowl hunting season recommendations.

DUCKS, SEA DUCKS, COOTS, AND MERGANSERS

BAG LIMITS

DUCKS: 6 daily, 18 in possession; daily limit may not include more than 4 mallards including 2 hen mallards, 1 black duck, 2 pintails, 1 mottled duck, 1 fulvous tree duck, 3 wood ducks, 2 redheads, 1 canvasback, 4 scoters and 2 scaup. Possession limit may not include more than 12 mallards including 6 hens, 3 black ducks, 6 pintails, 3 mottled ducks, 3 fulvous tree ducks, 9 wood ducks, 6 redheads, 3 canvasbacks, 12 scoters and 6 scaup.

MERGANSERS: 5 daily not more than 2 hooded mergansers, 6 in possession.

COOTS: 15 daily, 45 in possession.

Youth Waterfowl Hunting Days (Ducks, Mergansers, Canada Geese, Coots and Moorhens): Statewide: September 20; also in North and Northwest zones, September 27; in Lake Erie Zone, October 18; and in South Zone, November 8.

SEASON DATES

Lake Erie Zone

Ducks, sea ducks, coots and mergansers – Oct. 27 – Jan. 3

North Zone

Ducks, sea ducks, coots and mergansers – Oct. 11 – Nov. 29 & Dec. 23 – Jan. 10, 2015

Northwest Zone

Ducks, sea ducks, coots and mergansers – Oct. 11 – Dec. 13, & Dec. 27 – Jan. 1

South Zone

Ducks, sea ducks, coots and mergansers – Oct. 18 – 25 & Nov. 15 – Jan. 15, 2015

ATLANTIC BRANT

Oct. 18 – Nov. 21 (2 brant daily bag limit, 6 in possession).

LIGHT GEESE

Atlantic Population Goose Hunting Zone

Regular Season – Oct. 1 – Jan. 26, 2015 (No possession limit).

Conservation Season – Jan. 27, 2015 – Apr. 24, 2015 (25 daily bag limit, no possession limit. Permit required).

Southern James Bay Population Goose Hunting Zone

Regular Season – Oct. 1 – Jan. 23, 2015 (25 daily bag limit, no possession limit).

Conservation Season – Jan. 24, 2015 – Apr. 24, 2015 (25 daily bag limit, no possession limit. Permit required).

Resident Population Goose Hunting Zone

Regular Season – Oct. 28 – Feb. 28, 2015 (25 daily bag limit, no possession limit).

Conservation Season – March 2, 2015 – Apr. 24, 2015 (25 daily bag limit, no possession limit. Permit required).

CANADA GEESE

Atlantic Population Goose Hunting Zone

Nov. 15 – 29 & Dec. 15 – Jan. 26, 2015 (3 goose daily limit; 9 goose possession limit)

Southern James Bay Population Goose Hunting Zone

Oct. 11 – Nov. 29 & Dec. 15 – Jan. 23, 2015 (3 goose daily limit; 9 goose possession limit)

Resident Population Goose Hunting Zone

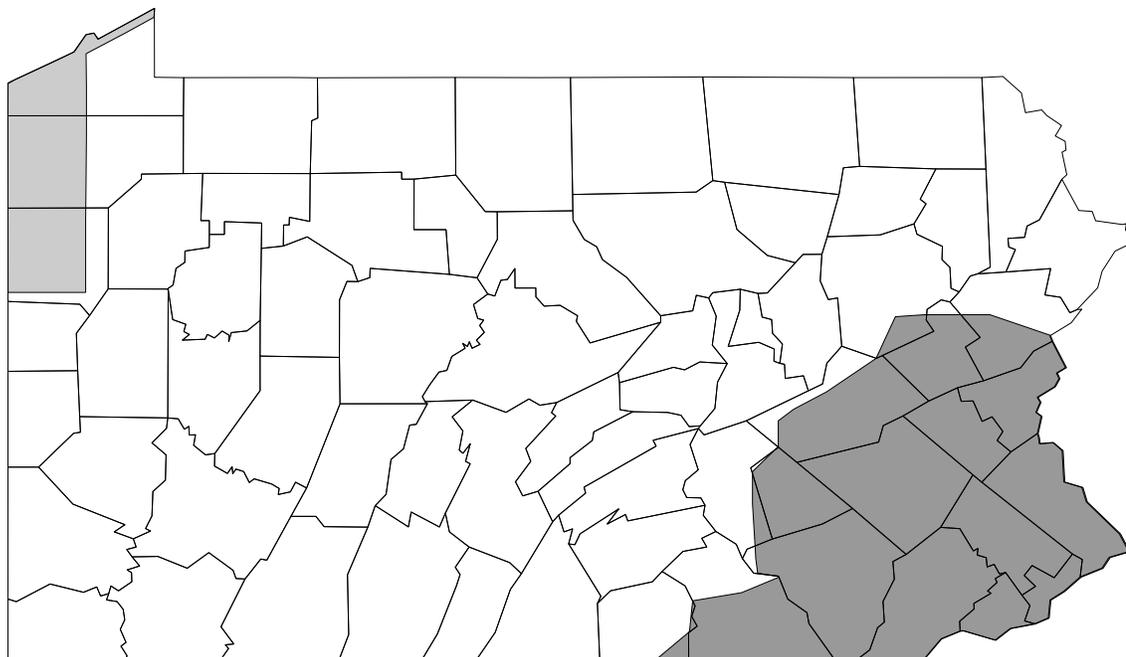
Oct. 25 – Nov. 29, Dec. 18 – Jan. 15, 2015, Feb. 2 – Feb. 28, 2015 (5 goose daily limit; 15 possession limit)

September Canada Goose Season - Statewide

September 1 – September 25 (8 goose daily bag limit, 24 in possession) **except:**

- (1) In the SJBZ zone the daily limit is 3 Canada geese, possession limit 9.
- (2) In the area south of SR 198 from the Ohio state line to intersection of SR 18, SR 18 south to SR 618, SR 618 south to US Route 6, US Route 6 east to US Route 322/SR 18, US Route 322/SR 18 west to intersection of SR 3013, SR 3013 south to the Crawford/Mercer County line. The daily bag limit is one goose; **except** on State Game Lands 214 where the season is closed to September goose hunting. Note: this restriction does not apply to youth participation on youth waterfowl hunting days September 20 & September 27, 2014 when regular season regulations apply.
- (3) Canada geese may be taken on Pymatuning State Park Reservoir and an area to extend 100 yards inland from the shoreline of the reservoir, excluding the area east of SR 3011 (Hartstown Road). The daily bag limit is 3 geese, possession limit of 9 geese.
- (4) In the area of Lancaster and Lebanon counties north of the Pennsylvania Turnpike I-76, east of SR 501 to SR 419, south of SR 419 to Lebanon-Berks county line, west of Lebanon-Berks county line and the Lancaster-Berks county line to SR 1053 (also known as Peartown Road and Greenville Road), west of SR 1053 to Pennsylvania Turnpike I-76, the daily bag limit is one goose, possession limit three geese; **except** on State Game Lands No. 46 (Middle Creek Wildlife Management Area) where the season is closed. Note: this restriction does not apply to youth participation on youth waterfowl hunting days September 20 & November 8, 2014 when regular season regulations apply.

Canada, Snow and White-Fronted Goose hunting zones for 2014-15 season in Pennsylvania



Pennsylvania

Resident Population Goose (RP) Zone

All of Pennsylvania **except** for the Southern James Bay Population (SJBP) zone **and** the Atlantic Population (AP) zone.

Southern James Bay Population (SJBP) Zone

The area north of I-80 and west of I-79 including in the city of Erie west of Bay Front Parkway to and including the Lake Erie Duck zone (Lake Erie, Presque Isle and the area within 150 yds of Lake Erie Shoreline).

Atlantic Population (AP) Zone

The area east of route SR 97 from Maryland state line to the intersection of SR 194, east of SR 194 to intersection of US Route 30, south of US Route 30 to SR 441, east of SR 441 to SR 743, east of SR 743 to intersection of I-81, east of I-81 to intersection of I-80, south of I-80 to New Jersey state line.

Appendix 2. Proposed 2015/2016 waterfowl hunting season recommendations.

DUCKS, SEA DUCKS, COOTS, AND MERGANSERS

BAG LIMITS

DUCKS: 6 daily, 18 in possession; daily limit may not include more than 4 mallards including 2 hen mallards, 1 black duck, 2 pintails, 1 mottled duck, 1 fulvous tree duck, 3 wood ducks, 2 redheads, 2 canvasbacks, 4 scoters and 2 scaup. Possession limit may not include more than 12 mallards including 6 hens, 3 black ducks, 6 pintails, 3 mottled ducks, 3 fulvous tree ducks, 9 wood ducks, 6 redheads, 3 canvasbacks, 12 scoters and 6 scaup.

MERGANSERS: 5 daily not more than 2 hooded mergansers, 6 in possession.

COOTS: 15 daily, 45 in possession.

Youth Waterfowl Hunting Days (Ducks, Mergansers, Canada Geese, Coots and Moorhens): Statewide: September 19; also in North and Northwest zones, September 26; in Lake Erie Zone, October 17; and in South Zone, November 7.

SEASON DATES

Lake Erie Zone

Ducks, sea ducks, coots and mergansers – Oct. 26 – Jan. 2

North Zone

Ducks, sea ducks, coots and mergansers – Oct. 10 – Nov. 28 & Dec. 19 – Jan. 7, 2016

Northwest Zone

Ducks, sea ducks, coots and mergansers – Oct. 10 – Dec. 12, & Dec. 29 – Jan. 2, 2016

South Zone

Ducks, sea ducks, coots and mergansers – Oct. 17 – 24 & Nov. 14 – Jan. 14, 2016

ATLANTIC BRANT

Oct. 17 – Nov. 20 (1 brant daily bag limit, 3 in possession).

LIGHT GEESE

Atlantic Population Goose Hunting Zone

Regular Season – Oct. 1 – Jan. 30, 2016 (25 daily bag limit, no possession limit).

Conservation Season – Feb. 1, 2016 – Apr. 22, 2016 (25 daily bag limit, no possession limit. Permit required).

Southern James Bay Population Goose Hunting Zone

Regular Season – Oct. 1 – Jan. 22, 2016 (25 daily bag limit, no possession limit).

Conservation Season – Jan. 23, 2016 – Apr. 22, 2016 (25 daily bag limit, no possession limit. Permit required).

Resident Population Goose Hunting Zone

Regular Season – Oct. 28 – Feb. 29, 2016 (25 daily bag limit, no possession limit).

Conservation Season – March 1, 2016 – Apr. 22, 2015 (25 daily bag limit, no possession limit. Permit required).

CANADA GEESE

Atlantic Population Goose Hunting Zone

Nov. 14 – 28 & Dec. 19 – Jan. 30, 2016 (3 goose daily limit; 9 goose possession limit)

Southern James Bay Population Goose Hunting Zone

Oct. 10 – Nov. 28 & Dec. 14 – Jan. 22, 2016 (3 goose daily limit; 9 goose possession limit)

Resident Population Goose Hunting Zone

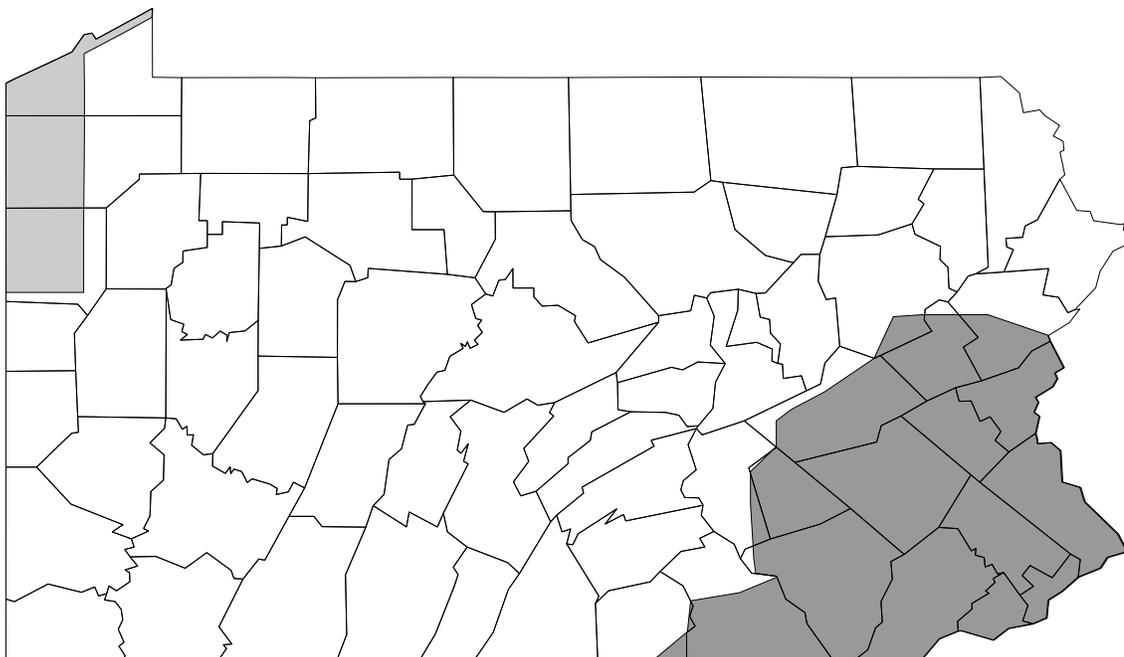
Oct. 24 – Nov. 28, Dec. 18 – Jan. 14, 2016, Feb. 1 – Feb. 29, 2016 (5 goose daily limit; 15 possession limit)

September Canada Goose Season - Statewide

September 1 – September 25 (8 goose daily bag limit, 24 in possession) **except:**

- (1) In the SJBZ zone the daily limit is 3 Canada geese, possession limit 9.
- (2) In the area south of SR 198 from the Ohio state line to intersection of SR 18, SR 18 south to SR 618, SR 618 south to US Route 6, US Route 6 east to US Route 322/SR 18, US Route 322/SR 18 west to intersection of SR 3013, SR 3013 south to the Crawford/Mercer County line. The daily bag limit is one goose; **except** on State Game Lands 214 where the season is closed to September goose hunting. Note: this restriction does not apply to youth participation on youth waterfowl hunting days September 20 & September 27, 2014 when regular season regulations apply.
- (3) Canada geese may be taken on Pymatuning State Park Reservoir and an area to extend 100 yards inland from the shoreline of the reservoir, excluding the area east of SR 3011 (Hartstown Road). The daily bag limit is 3 geese, possession limit of 9 geese.
- (4) In the area of Lancaster and Lebanon counties north of the Pennsylvania Turnpike I-76, east of SR 501 to SR 419, south of SR 419 to Lebanon-Berks county line, west of Lebanon-Berks county line and the Lancaster-Berks county line to SR 1053 (also known as Peartown Road and Greenville Road), west of SR 1053 to Pennsylvania Turnpike I-76, the daily bag limit is one goose, possession limit three geese; **except** on State Game Lands No. 46 (Middle Creek Wildlife Management Area) where the season is closed. Note: this restriction does not apply to youth participation on youth waterfowl hunting days September 20 & November 8, 2014 when regular season regulations apply.

Canada, Snow and White-Fronted Goose hunting zones for 2015-16 season in Pennsylvania



Pennsylvania

Resident Population Goose (RP) Zone

All of Pennsylvania **except** for the Southern James Bay Population (SJBP) zone **and** the Atlantic Population (AP) zone.

Southern James Bay Population (SJBP) Zone

The area north of I-80 and west of I-79 including in the city of Erie west of Bay Front Parkway to and including the Lake Erie Duck zone (Lake Erie, Presque Isle and the area within 150 yds of Lake Erie Shoreline).

Atlantic Population (AP) Zone

The area east of route SR 97 from Maryland state line to the intersection of SR 194, east of SR 194 to intersection of US Route 30, south of US Route 30 to SR 441, east of SR 441 to SR 743, east of SR 743 to intersection of I-81, east of I-81 to intersection of I-80, south of I-80 to New Jersey state line.

Appendix 3. 2016 Atlantic Flyway Midwinter Waterfowl Survey results.

Species	CT	DE	FL	GA	MA	MD	ME	NC	NH	NY*	PA*	RI	SC	VA	VT	WV	Atlantic Flyway Total
Mallard		8424		339		41773				64	3886	1480					55966
Black duck		8236		0		19218				45897	916	2362					76609
Mottled duck		0		8		0				0	0	0					8
Gadwall		2148		587		3218				137	250	484					6824
Wigeon		270		357		456				10	6	120					1219
G.W. Teal		235		1734		2392				0	5	0					4366
B.W. Teal		0		329		0				0	0	0					329
Showler		712		426		121				0	36	0					1295
Pintail		525		0		2552				0	4	0					3081
Wood duck		0		55		10				0	0	0					65
Total Dabblers		20295		2101		67348				46108	5098	4446					145396
Redhead		0		0		17995				0	1313	0					19248
Canvasback		80		1017		19743				2	511	0					21333
Scaup		0		1366		91840				110	767	750					94833
Ringneck		318		11608		677				0	412	0					13015
Goldeneye		30		0		1076				0	407	3785					5278
Bufflehead		1285		85		26720				81	105	2685					30961
Ruddy		535		4		88003				0	255	0					88797
Total Divers		2208		14080		245994				193	3770	7220					273465
Eider		0		0		0				0	0	408					409
Scoter		0		650		7078				0	0	2					7730
Long-billed duck		0		36		51				0	0	0					87
Harlequin		0		0		0				0	0	4					4
Total Seaducks		0		686		7525				0	0	417					8628
Merganser		483		202		1128				0	7789	1150					10752
Unidentified ducks																	0
Total Ducks		22986		17069		321995				46301	16657	13233					0
Brant	2019	0		0	1128	1043		45		83894	57265	0	4059	0	8446		157899
Snow geese	0	142500		0	0	32601		0		0	0	308	0	0	0		175209
Canada geese	0	26603		280	0	293844		13367		1318	0	21097	12272	0	0		366761
Greater white-fronted g	0	0		0	0	0		0		0	0	0	0	0	0		0
Total Geese	2019	169103		280	1128	327488		13412		85212	57265	21205	16331	0	8446		701869
Tundra swans	0	341		0	0	11220		63466		82	0	810	0	332	10368		86619
Trumpeter swans	0	0		0	0	0		0		0	0	0	0	0	0		0
Mute swans	0	2		0	0	4		0		0	0	14	546	0	0		566
Total Swans	0	343		0	0	11224		63466		82	0	824	546	332	10368		87185
Total Waterfowl	2019	192432		17329	1128	660707		76878		131595	57265	38686	30110	332	18814		3070859
Coot	0	525		1245	0	274		0		0	0	336	5	0	0		2385
Sandhill Crane	0	0		12	0	0		0		0	0	0	0	0	0		12

* n counted all birds seen during survey but did not survey similar extents to previous years

Appendix 4. 2016 Atlantic Flyway Breeding Waterfowl Plot Survey results.

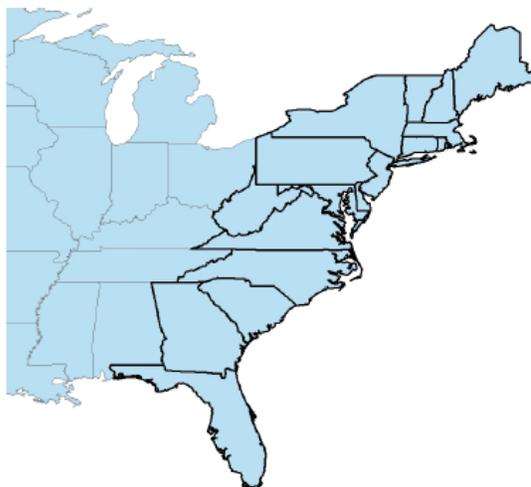
ATLANTIC FLYWAY BREEDING WATERFOWL PLOT SURVEY

Breeding Pair and Population Size Estimates Report

Anthony Roberts

June 30, 2016

U.S. Fish and Wildlife Service
Division of Migratory Bird Management
Atlantic Flyway Office
11510 American Holly Drive
Laurel, Maryland 20708



Suggested citation: U.S. Fish and Wildlife Service. 2016. Atlantic Flyway Breeding Waterfowl Plot Survey report 2016. U.S. Department of the Interior, Washington, D.C. USA.

Acknowledgments

The information contained in this report is the result of efforts from multiple agencies both state and federal. The following is a list of agencies and personnel involved in data collection.

Connecticut

Department of Energy and Environmental Protection
Min Huang and Kelly Kubik.

Delaware

Division of Fish and Wildlife
Agency personnel and cooperators.

Maryland

Department of Natural Resources
Brent Evans, Donald Webster, Josh Homyack, Rick Walls, Pete Bendel, Brynn Bales, Matt Adams, Nick Sagwitz, Bud Creasy, Jared Thompson, Wade Bradford, Joe Harris, Greg Schanck, Joey Harris, Tom Decker, George Timko, Rande Brown, and Rob Harvey.

Massachusetts

Department of Fish and Game
Agency personnel.

New Hampshire

Department of Fish and Game
Agency personnel and cooperators.

New Jersey

Department of Fisheries and Wildlife
Ted Nichols, Joe Garris, Brian Kirkpatrick, Jodi Powers, Kim Tinnes, Cody Meyer, Lee Widjeskog, and Andrew Burnett.
US Fish and Wildlife Service: Forsythe National Wildlife Refuge
Mason Siegesi

New York

Division of Fish, Wildlife and Marine Resources
Division of Fish and Wildlife Agency personnel and cooperators.

Pennsylvania

Game Commission
Dan Brauning, Mary Jo Casalena, Roger Coup, John Dunn, Jason Farabaugh, Molly Giles, Ian Gregg, Doug Gross, Tom Hardisky, Tim Hoppe, Kevin Jacobs, Wyatt Knepp, Matt Lovallo, John Morgan, Patrick Snickles, Jeremy Stempka, Mark Ternent, Samara Trusso, Melanie Weaver, Kevin Wenner, and Lisa Williams.

Rhode Island

Division of Fish and Wildlife

Agency personnel and cooperators.

Vermont

Department of Fish and Wildlife
Agency personnel and cooperators.

Virginia

Department of Game and Inland Fisheries

Pete Acker, Bill Bassinger, Jason Blevins, Al Bourgeois, Andrew Bouton, Jim Bowman, Gary Costanzo, Cameron Dobyns, David Ellinghausen, Chelsea Faller, Mark Frank, Fred Frenzel, Marvin Gautier, Danny Johnson, David Kocka, Ben Lewis, Danny Lovelace, Katie Martin, Bill Mohler, T. Moss, Aaron Proctor, Kevin Rose, Gene Sours, Joe Watson and Tommy Willingham.

Author: This report was prepared by the U.S. Fish and Wildlife Service, Division of Migratory Bird Management, Atlantic Flyway Office. The principal author was Anthony Roberts.

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-km² 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 fluctuations. 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, 1993-2015, and percent change from 2014 to 2015 and from the long-term average to 2015.

Year	N	Mallards		Black ducks		Wood ducks		Canada geese			
		Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	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
Long-term average (1993-2014)		735,797	10,973	61,048	2,519	381,237	7,314	937,936	20,534	1,051,987	26,522
Percent change from:		%	<i>P</i>	%	<i>P</i>	%	<i>P</i>	%	<i>P</i>	%	<i>P</i>
2014		-14.89	0.1729	-22.14	0.5383	-3.65	0.7529	-11.94	0.7098	-11.16	0.7151
LTA		-26.60	0.0000	-30.50	0.2080	6.54	0.5175	-4.99	0.5991	-8.38	0.3380

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Final Report, June 30, 2016

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.

Year	N	Mallards		Black ducks		Wood ducks		Canada geese	
		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:		%	<i>P</i>	%	<i>P</i>	%	<i>P</i>	%	<i>P</i>
	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	Estimate	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:		%	<i>P</i>	%	<i>P</i>	%	<i>P</i>	%	<i>P</i>	%	<i>P</i>	%	<i>P</i>
	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

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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.

Year	N	Gadwall		Green-winged teal		Blue-winged teal		Common merganser		Hooded merganser		Mute swan	
		Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	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:		%	<i>P</i>	%	<i>P</i>	%	<i>P</i>	%	<i>P</i>	%	<i>P</i>	%	<i>P</i>
	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

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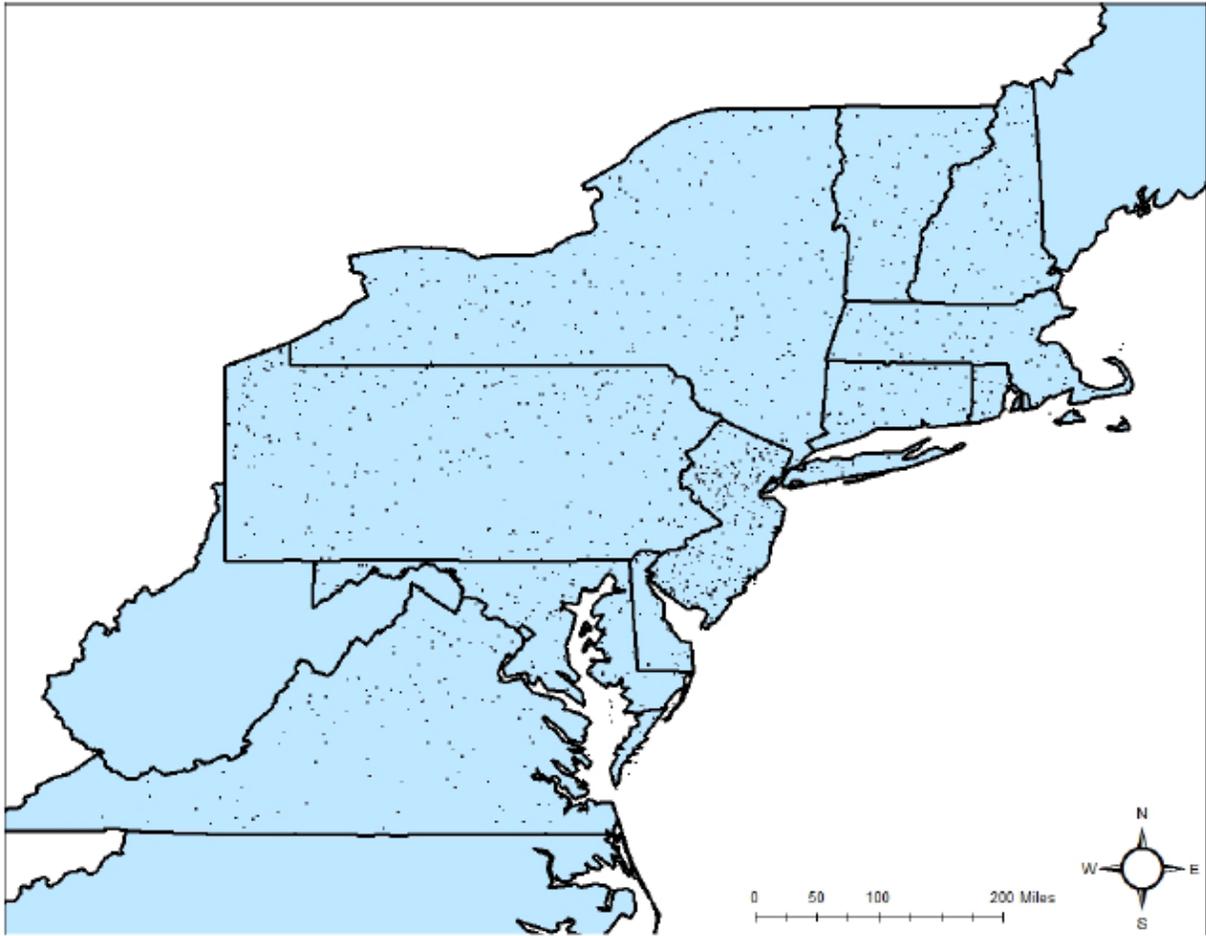


Figure 1: Map of 1-km² plots in the Atlantic Flyway breeding plot survey, Virginia to New Hampshire, distributed across Breeding Bird Strata relative to the amount of a stratum in a state.

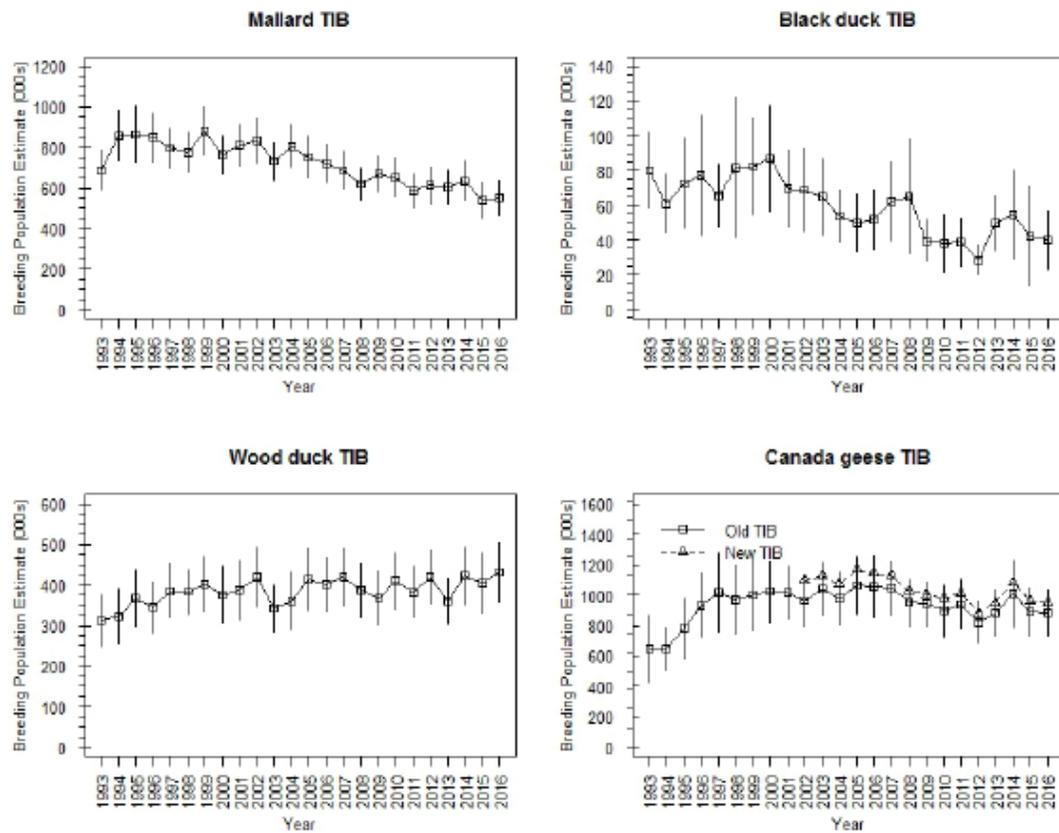


Figure 2: Population estimates and 95% confidence intervals for mallards, black ducks, wood ducks, and Canada geese, 1993-2015.

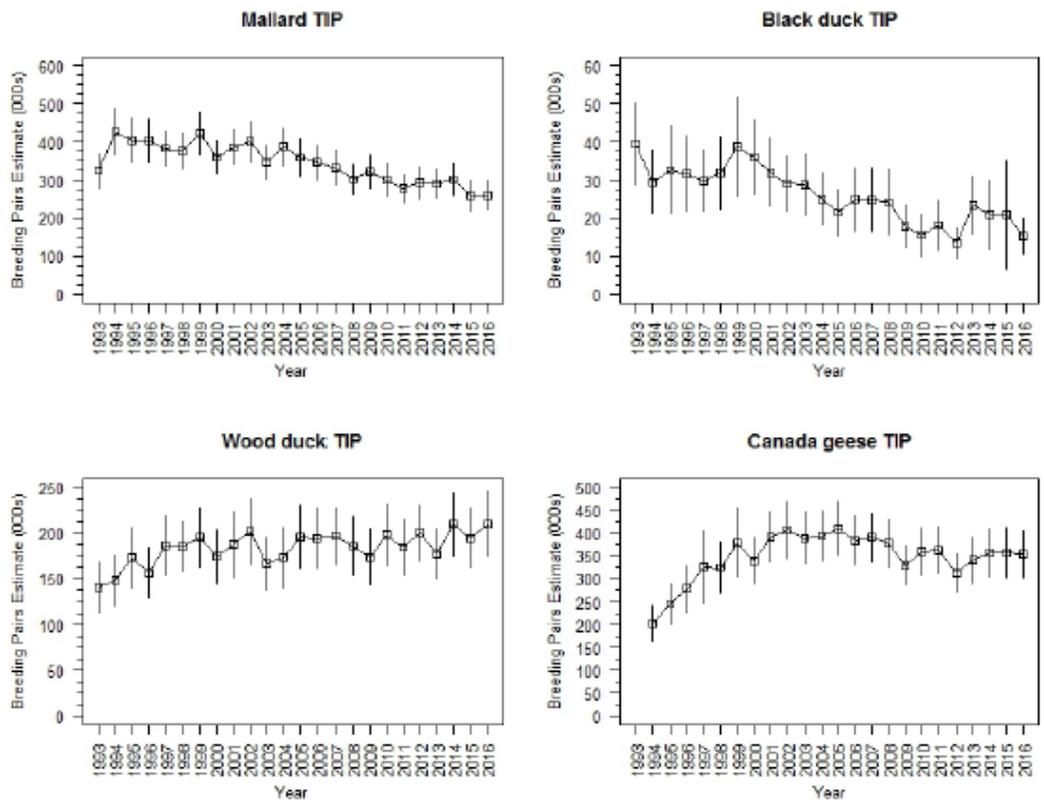


Figure 3: Breeding pair estimates and 95% confidence intervals for mallards, black ducks, wood ducks, and Canada geese, 1993-2015.