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

WORK LOCATION(S): Statewide

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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 2005-06 were 60 days with a bag limit of 6 birds. The daily limit and possession limits for scaup were reduced to 2 and 4, respectively over concern for the status of this species. Canada goose season lengths and bag limits were similar to 2004-05, but boundaries were changed for the Atlantic Population (AP), Southern James Bay Population (SJBP), Pymatuning, and Resident Population (RP) hunting zones. White-fronted geese were for the first time also included in the list of legal game species. Estimated active duck and goose hunters in Pennsylvania during 2005-06 were 28,600 and 37,000 respectively. These respective estimates were up 21% and 14% from 2004-05. Pennsylvania's total duck harvest (USFWS Harvest Information Program -HIP) estimate was 132,000, down 5% from 2004-05. For the AF, total duck harvest was similar to 2004-05 and harvests of most of the major individual species increased except for scaup. Pennsylvania 2005-06 Canada goose harvest was 181,000 (up 8% from 2004-05) of which 39% occurred during September and 61% during the regular season period. Canada goose harvest was 774,500 in the AF. Pennsylvania's estimated snow goose harvest of 8,300 in 2005-06 increased 130% from the previous year and also increased 12% in the AF to 35,400. During the Pennsylvania portion of the 2006 AF Midwinter Waterfowl Survey (MWS), conducted in January, we observed 70,982 waterfowl, 12% lower than the total from the 2005 survey, but similar to the 1996-2005 average. Trends for the 6 major wintering species were mixed with tundra swans (3 times higher), Canada geese (up 24%), and mallards (up 9%) increasing from 2005, and snow geese (down 60%), mergansers (down 75%), and black ducks (down 33%) decreasing from last year. Most duck species were below their 1996-2005 averages, including mallards (43% below), black ducks (28% below), and mergansers (58% below). Geese and swans were above their 10-year averages (snow geese 23% above and tundra swans more than twice the 1996-2005 average). In the Pennsylvania portion of the 2006 AF Breeding Waterfowl Survey, conducted in April and May,

point estimates for breeding pairs of mallards (80,667) and wood ducks (61,014) were statistically similar to 2005 and the 1993-2005 long-term average (LTA). No American black ducks were observed on survey plots for the third consecutive year. Numbers of black ducks banded in Pennsylvania during August and September have also been declining in recent years. Breeding black ducks in Pennsylvania are increasingly rare and is cause for concern. The 2006 Pennsylvania Canada goose total population estimate (229,321) and breeding pairs (88,478) were statistically similar to 2005 and the LTA. For the Northeast U.S. survey area, all pair estimates were statistically similar to 2005. The mallard total population estimate of 725K declined by 3% from 2005 and was 9% below the LTA. Wood duck numbers were similar to 2005 and 9% above the LTA. The black duck estimate increased slightly from 2005, but was still 26% below the LTA. There is much concern about declining trends in black ducks over the last 6 years, however population changes were not significant. The spring Canada goose breeding population estimate was 1.15 million, similar to 2005 and the LTA. Spring 2006 breeding population estimates were similar for AP Canada geese, but increased significantly for the Southern James Bay Population (SJBP). Production is expected to be above average for both of these migratory populations due to early snow melt and a strong nesting effort on their breeding grounds. Conditions in the Northeast U.S. early in the breeding season were generally favorable for nesting waterfowl, with warm temperature and dry to normal moisture conditions. Heavy rains and cooling temperatures during May and June in the northern and western portions of the survey area may have affected production through nest flooding and brood losses. In the southern part of the survey area, cool temperatures and poor wetland conditions caused by less than normal precipitation provided poor conditions for brood rearing. Overall impressions from field biologists' reports were that production this year may be reduced because of poor habitat and weather conditions.

OBJECTIVE

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

METHODS

Hunter activity and total waterfowl harvest were estimated from the USFWS Harvest Information Program (HIP) and the PGC's Game Take Survey (see Librandi Mumma, T. M. 2006 for description of methods). The HIP survey, which became fully operational in 1999, has replaced the traditional USFWS Mail Questionnaire Survey (MQS), which used duck stamp buyers as a sampling frame and was phased out after the 2001 season. From 1999-2001 the 2 surveys were conducted concurrently. The USFWS is in the process of formally comparing the results from the 2 surveys during this period of overlap to provide a basis for continuity between estimates derived from them. Until that analysis is completed, results from the 2 surveys cannot be considered comparable, and it is difficult to place recent harvest estimates in historical context. The species, age, sex, geographical, and temporal distribution of the total harvest were 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. A pilot study from 1998-2001 indicated that use of tail fans alone for age classification of geese introduces a substantial negative bias in age ratios, because many juveniles from temperate-nesting

populations completely replace their juvenile rectrices with adult feathers before or during the hunting season. Consequently, the USFWS now uses the tips of primary feathers in conjunction with tail fans to assign ages, which provides more accurate age ratio estimates. Productivity data for snow geese, tundra swans, and Atlantic brant is obtained from a survey conducted on major wintering areas (between New York and North Carolina) by Atlantic Flyway states and National Wildlife Refuges in early winter. The percentage of immatures and number of young per family group observed during this survey provide an index to production during the previous breeding season for these 3 species that are not well surveyed on their Arctic breeding grounds.

Estimates of numbers of wintering waterfowl are obtained from the MWS. States in the AF conduct this survey, primarily from aircraft, each January on major coastal and inland waterfowl wintering areas. Segment coverage in Pennsylvania from 2002-2006 has followed an “MWS-Lite” approach with survey methodology for the Delaware River differing substantially from prior years (Gregg et al. 2002). Therefore, state-level results for 2002-2006 may not be completely comparable to prior years, particularly for Canada and snow geese. For these species, comparisons based on the segments not affected by the procedural changes in 2002 may be more relevant. In 2005, use of the USFWS voice/GPS software program was expanded to all aerially surveyed MWS segments in Pennsylvania. This program links voice recordings of waterfowl observations to the GPS position of the aircraft. Transcribed species totals from this program can be input into the USFWS database and the geo-referenced data on waterfowl concentrations provides important information for habitat conservation programs.

Information on breeding population size of mallards, black ducks, wood ducks, Canada geese, and other waterfowl was obtained from the Atlantic Flyway Breeding Waterfowl Plot Survey. This survey has been conducted annually since 1989 in Pennsylvania and other AF states from Virginia to New Hampshire. Established 1-km^2 plots are surveyed for ducks and geese once each year between mid-April and early May. Breeding pair units are determined from the presence of pairs, lone drakes, and groups of drakes. 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. Additional breeding survey data for areas not covered by the AF Breeding Waterfowl Survey was provided by the USFWS.

RESULTS

Hunter Activity and Harvest

As in 2004-05, duck season length in 2005-06 was 60 days with outside framework dates of the Saturday nearest to the 24 September and the last Sunday in January. Similar to previous years, duck seasons selected for Pennsylvania included split seasons in all 4 zones with the first split opening in October and the second split closing between late December and mid-January (Appendix 1). The aggregate daily duck bag limit remained at 6 birds. The daily bag and possession limits for scaup were reduced to 2 and 4, respectively. This was in response to the continued 22-year decline in breeding populations of scaup. A record low breeding population estimate of 2.4 million scaup (both species combined) was observed in 2005. The canvasback harvest strategy again called for a 30-day 1-bird bag limit within the general duck season. The partial season for canvasbacks was taken in the

middle or latter portion of the general duck season, depending on the zone. The season for pintails was expanded to a full 60-day 1-bird bag limit for 2005-06 due the improved breeding population status for this species. The pintail breeding population increased 17% from 2004 to 2.6 million birds and at this level the Interim Pintail Harvest Strategy calls for a full season length at a 1-bird daily bag limit.

Boundaries of Pennsylvania's 5 Canada goose harvest zones (RP, SJBP, Pymatuning, AP North, and AP South) were modified for the 2005-06 season (Appendix 1). The AP zone was expanded into southeastern Adams County to address harvest of AP geese in the RP zone. Analysis of band recovery data indicated this area contained significant numbers of AP band recoveries. Similarly, analysis of band recovery patterns and neckband observation data in the Pymatuning zone indicated eastern portions of the zone including Conneaut Lake are more similar to those in the adjacent SJBP zone than the higher harvest Pymatuning zone. The SJBP zone and Pymatuning zone boundaries were modified to reflect this new information. An early Canada goose season (1-24 September) was again held statewide (except for the Pymatuning Zone and SGL 46, the Middle Creek Wildlife Management Area in Lebanon/Lancaster counties). The daily bag limit was again 8 birds, 16 in possession statewide. Regular Canada goose seasons and bag limits in the AP, RP, SJBP, and Pymatuning zones remained the same as in 2004.

The numbers of active duck and goose hunters in Pennsylvania as estimated from the HIP survey were 28,600 and 37,000, respectively. These estimates were up 21% and 14% respectively from 2004-05. The PGC Game Take Survey estimated 26,700 duck hunters and 37,400 goose hunters, similar to HIP estimates. At present, the HIP Survey does not allow for estimation of the number of waterfowl hunters at the flyway level because there is no mechanism to prevent double-counting of individual hunters that register more than once (due to the requirement to complete a separate HIP registration for each state where a hunter wishes to pursue migratory game birds). Hunter numbers are likely relatively stable since duck stamp sales at the flyway level have exhibited little annual change over the past several years. However, the estimated number of days hunted for ducks in 2005-06 declined 8% while the number of goose hunter days increased 5%. Seasonal duck and goose harvest per hunter in Pennsylvania in 2005-06 was 4.6 and 5.1, respectively.

The HIP estimate of total Pennsylvania duck harvest for 2005-06 (Table 1) was 132,300, down 5% from the 2004-05 estimates. State-level HIP harvest estimates to date have shown more year-to-year variability than either MQS or Game Take Survey estimates, and additional analysis and accumulation of HIP data is needed to assess the accuracy and precision of the various surveys for estimating state waterfowl harvests. Total AF regular season duck harvest was 1.6 million, down 13.6% from 2004-05.

The 4 most commonly harvested duck species in Pennsylvania were mallard (50% of the total harvest), wood duck (22%), black duck (5%), and green-winged teal (5%). The harvest of the following species increased from 2004-05; black duck (27%), gadwall (67%), green-winged teal (19%), wood duck (3%), while harvest decreased for mallards (7%), combined lesser and greater scaup (19%), bufflehead (6%) and hooded merganser (5%) (Table 2). At the flyway level, harvests increased for all major species except scaup from 2004-05, mallards (444,300, similar), wood ducks (323,500, up 14%), green-winged teal (120,700, similar), black ducks (93,400, up 23%), blue-winged teal 77,100, up 4%), and ring-necked ducks (109,000, up 40%). Combined greater and lesser

scaup harvests declined only slightly (down 2%) from 2004-05 despite a reduction in daily bag from 3 to 2 birds.

HIP Canada goose harvest estimate in Pennsylvania (Table 1) for 2005-06 was 189,300, 13% higher than 2004-05. With the recent expansion of regular season harvest opportunities in the AP and RP zones, the regular season (November-February) has regained the distinction of accounting for the largest proportion of the annual Pennsylvania Canada goose harvest (60% in 2005-06). The September season continues to account for a substantial proportion (39%) of the harvest. AF Canada goose harvest during the 2005-06 season was 774,500, a 20% increase from 2004-05.

Estimated snow goose harvest in Pennsylvania was 8,300 birds (USFWS-HIP), up 130% from the 2004-05 estimates. Total snow goose harvest for the flyway (35,400) increased 12% from 2004-05.

The trend in the number of juveniles per adult in the AF harvest (Table 3) was up from 2004-05 to 2005-06 for the 10 of 11 most commonly harvested waterfowl species, while wood ducks were similar. It should be noted that Canada goose age ratios from 1998-2005 are not directly comparable to those from 1997 and prior because the latter are based on tail fan data only. The age ratios reflect improved waterfowl production from the 2005-breeding season in duck production areas most important to the Atlantic Flyway compared to 2004. The 2005 production index for tundra swans and snow geese at the state level were not determined because lack of observable swans in snow geese during the survey period (Table 4). Flyway level results also showed a decline in tundra swan productivity, but indicated a slight increase in greater snow goose and Atlantic brant productivity over 2004.

Midwinter Waterfowl Survey

The Pennsylvania portion of the 2006 MWS was conducted between 4 and 10 January. Survey methods were similar to those used in past years, with fixed-wing aerial surveys supplemented by ground surveys at Middle Creek Wildlife Management Area. The NJDFW and U. S. Fish and Wildlife Service (USFWS) aerially surveyed the middle Delaware River segment on 8 January. Water levels were above average in most surveyed water bodies. Rivers were ice-free, and ice cover on lakes and marshes, while widely variable, was generally less than average. Under these conditions, waterfowl tend to be more dispersed and difficult to observe than usual, which may have reduced survey totals somewhat.

We observed 70,982 waterfowl in Pennsylvania (Table 5). This included 4,570 dabbling ducks (mostly mallards and black ducks), 527 diving ducks, 1,009 mergansers, 62,158 geese (83% of which were Canada geese), and 2,487 swans (99% of which were tundra swans). The overall total was 12% lower than in the 2005 survey, but similar to the 1996-2005 average. As usual, the highest numbers of waterfowl were observed in Zone 3 (southeastern Pennsylvania), and although totals for this zone were down from last year (especially along the Delaware River), they remained above the 10-year zone average. Totals in Zone 1 (northwestern Pennsylvania) were up from last year but slightly below the 10-year average, while totals in Zone 2 (Susquehanna River) were well below both 2005 and average levels. Trends for the 6 major wintering species were mixed with tundra swans (3 times higher), Canada geese (up 24% overall, 31% when comparing only the 11 segments unaffected by the 2002 changes), and mallards (up 9%) increasing from 2005 and snow geese (down 60%), mergansers (down 75%), and black ducks (down 33%) decreasing from last

year. Most duck species were below there 1996-2005 averages, including mallards (43% below), black ducks (28% below), and mergansers (58% below). Geese and swans were above their 10-year averages, including Canada geese (8% above; 12% above when comparing only the 11 segments unaffected by the 2002 procedural changes), snow geese (23% above), and tundra swans (more than twice the 1996-2005 average).

For the entire AF, 2,743,455 waterfowl were observed in the MWS (Appendix 2). The grand total is not directly comparable to results from prior years because no survey was conducted in Florida in 2005 and 2006, but many of the individual species numbers remain relatively comparable because only negligible proportions of their flyway totals have historically been observed in Florida. Flyway mallard numbers decreased 12% from 2005 and were 19% below the 1995-2004 average. Black ducks were 4% below 2005 and 11% below the 10-year average. Canada and snow geese were unchanged from 2005, but declined 11% and 1%, respectively, from their 10-year averages. Tundra swans were essentially unchanged from 2005 at about 70,000 birds, but continue to be 22% below their 10-year average of 90,700. Long-term flyway MWS trends have been increasing for Canada and snow geese and tundra swans and relatively stable for most duck species; black ducks declined substantially between the 1950's and 1980's but have been stable over the past 2 decades.

Breeding Waterfowl Survey

Two hundred sixteen 1-km^2 plots containing wetland habitats distributed across 6 physiographic regions (Figure 1) of Pennsylvania were field checked for breeding waterfowl, with breeding pair estimates for the most common breeding waterfowl species calculated for 2006 (Table 6). These estimates and those for other species encountered during the breeding surveys were also compared to survey results from the past 13 years (Table 7). GIS mapping of survey plots were completed in 2006.

Habitat conditions were dry in Pennsylvania during the survey period. Ground moisture and water levels were below average across most of Pennsylvania, while temperatures were above average. Upon completion of the survey, a series of slow-moving cold fronts deposited abundant precipitation while temperatures fell below average. From 11 to 26 May, up to 6 inches of rain accumulated in western Pennsylvania, causing some flooding. The extended cold, wet conditions may have caused some nest and hatched young losses. Vegetation phenology appeared earlier than average while hatching chronology was normal.

Survey results are presented in Table 6. Please note that breeding pair estimates presented has large 95% confidence intervals on the strata at 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. The 2006 survey results are compared with the 1993 to 2005 average in Table 7.

All estimates from the 2006 statewide survey were statistically similar to the 1993-2005 average. The number of mallard pairs in 2006 was estimated at 80,667, compared to the average of 99,496 pairs (Table 7). Stratum 10 and stratum 13 in eastern Pennsylvania had the highest density of breeding mallards (1.29 and 0.91 pairs/km^2, respectively). There were no black ducks observed in the Commonwealth on survey plots for the third consecutive year and the fourth time in 16 years (none were also observed in 1992). Black

ducks have been observed at very low densities since the survey was initiated in 1989. However, numbers of black ducks banded in Pennsylvania during August and September have also been declining in recent years (Gregg 2005). Breeding black ducks in Pennsylvania are increasingly rare and is cause for concern. There were 61,014 wood duck breeding pairs estimated during the 2006 survey. This estimate is statistically similar to the average of 50,014 pairs. Wood duck densities were highest in northwestern and northeastern Pennsylvania with 1.03 and 0.84 pairs/km^2 respectively. The trend in wood duck pairs has been stable since liberal hunting regulations were adopted in 1995. The estimate of total blue-winged teal (1,979) was down 76% from average, while total green-winged teal numbers (7,172) were 55% higher than average. It should be noted that an unknown number of migrating teal are counted in this survey each year and may lead to wide fluctuations in these estimates not related to breeding populations. The 2006 estimates of total hooded mergansers (9,625) were nearly 3.5 times higher, but still statistically similar to average due to large confidence intervals. Common merganser numbers (12,916) were also similar to average. The trends for both breeding merganser species appear stable since 1993.

The 2006 Pennsylvania Canada goose total population estimate of 229,321 is statistically similar to the average of 223,690 geese (Table 1). As expected, the highest densities of total geese were observed in southeastern (5.51 geese/km^2) and northwestern (4.26 pairs/km^2) portions of the Commonwealth. The number of Canada goose breeding pairs in 2006 was estimated at 88,478, also statistically similar to the average of 91,441. Pairs were again most abundant in southeast (1.73 pairs/km^2) and northwest (1.66 pairs/km^2) Pennsylvania. It is notable that Canada goose estimates for 2006 marks a numerical decline over estimates from 2003 to 2005, although estimates are statistically similar and could be a result of normal sampling variation. There has been significant expansion of hunting season length and bag limits over the last 5 years as well as other lethal and non-lethal programs implemented to control Canada goose populations. We will continue to closely monitor this population and harvest.

Breeding pair estimates for the most common breeding species from the Atlantic Flyway Breeding Waterfowl Plot Survey for 2006 (Appendix 3) were: mallard, 345,742 pairs; black duck, 24,907 pairs; wood duck, 194,578 pairs; and Canada goose, 384,715 pairs. The estimate for total Canada geese (factoring in non-breeding individuals) was 1,057,251 birds. The point estimates increased for black duck and decreased for the other species noted. All were statistically similar to 2005. The 2006 black duck population estimate was significantly lower than the LTA. The Atlantic Flyway Resident Population of Canada geese are currently approximately 39% above the Atlantic Flyway Resident Canada Goose Management Plan goal of 650,000 birds.

The number of ducks counted in the traditional mid-continent survey area was 36.1 million, significantly higher than the 2005 estimate of 31.7 million. Mallard abundance was 7.28 million, 8% above the 2005 estimate, but 3% below the LTA (1955-2005). Other common species relative to the LTA include gadwall (+67%), American wigeon (-17%), American green-winged teal (+39%), blue-winged teal (+30%), northern shoveler (+69%), northern pintail (-18%), redhead (+47%), canvasback (+23%) and scaup (greater and lesser combined, -37%). Populations of wigeon, pintails, and scaup continue to be of particular concern and are well below North American Waterfowl Management Plan (NAWMP) goals. The 2006 total May pond estimate for the U.S./Canadian prairies and Canadian parklands was 6.1 million, up 13% from the 2005 estimate of 5.4 million and 26% above the long-term average. Improvements in

Canadian and U.S. prairie habitats were primarily due to average to above-average precipitation, warm spring temperatures, and carry-over effects from the good summer conditions of 2005. Overall, biologists are optimistic of improved duck production from the mid-Continent in 2006.

In the eastern surveyed areas of Canada and Maine, estimates for mallards (+1%), black ducks (+7%), green-winged teal (+2%), mergansers (+20%), ring-necked ducks (+7%), goldeneyes (-14%), bufflehead (-51%) and scaup (+198%) were similar to the 1990 to 2005 average. Spring-like conditions arrived early in the East, with early ice break-up and relatively mild temperatures. Biologists reported that habitat conditions were generally good across most of the survey area. Most regions had a warm, dry winter and a dry early spring. Extreme southern Ontario was relatively dry during the survey period and habitats were in fair to poor condition. However, precipitation after survey completion improved habitat conditions in this region. Abundant rain in May improved water levels in Maine, the Maritimes, southern Ontario, and Quebec, but caused some flooding in southern Ontario and Quebec and along the coast of Maine, New Brunswick, and Nova Scotia. In Quebec, a very early spring assured good habitat availability. Despite the early spring and the abundance of spring precipitation, a dry winter still left most of the marshes and rivers drier than in recent years. Many bogs were noticeably drier than recent years or dry entirely in a few cases.

In the Ungava Peninsula region of northern Quebec, where most breeding AP Canada geese are concentrated, 2006 breeding pair surveys estimated 160,000 breeding pairs and 1.14 million total population, both similar to 2005. Nesting and banding studies across the AP breeding range have confirmed another strong nesting effort. The forecast is for good production due to favorable nesting conditions. A large fall flight, with many juveniles is expected from this population. SJBP Canada geese from Akimiski Island, Nunavut, and the James Bay lowlands of Ontario are the predominant migratory goose population in northwest Pennsylvania and especially at Pymatuning. There were 160,400K Canada geese estimated this spring, up 3.5 times from 2005 (mainly due to poor 2005 survey methods), and highest recorded since the survey began in 1990. Nesting studies on Akimiski Island confirmed good nesting conditions with above average gosling production. An above average fall flight is expected.

The number of greater snow geese counted on spring staging areas in the St. Lawrence Valley was 1.016 million, up 25% from 2005 and the highest on record. Nesting studies from the largest known breeding colony on Bylot Island indicated lower nest densities due to delayed snowmelt during nest initiation. Clutch sizes were larger than average, but nest predation was moderately high. Fall-flight is expected to have fewer juveniles than average, but still quite large due to an abundant population.

RECOMMENDATION

1. Continue waterfowl breeding and wintering survey efforts during FY 2006 to provide annual information on waterfowl population status.

2. Further analyze American black duck survey, banding and harvest data to determine if additional state-level harvest restrictions are warranted in 2007-08 to help protect local breeding populations.

LITERATURE CITED

Gregg, I. D., J. P. Dunn, and K. J. Jacobs. 2002. Waterfowl population monitoring. Annual Job Report 51004. Pennsylvania Game Commission, Harrisburg, Pennsylvania, USA.

Gregg, I. D. 2005. Waterfowl Banding. Annual Job Report 51001. Pennsylvania Game Commission, Harrisburg, Pennsylvania, USA.

Hill, M. R. J., R. T. Alisauskas, C. D. Ankney, and J. O. Leafloor. 2003. Influence of body size and condition on survival of juvenile Canada geese. Journal of Wildlife Management 67:530-541.

Librandi Mumma, T. M. 2006. Game Take Survey. Annual Job Report 11101. Pennsylvania Game Commission, Harrisburg, Pennsylvania, USA.

U.S. Fish and Wildlife Service. 2006. Waterfowl population status, 2006. U.S. Department of the Interior, Washington, D.C., USA.

Table 1. Waterfowl harvest in Pennsylvania as estimated by USFWS Harvest Information Program Survey (USFWS–HIP), USFWS Mail Questionnaire Survey (USFWS–MQS), and PGC game take survey, 1995-2005.

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005[a]
Ducks											
USFWS–HIP					148,000	140,200	248,300	248,100	124,300	138,000	132,300
UFWS–MQS	104,600	113,700	141,800	131,300	143,000	112,600	129,100				
PGC	156,511	151,142	188,034	146,050	164,328	185,185	143,907	169,828	191,132	[b]	163,065
Canada Geese											
USFWS-HIP					152,500	99,200	215,100	199,900	188,200	168,000	189,300
USFWS-MQS	54,600	80,300	104,500	91,100	94,700	81,500	125,800				
PGC	64,380	83,780	112,752	127,000	118,682	162,538	191,318	171,599	207,632	[b]	208,704

[a] Preliminary.
[b] PGC Game take survey not conducted.

Table 2. Harvest estimates (USFWS) for major duck species in Pennsylvania, 1995-2005.

Species	1995[a]	1996[a]	1997[a]	1998[a]	1999[b]	2000[b]	2001[b]	2002[b]	2003[b]	2004[b]	2005[c]
Mallard	50,500	56,600	71,000	60,900	71,500	77,400	125,700	124,600	60,300	71,600	66,500
Black duck	6,500	7,500	8,400	5,000	7,300	8,600	13,800	15,200	7,000	5,600	7,100
Wood duck	27,000	30,400	35,700	39,200	37,200	34,700	72,500	60,900	27,400	27,700	28,600
Green-winged teal	3,300	2,900	4,800	6,600	9,500	5,300	7,400	11,800	7,100	5,000	6,100
Blue-winged teal	2,800	1,400	1,100	300	900	300	1,900	1,300	700	100	1,900
Bufflehead	1,200	2,700	4,800	6,000	1,900	2,000	4,600	6,400	3,000	5,200	2,100
Lesser scaup	4,500	2,000	1,900	600	2,500	400	2,200	3,500	4,500	3,100	2,700

[a] Estimate based on Mail Questionnaire Survey.
[b] Estimate based on Harvest Information Program Survey.
[c] Preliminary.

Table 3. Age ratios (Immature/Adult) of the 10 most commonly harvested duck species, plus pintails and Canada geese (as determined from wing and tail collections) during the 1995-2005 hunting seasons in the Atlantic Flyway. Duck species presented in order of average percentage species composition in the 2001-2003 flyway harvests.

Species	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005[a]
Mallard	1.09	1.15	1.25	1.03	0.91	0.95	1.14	0.95	1.26	1.37	1.54
Wood duck	1.24	1.23	1.18	1.09	1.03	1.22	1.20	1.15	1.59	1.28	1.27
Green-winged teal	1.81	1.61	2.33	2.33	2.37	1.20	1.15	1.88	1.83	1.30	1.67
Black duck	1.14	0.99	1.38	1.24	1.00	0.82	0.93	1.07	1.12	0.87	1.56
Ring-necked duck	1.44	1.03	2.05	1.33	1.11	0.73	1.19	1.11	1.17	1.02	2.63
Blue-winged teal	2.30	1.98	2.00	1.03	1.39	0.73	1.34	0.83	1.29	0.88	1.36
Lesser scaup	1.07	0.64	1.05	1.69	0.27	0.34	0.63	0.46	0.77	0.37	0.50
Bufflehead	0.79	0.92	0.74	0.96	0.64	0.47	0.86	1.29	0.78	0.68	0.88
Gadwall	1.65	1.52	1.27	0.71	1.97	0.79	0.83	0.51	0.86	0.73	1.30
American wigeon	0.87	0.58	1.01	1.23	1.08	0.50	1.01	0.92	0.90	0.75	0.84
Northern pintail	0.76	0.81	2.03	1.80	1.18	0.57	1.02	1.32	2.29	0.76	2.07
Canada goose	0.36[b]	0.22[b]	0.33[b]	0.50[c]	0.60[c]	0.41[c]	0.48[c]	0.40[c]	0.56[c]	0.46[c]	0.62[c]

[a] Preliminary.
[b] Age ratios determined from tail fans only.
[c] Age ratios determined from a combination of tail fans and primary tips.

Table 4. Productivity data (percent immatures) for Atlantic brant, greater snow geese, and tundra swans wintering in the Atlantic Flyway, 1996-2005.

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Atlantic brant	15.3	17.5	24.1	1.5	25.1	24.7	6.9	17.2	13.1	15.0
Gr. snow geese										
PA	62.3	32.3	NA	0.0	20.9	25.0	4.9	53.2	30.9	NA
AF	30.5	28.7	26.5	2.8	34.6	21.2	2.8	15.8	12.1	15.5
Tundra swans										
PA	17.5	6.4	NA	16.1	8.1	16.3	9.6	13.2	10.9	NA
AF	10.0	7.5	15.7	10.4	10.2	9.8	8.0	5.2	16.1	9.6

[a] NA = not available.

Table 5. Number of waterfowl recorded in zones 1-3 during Pennsylvania's Midwinter Waterfowl Survey, 1996-2006. Totals for 2002-06 may not be completely comparable those from 2001 and prior because of procedural changes to survey in 2002.

Species	2006[a]	2005[a]	2004[a]	2003[a]	2002[a]	2001	2000	1999	1998	1997	1996	1996-2005 Avg.
Canada goose	51,844	41,839	48,454	77,224	78,828	48,198	29,388	44,821	33,350	35,657	40,244	47,800
Mallard	2,676	2,453	4,460	3,082	4,124	4,306	7,184	6,274	5,921	6,049	3,452	4,731
Black duck	1,865	2,763	2,079	1,775	2,904	1,570	3,878	2,185	5,098	2,365	1,236	2,585
Gadwall	5	13	18	0	0	2	12	1	20	23	0	9
Wigeon	1	0	0	0	11	0	1	0	0	3	0	2
Green-winged teal	12	13	0	2	1	0	6	0	18	0	0	4
Blue-winged teal	0	0	0	0	0	0	0	0	0	0	0	0
Shoveler	1	0	25	0	119	9	61	49	79	23	4	37
Pintail	10	1	24	0	6	0	12	2	13	12	0	7
Wood duck	0	0	0	0	0	0	0	1	0	0	0	0
Redhead	0	0	10	0	20	1	0	60	16	1	4	11
Canvasback	0	91	10	0	0	0	13	66	164	5	2	35
Scaup	302	2,379	260	0	0	34	357	400	287	230	25	397
Ring-necked duck	0	0	0	11	12	44	15	1	0	35	7	13
Goldeneye	159	16	116	70	41	10	352	82	161	942	61	185
Bufflehead	66	13	204	237	1,841	191	335	102	238	45	4	321
Ruddy duck	0	0	6	1	8	33	25	56	66	0	6	20
Long-tailed duck	0	0	0	0	0	0	0	6	0	0	0	1
Scoters	0	0	0	0	0	0	2	0	0	0	0	0
Mergansers	1,009	3,993	759	992	564	1,070	7,968	1,949	2,886	1,816	1,773	2,377
Unidentified ducks	31	12	0	25	27	53	9	0	35	29	19	21
Brant	0	0	0	0	0	2	0	0	0	0	0	0
Snow goose	10,314	25,909	11,100	9,602	4,347	0	1,400	9,023	10,463	11,695	58	8,360
White-fronted goose	0	0	0	0	0	0	0	1	0	0	0	0
Tundra swan	2,464	786	1,261	548	1,098	363	1,106	553	1,949	3,515	115	1,129
Mute swan	23	22	33	27	13	32	32	10	13	27	13	22
Unidentified swans	0	2	0	0	0	3	0	0	0	0	0	1
Coot	200	75	25	50	250	265	1,050	339	420	685	61	322
Totals	70,982	80,380	68,844	93,646	94,214	56,186	53,206	65,981	61,197	63,157	47,084	68,390

Table 6. Number of waterfowl breeding pairs ± 95% confidence interval by physiographic strata in Pennsylvania for 2006.

Strata	Mallard		Black duck		Wood duck		Canada goose		Canada goose	
	Pairs	95%C.I.	Pairs	95%C.I.	Pairs	95%C.I.	Pairs	95%C.I.	Total	95%C.I.
10	16,916	8,785	0		3,222	3,231	22,823	8,616	72,498	40,713
13	28,562	19,102	0		18,809	19,456	11,146	7,597	26,472	21,550
22	11,320	9,323	0		7,325	5,509	11,320	8,089	33,295	31,636
241	7,917	5,556	0		10,179	4,586	16,399	11,533	42,129	32,921
242	7,434	5,852	0		10,619	7,069	15,929	12,278	31,504	24,226
243	8,517	4,022	0		10,860	5,575	10,860	7,324	23,423	16,149
2006 PA Total	80,667	24,704	0		61,014	22,834	88,478	23,126	229,321	71,093

Table 7. Pennsylvania waterfowl population estimates from 1997 to 2006 and the 1993-2005 averages.

Species Estimate	2006	2005	2004	2003	2002	2001	2000	1999	1998	1997	1993-2005 Average
Mallard pairs	80.667	95,685	84,806	82,302	84,534	89,030	88,443	121,51	92,453	109,76	99,496
Mallard total	174,37	197,97	177,71	170,06	171,75	189,71	185,31	246,35	191,08	223,01	205,570
Black duck pairs	0	0	0	622	2,010	2,026	354	1,444	1,375	1,444	1,038
Black duck total	0	0	0	1,245	4,020	4,052	709	2,889	2,749	2,889	2,076
Wood duck pairs	61,014	60,536	47,368	46,855	65,684	56,276	43,296	59,011	52,368	57,733	50,014
Wood duck total	128,00	132,55	94,736	93,711	132,85	116,29	92,648	122,78	112,62	123,14	102,769
Canada goose pairs	88,478	115,29	122,85	101,56	85,192	96,468	85,379	104,34	88,975	87,849	91,441
Canada goose total	229,32	282,23	299,00	254,19	234,75	246,85	225,47	261,96	196,66	194,60	223,690
Bl-wing teal total	1,979	2,746	8,041	1,273	7,842	8,373	10,293	9,305	15,492	13,697	8,246
Gr-wing teal total	7,172	7,089	9,138	5,266	4,131	4,664	7,015	4,338	2,633	3,977	4,639
Hooded merg. total	7,646	9,625	1,272	4,318	4,205	1,417	3,686	2,833	1,630	5,665	3,302
Common merg. total	15,167	12,916	14,671	14,335	14,371	14,020	12,292	33,325	11,581	16,304	13,468

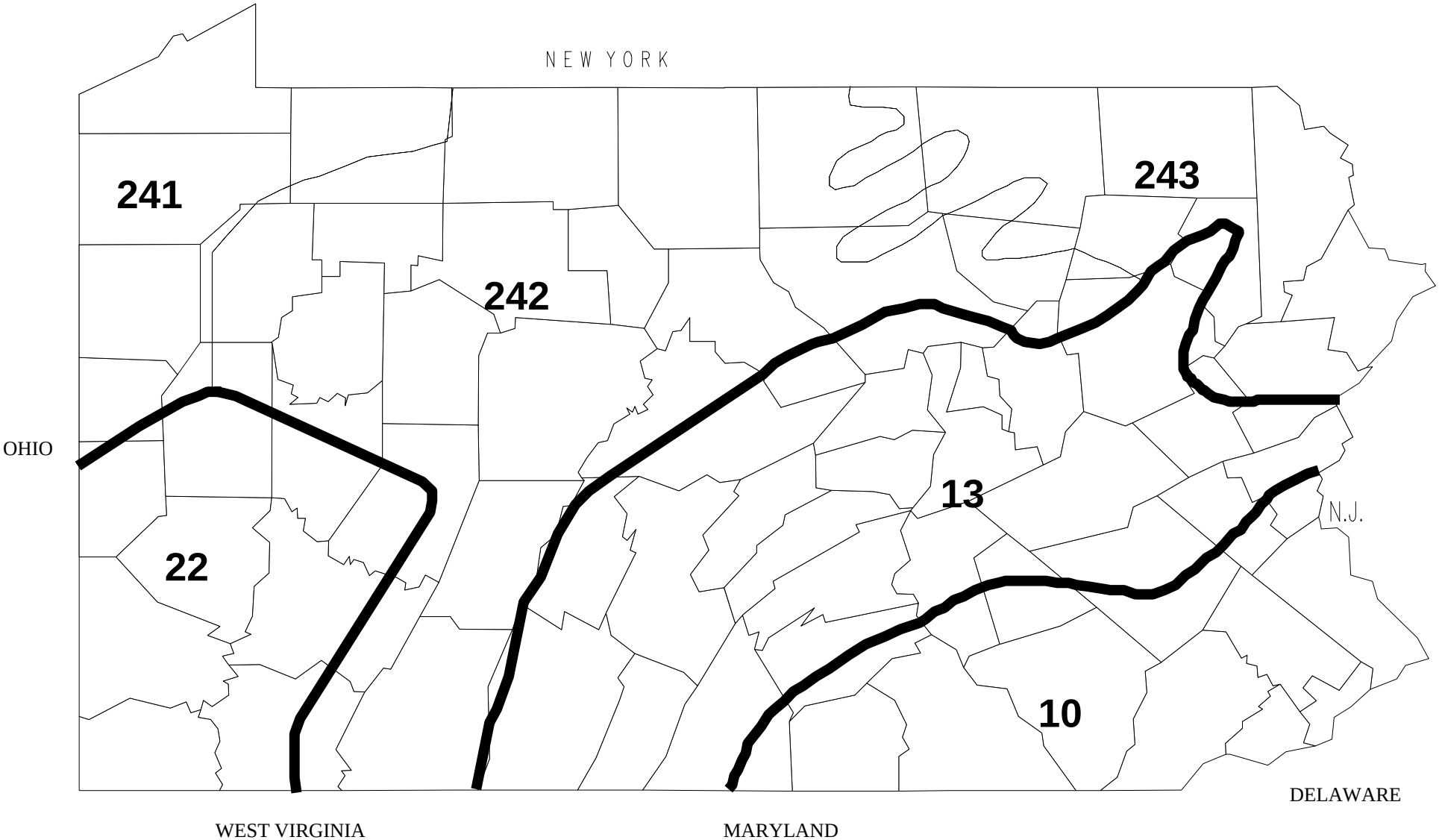


Figure 1. Physiographic zones sampled for breeding waterfowl in Pennsylvania.

Appendix 1
2005-2006 Pennsylvania Waterfowl Seasons

BUREAU OF WILDLIFE MANAGEMENT
MIGRATORY GAME BIRD SECTION

2005/2006 WATERFOWL HUNTING SEASON REGULATIONS

DUCKS, SEA DUCKS, COOTS, AND MERGANSERS

BAG LIMITS

DUCKS: 6 daily, 12 in possession; daily limit may not include more than 4 mallards including 2 hen mallards, 1 black duck, 1 pintail, 1 mottled duck, 1 fulvous tree duck, 2 wood ducks, 2 redheads, 1 canvasback, 4 scoters and 2 scaup. Possession limit may not include more than 8 mallards including 4 hens, 2 black ducks, 2 pintails, 2 mottled duck, 2 fulvous tree duck, 4 wood ducks, 4 redheads, 2 canvasbacks, 8 scoters and 4 scaup.

MERGANSERS: 5 daily not more than 2 hooded mergansers, 4 in possession.

COOTS: 15 Daily, 30 in possession

Youth Waterfowl Hunting Day (Ducks, Mergansers, Canada Geese, Coots and Moorhens): September 23.

SEASON DATES

Lake Erie Zone

Ducks, sea ducks, coots and mergansers- Oct. 23 – Nov. 25 & Nov. 29 – Jan. 2.

North Zone

Ducks, sea ducks, coots and mergansers -Oct. 14–28 & Nov. 8 – Jan. 1.

Northwest Zone

Ducks, sea ducks, coots and mergansers Oct. 14 – Nov. 25 & Dec. 11 – Jan. 5.

South Zone

Ducks, sea ducks, coots and mergansers Oct. 14 - 21 & Nov. 15 - Jan. 15.

ATLANTIC BRANT

Oct. 14 -Nov. 17 (2 brant daily bag limit, 4 in possession).

SNOW GEESE

Nov. 7 – Mar. 10 (15 daily bag limit, no possession limit).

CANADA GEESE

Pymatuning Zone

Oct. 28 - Nov. 25 & Dec. 11 – Jan. 8 (2 goose daily bag limit)

Atlantic Population Zone

Nov. 15 – 25 & Dec. 12 – Jan. 20 (3 goose daily limit).

Southern James Bay Canada Goose Hunting Zone

Nov. 13 – Dec. 30 (2 goose daily bag limit) &
Jan. 15 - Feb. 15 (5 goose daily bag limit).

Resident Canada Goose Zone.

Nov. 15 - 25 & Dec. 8 - Feb. 15 (5 goose daily limit)

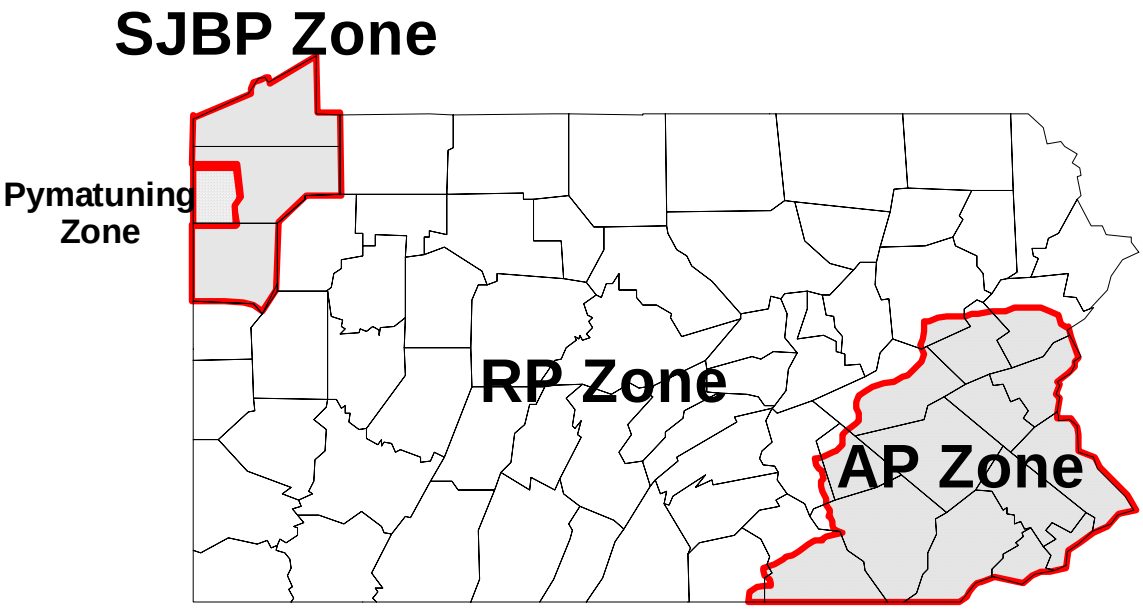
Early Resident Canada Goose Season - Statewide

September 1 – September 25 (8 goose daily bag limit, 16 in possession) **except:**

(1) No September goose season in the Pymatuning zone, **except** 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).

(2) 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 two geese; **except** on State Game Lands No. 46 (Middle Creek Wildlife Management Area) where the season is closed.

Canada goose hunting zones for 2005-06 season in Pennsylvania.



Resident Canada Goose Zone (RP).

All of Pennsylvania **except** for Crawford, Erie, and Mercer counties **and** 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).

Southern James Bay Population (SJBP) Zone

Erie, Mercer and Crawford Counties **except** for the Pymatuning Zone (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.)

Pymatuning Zone

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.

Atlantic Population (AP) Zone

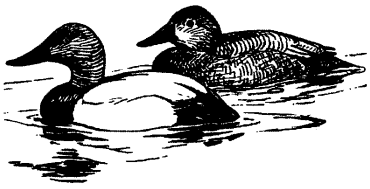
The area east of route SR 97 from Maryland State Line to the intersection of SR 194, east of SR 194 to intersection of US Route 30, south of US Route 30 to SR 441, east of SR 441 to SR 743, east of SR 743 to intersection of I-81, east of I-81 to intersection of I-80, south of I-80 to New Jersey state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

Appendix 2
Atlantic Flyway Midwinter Waterfowl Survey, 2006 Final Report

Atlantic Flyway

Midwinter Waterfowl Survey 2006

Final Report
13 March 2006



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2006 Atlantic Flyway
Midwinter Waterfowl Survey

Species	ME	VT	NH	MA	CT	RI	NY	PA	WV	NJ	DE
Mallard	4,025	431	538	4,249	924	1,879	11,324	2,506	1,759	26,970	10,126
Black duck	16,631	46	408	17,465	1,983	3,776	11,127	1,825	420	91,270	8,254
Mexican duck	0	0	0	0	0	0	0	0	0	0	0
Mottled duck	0	0	0	0	0	0	0	0	0	0	0
Gadwall	0	0	0	0	20	28	15	5	91	1,535	1,121
American wigeon	1	0	0	16	126	230	121	1	31	1,555	85
G.W. Teal	2	0	0	0	0	0	0	12	4	475	1,340
B.W. Teal	0	0	0	0	0	0	0	0	0	0	0
N. Shoveler	0	0	0	0	0	0	0	1	0	115	752
N. Pintail	0	0	0	95	0	0	6	10	50	2,565	7,359
Wood duck	0	0	0	0	0	0	0	0	1	0	14
Whistling duck	0	0	0	0	0	0	0	0	0	0	0
Total Dabblers	20,659	477	946	21,825	3,053	5,913	22,593	4,360	2,356	124,485	29,051
Redhead	0	0	0	0	0	0	21,952	0	0	100	0
Canvasback	0	0	0	0	70	45	2,005	0	10	2,745	0
Scaup	73	250	1,500	3,247	4,183	7,010	70,138	302	26	51,520	51
Ringneck	12	0	0	0	69	0	0	0	0	580	1,845
Goldeneye	5,982	3,622	6	7,883	634	265	3,661	159	5	65	0
Bufflehead	6,770	0	41	6,883	737	816	8,528	33	71	12,230	381
Ruddy duck	0	0	0	6	100	0	285	0	6	1,810	535
Total Divers	12,837	3,872	1,547	18,019	5,793	8,136	106,569	494	118	69,050	2,812
Eider	34,041	0	841	48,718	0	14,100	469	0	0	100	0
Scoter	4,351	0	85	3,385	50	3,600	8,838	0	0	11,360	0
Long-tailed Duck	2,865	0	50	730	99	26	5,330	0	0	915	0
Harlequin	30	0	0	39	0	0	0	0	0	0	0
Total Seaducks	41,287	0	976	52,872	149	17,726	14,637	0	0	12,375	0
Merganser	4,114	1,908	69	4,931	1,923	668	16,030	786	56	19,580	222
Unidentified Duck	0	0	0	20	0	0	10	31	0	0	0
Total Ducks	78,897	6,257	3,538	97,667	10,918	32,443	159,839	5,671	2,530	225,490	32,085
Brant	0	0	0	1,760	1,002	1,750	60,324	0	0	63,815	2,145
Snow goose	0	0	0	5	0	40	1,060	10,314	0	102,050	155,048
Canada Goose	3,338	25	3,413	10,858	3,025	10,045	93,205	42,479	3,800	160,185	117,657
W.F. Goose	0	0	0	0	0	0	0	0	0	0	0
Total Geese	3,338	25	3,413	12,623	4,027	11,835	154,589	52,793	3,800	326,050	274,850
Tundra swan	0	0	0	0	0	0	399	2,464	2	165	147
Trumpeter swan	0	0	0	0	0	0	0	0	0	0	0
Mute Swan	1	0	41	622	853	1,382	1,526	19	0	2,498	191
Unidentified Swan	0	0	0	0	0	0	60	0	0	0	0
Total Swans	1	0	41	622	853	1,382	1,985	2,483	2	2,663	338
Total Waterfowl	82,236	6,282	6,992	110,912	15,798	45,660	316,413	60,947	6,332	554,203	307,273
Coot	0	0	0	0	0	2	162	200	12	80	0
S.H. Cranes	0	0	0	0	0	0	0	0	0	0	0

2006 Atlantic Flyway
Midwinter Waterfowl Survey

Species	MD	VA	NC	SC	GA	FL	Flyway Total*	2005 Total*	% change 2005-2006
Mallard	32,525	12,336	3,471	2,275	810		116,148	131,802	-11.88
Black duck	13,279	18,385	4,757	998	29		190,653	184,055	3.58
Mexican duck	0	0	0	0	0		0	0	N/A
Mottled duck	0	0	0	0	14		14	15	-6.67
Gadwall	1,248	11,050	5,196	6,020	462		26,791	16,909	58.44
American wigeon	305	5,117	12,619	1,852	592		22,651	17,800	27.25
G.W. Teal	397	3,377	40,640	17,123	2,207		65,577	63,501	3.27
B.W. Teal	0	0	0	1,926	1,080		3,006	3,702	-18.80
N. Shoveler	18	1,557	834	4,321	393		7,991	4,599	73.76
N. Pintail	2,546	1,727	32,443	24,179	0		70,980	36,143	96.39
Wood duck	0	35	61	1,708	125		1,944	2,927	-33.58
Whistling duck	0	0	0	0	0		0	0	N/A
Total Dabblers	50,318	53,584	100,021	60,402	5,712		505,755	**461,453**	**9.60**
Redhead	1,841	1,480	12,724	41	7		38,145	45,630	-16.40
Canvasback	33,759	14,534	843	1,067	2,698		57,776	58,980	-2.04
Scaup	79,491	3,882	22,916	566	3,920		249,075	338,871	-26.50
Ringneck	460	6,248	12,310	20,293	4,833		46,650	41,790	11.63
Goldeneye	725	146	0	0	0		23,153	21,441	7.98
Bufflehead	11,768	11,294	5,153	379	274		65,358	75,356	-13.27
Ruddy duck	12,117	14,962	9,147	1,031	125		40,124	57,038	-29.65
Total Divers	140,161	52,546	63,093	23,377	11,857	No Survey	520,281	**639,106**	**-18.59**
Eider	0	0	0	0	0		98,269	87,850	11.86
Scoter	9,975	6,560	1,002	0	30		49,236	77,322	-36.32
Long-tailed Duck	744	317	0	0	0		11,076	10,141	9.22
Harlequin	0	0	0	0	0		69	31	122.58
Total Seaducks	10,719	6,877	1,002	0	30		158,650	**175,344**	**-9.52**
Merganser	7,003	4,139	6,133	348	275		68,185	53,970	26.34
Unidentified Duck	154	0	106	165	29		515	364	41.48
Total Ducks	208,355	117,146	170,355	84,292	17,903		1,253,386	**1,330,237**	**-5.78**
Brant	2,353	13,122	368	0	0		146,639	123,248	18.98
Snow goose	49,150	12,871	53,538	649	0		384,725	338,666	13.60
Canada Goose	305,373	110,376	14,228	1,469	1,002		880,478	873,270	0.83
W.F. Goose	0	0	0	3	0		3	0	N/A
Total Geese	356,876	136,369	68,134	2,121	1,002		1,411,845	**1,335,184**	**5.74**
Tundra swan	8,239	4,576	54,064	398	0		70,454	68,735	2.50
Trumpeter swan	0	0	0	0	0		0	0	N/A
Mute Swan	1,444	1,078	0	0	1		9,656	9,297	3.86
Unidentified Swan	2,145	0	0	0	0		2,205	2	110150.00
Total Swans	11,828	5,654	54,064	398	1		82,315	**78,034**	**5.49**
Total Waterfowl	577,059	259,169	292,553	86,811	18,906		2,747,546 0	2,743,455	0.15
Coot	140	730	22,625	32,909	89,514		146,374	145,951	0.29
S.H. Cranes	0	0	0	0	105		105	0	N/A

* Flyway totals for 2005 and 2006 are not comparable with totals from other years because of lack of survey in Florida. Totals for mottled ducks, whistling ducks, blue-winged teal, redheads, scaup, ringnecked ducks, and to a lessere extent, wigeon and shovelers are especially suspect

ATLANTIC FLYWAY BREEDING WATERFOWL PLOT SURVEY

Breeding Pair and Population Size Estimates

2006

Robert V. Raftovich

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

7 September 2006

Conditions early in the breeding season were generally favorable for nesting waterfowl, with warm temperature and dry to normal moisture conditions. Heavy rains and cooling temperatures during May and June in the northern and western portions of the survey area may have affected production through nest flooding and brood losses. In the southern part of the survey area, cool temperatures and poor wetland conditions caused by less than normal precipitation provided poor conditions for brood rearing. Overall impressions from field biologists' reports was that production this year may be reduced because of poor habitat and weather conditions.

Delaware did not conduct their survey this year because of personnel issues. Thus, state-level estimates are not available for Delaware. However, because survey-area estimates are summed from stratum estimates (rather than stratum-within-state estimates) and most plots in the strata that occur in Delaware (4, 10, and 99) were surveyed, valid estimates are available for strata, and for the entire survey area. However, sample sizes for these strata are reduced, which may affect the precision of the estimates.

In 2006, 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 × 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 × (pairs + singles) + grouped birds.

Breeding population and breeding pairs estimates for this year are compared with estimates from 2005 and long-term (1993-2005) averages. Statistical comparisons were made with a 2-tailed *z*-test. The statistic was compared with the normal distribution in SAS. The *z* test statistic was calculated as:

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

Variance of the long-term average was calculated as:

$$\mathrm{Var}_{\mathrm{LTA}} = \frac{\sum_{i=1}^{n} \mathrm{Var}_i}{n^2}$$

Where:

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

This was the fourth year that social grouping information (i.e. singles, pairs, flocks, groups) was collected for gadwall, green-winged and blue-winged teal, common and hooded mergansers, and mute swans. Comparisons with estimates from 2005 were made as with mallards, black ducks, wood ducks, and Canada geese. Long-term averages for these species will be presented once there are at least 5 years of estimates on which to base the average.

Population and breeding pairs estimates for mallards declined from last year (Figures 1 and 2), and remained below the long-term averages of 800,239 and 382,909, respectively. None of these differences were statistically significant (Tables 1 and 2). Black population and breeding pairs estimates increased slightly and non-significantly from last year. However, both estimates remain substantially below their long-term averages, with a significant difference for the population estimate (Tables 1 and 2). Given the previous population trajectory exhibited by black ducks, this population still warrants close attention, despite this year's estimates. Wood duck population and pairs estimates remain essentially unchanged from last year and above their long-term average (Tables 1 and 2). Canada goose population estimates remain unchanged from last year and slightly above their long-term average. Breeding pairs declined (non-significantly) from last year, but remain above their long-term average (Tables 1 and 2).

Population and breeding pair estimates for gadwall, teal, mergansers, and mute swans remain extremely variable, with large year-to-year fluctuations and most coefficients of variation

exceeding 25% and the lowest in the high teens (Tables 3 and 4). Gadwall breeding pair estimates seem much more stable than population estimates, and considerably smaller than would be expected given the magnitude of the population estimate. This could indicate substantial migration of gadwall though the survey area during the survey period. Green-winged teal and mute swans showed large, but statistically non-significant increases in both population and breeding pairs estimates (although the change for the mute swan population estimate approached significance)(Tables 3 and 4). Blue-winged teal and hooded mergansers show declines from 2005, but these were again not statistically significant (Tables 3 and 4). Common merganser estimates remained essentially unchanged (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, 1993-2006, and percent change from 2005 to 2006 and from the long-term average to 2006.

		Mallards		Black ducks		Wood ducks		Canada geese			
Year	N	Estimate	SE	Estimate	SE	Estimate	SE	Estimate [a]	SE	Estimate [b]	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	1,486	833,669	56,241	68,702	12,215	420,163	37,817	965,706	86,933		
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	805,935	51,733	53,891	7,713	359,904	35,982	978,554	89,813	1,048,678	92,959
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
Long-term average (1993-2005)											
		800,239	15,312	70,344	3,574	370,574	9,576	929,243	28,370	1,114,161	55,817
Percent change from:		%	*p*	%	*p*	%	*p*	%	*p*	%	*p*
	2005	-4.28	0.6533	4.38	0.8591	-3.04	0.8080	-0.70	0.9580	-1.98	0.8754
	LTA	-9.85	0.1151	-26.19	0.0302	8.20	0.4143	13.78	0.1741	2.67	0.7835

[a] Estimates based on the 1993-2002 method of calculating total indicated birds [TIB = (2×pairs) + singles + groups].

[b] Estimates based on the post-2002 method of calculating total indicated birds [TIB = 2×(pairs + singles) + groups].

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, 1993-2006, and percent change from 2005 to 2006 and from the long-term average to 2006.

		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	1,486	400,807	26,602	29,059	3,648	202,171	18,305	405,902	32,094
2003	1,495	347,309	22,299	28,863	4,186	167,135	14,664	389,793	28,280
2004	1,485	386,832	25,128	25,028	3,499	172,730	16,863	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
Long-term average (1993-2005)									
		382,909	7,179	31,228	1,311	175,668	4,451	340,757	8,534
Percent change from:		%	*p*	%	*p*	%	*p*	%	*p*
	2005	-3.48	0.7124	16.00	0.5133	-0.68	0.9562	-6.29	0.5279
	LTA	-9.71	0.1166	-20.24	0.1530	10.76	0.2742	12.90	0.1256

Table 3. Population estimates and standard errors for gadwall, green-winged teal, blue winged teal, common mergansers, hooded mergansers, and mute swans from the Atlantic Flyway Breeding Waterfowl Plot Survey, 2003-2006, and percent change from 2005 to 2006.

		Gadwall		Green-winged teal		Blue-winged teal		Common merganser		Hooded merganser		Mute swan	
Year	N	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	42,844	14,182	41,884	11,149	21,208	8,578
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
Percent change													
from:		%	*p*	%	*p*	%	*p*	%	*p*	%	*p*	%	*p*
	2005	-55.18	0.5382	77.31	0.1514	-52.86	0.2372	6.91	0.8447	-20.17	0.5156	97.42	0.1002

Table 4. Breeding pair estimates and standard errors for gadwall, green-winged teal, blue winged teal, common mergansers, hooded mergansers, and mute swans from the Atlantic Flyway Breeding Waterfowl Plot Survey, 2003-2006, and percent change from 2005 to 2006.

		Gadwall		Green-winged teal		Blue-winged teal		Common merganser		Hooded merganser		Mute swan	
Year	N	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	18,616	6,860	19,028	5,402	8,812	2,498
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
Percent change													
from:		%	*p*	%	*p*	%	*p*	%	*p*	%	*p*	%	*p*
	2005	63.67	0.5785	84.93	0.1811	-38.03	0.4293	-0.78	0.9816	-42.33	0.0775	68.87	0.2085

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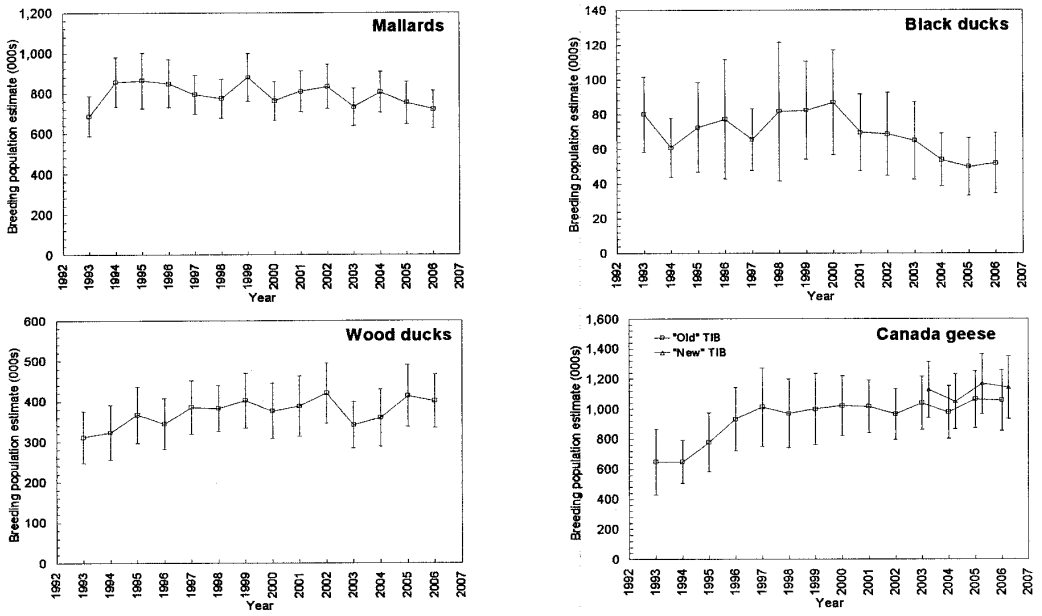

Figure 1. Population estimates and 95% confidence intervals for mallards, black ducks, wood ducks, and Canada geese, 1993-2006.

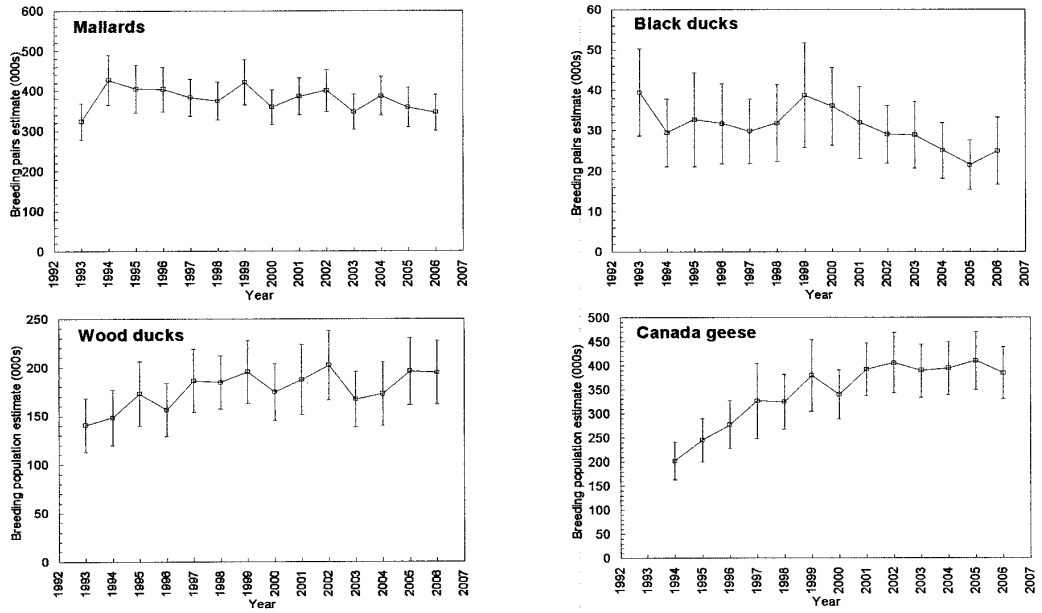

Figure 2. Breeding pair estimates and 95% confidence intervals for mallards, black ducks, wood ducks, and Canada geese, 1993-2005.