

Chesapeake Bay Breeding Waterfowl Populations

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Abstract.—This paper presents information on the most common species of waterfowl that breed in the Chesapeake Bay including Mallard (*Anas platyrhynchos*), Wood Duck (*Aix sponsa*), American Black Duck (*Anas rubripes*), Canada Goose (*Branta canadensis*), and Mute Swan (*Cygnus olor*). Long-term (40 years) and short-term (13 years) trends in breeding populations were evaluated using the North American Breeding Bird Survey and the Atlantic Flyway Breeding Waterfowl Survey. Species that have adapted to landscape-level and local habitat changes in the past 40 years have expanded, especially Mute Swans, Canada Geese, and Mallards, while species that are less tolerant of these changes such as American Black Ducks have declined. Wood Ducks may be showing some recent declines in the Bay region, even though the Atlantic Flyway population is increasing. Losses of forested wetland habitats around the Bay may account for some of this decline.

Keywords.—Chesapeake Bay, waterfowl, breeding populations, ducks, geese, swans.

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Several waterfowl species breed in the Chesapeake Bay area of Virginia and Maryland. The most common breeders include Mallards (*Anas platyrhynchos*), Wood Ducks (*Aix sponsa*), American Black Ducks (*Anas rubripes*, hereafter Black Ducks), Canada Geese (*Branta canadensis*), and Mute Swans (*Cygnus olor*). These species are widely distributed across the region and constitute the majority of the waterfowl that nest here. Some of these populations, including Mallards, Canada Geese, and Mute Swans are generally thought to be increasing in the region, while others such as the Black Duck appear to be declining or remaining stable. This paper examines the short- and long-term trends of these common breeding waterfowl populations in the region.

Other species that can be found nesting in the region include Gadwall (*Anas strepera*), Blue-winged (*Anas discors*) and Green-winged Teal (*Anas creca*), Hooded Merganser (*Lophodytes cucullatus*), and occasionally others. These species have only a limited distribution, constitute only a small percentage of the breeding waterfowl in the area, and are not addressed in this paper.

METHODS

Estimates of breeding waterfowl populations in the Chesapeake Bay Region (Bay Region) of Virginia and Maryland were calculated using data from several sources including the Atlantic Flyway Breeding Waterfowl Plot Survey (Plot Survey) (Heusmann and Sauer 2000), the

Breeding Bird Survey (Sauer *et al.* 2005), and the Atlantic Flyway Mute Swan Survey (Swan Survey) (Allin 2003).

Estimates of short-term trends (1993-2005) in breeding populations of Mallards, Black Ducks, Wood Ducks, and Canada Geese were derived from data collected as part of the Plot Survey. This survey has been described in detail by Heusmann and Sauer (1997, 2000), and involves monitoring 1-km² plots apportioned randomly across physiographic strata. Plots are monitored once each year during the April/May nesting period by ground and/or aerial surveys. Observers record numbers and species of all waterfowl seen on the plot. For this paper, data from only the Upper Coastal Plain and Salt Marsh physiographic strata were used, which encompasses the majority of the Chesapeake Bay watershed in the states of Maryland and Virginia. Plots were surveyed annually from 1993 through 2005. Estimates for the Chesapeake Bay Region were calculated by summing the state strata estimates for Maryland and Virginia for the two physiographic units. Simple linear regression was used to evaluate trends in breeding waterfowl populations over time. Trends for the Chesapeake Bay area were compared to those for the entire survey area in the Atlantic Flyway, which includes all states from Virginia to Vermont (Raftovich 2005).

Long-term trends in breeding populations of Mallards, Black Ducks, Wood Ducks, Canada Geese, and Mute Swans were derived from data obtained from the North American Breeding Bird Survey (BBS; Sauer *et al.* 2005). The BBS is an annual roadside survey designed primarily to assess songbird populations, but provides estimates for other bird species including waterfowl. It is conducted along standard routes established randomly across representative habitats. Each survey route is 39 km with 50 stops located at 0.8-kilometer intervals along the route. A three-minute point count is conducted at each stop, during which the observer records all birds heard or seen within 0.4 kilometers of the stop. Data from all BBS routes in both states were used in this analysis and no attempt was made to separate those routes that fell only in the Upper Coastal Plain or salt marsh. However, most BBS routes in Maryland and Virginia fall within the Chesapeake Bay Watershed. Population trend estimates are expressed as the percent change in

breeding population per year over the entire time period (1966-2005). Calculation of the statistical significance (P-value) of the trend was described by Sauer *et al.* (2005). Long-term trends derived from the Breeding Bird Survey were compared to the short-term trends calculated from the Plot Survey.

The Atlantic Flyway Mute Swan Survey (Swan Survey) (Allin 2003) and the BBS were used to assess trends in Mute Swan populations in the Chesapeake Bay Region. The Swan Survey is an aerial and ground survey conducted in late summer (August-September) throughout the range of the Mute Swan in the Atlantic Flyway. Attempts are made to conduct a complete census of swans. Swans are classified as adults or juveniles based on plumage characteristics, and family units are identified wherever possible. The survey provides an estimate of Mute Swan population size and productivity. This survey has been conducted every three years since 1986 by the Atlantic Flyway states. Data from the Chesapeake Bay area in Virginia and Maryland from 1986 through 2002 were used to assess short-term trends in Mute Swan numbers. Data from the Breeding Bird Survey from 1966-2005 were used to evaluate the long-term trend in Mute Swan numbers in the Bay Region. Analysis of Breeding Bird Survey data was similar to that described above for other waterfowl populations.

RESULTS

Black Ducks

Long-Term Trends.—The number of Black Ducks observed on the BBS is small, and no trend estimate is available for Virginia. Therefore, trend estimates for Maryland and the Upper Coastal Plain in general were used to evaluate Black Duck trends in the Chesapeake Bay region. The Upper Coastal Plain includes coastal areas of Virginia, Maryland, Delaware, and New Jersey. The trend in this area was assumed to be similar to that in the Bay Region as the habitats and environmental conditions are similar. Results suggest a long-term decline in the Black Duck breeding population in Maryland (trend = -4.06% per year, $P > 0.10$), and a similar trend in the Upper Coastal Plain (trend = -2.83% per year, $P > 0.10$), although these trends are not statistically significant (Fig. 1).

Short-Term Trends.—Results from the Plot Survey indicate a significant decline ($P < 0.05$) in the number of breeding Black Ducks in the Atlantic Flyway from 1993 through 2005 (Fig. 2). In the Bay Region, breeding Black Duck numbers appear to have declined, however, there are relatively small numbers of breeding Black Ducks counted on the survey. Annual counts are

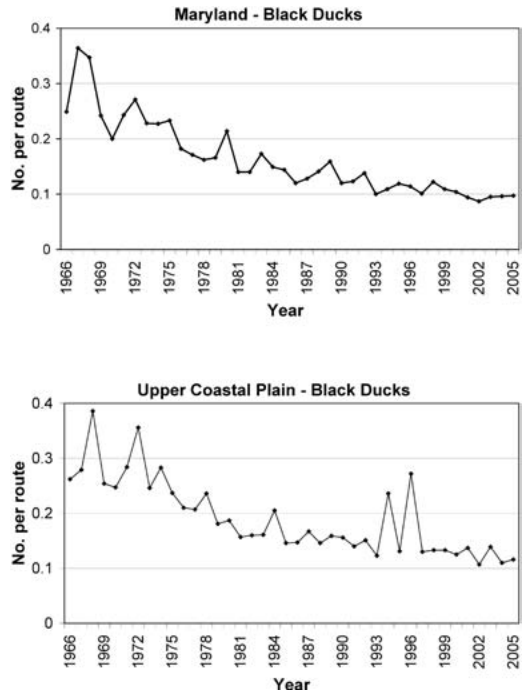


Figure 1. Average number of Black Ducks observed per Breeding Bird Survey route in Maryland (top) and the Upper Coastal Plain (bottom) 1966-2005.

quite variable and the trend is not significant ($P > 0.10$) (Fig. 2). Data from other sources indicate there are fewer Black Ducks breeding in the Chesapeake Bay portion of Maryland (Stotts 1987) and on offshore islands in the Virginia portion of the Bay (GRC, unpublished data). The estimated number of breeding pairs of Black Ducks has averaged 3,658 in the Bay Region and 31,228 in the Atlantic Flyway from 1993-2005.

Mallards

Long-Term Trends.—Results from the BBS indicate a long-term increase in the number of Mallards breeding in the Bay Region. There was a significant positive trend in the number of breeding Mallards in both Maryland (trend = 8.0% per year, $P < 0.05$) and Virginia (trend = 5.1% per year, $P < 0.05$) (Fig. 3). In Maryland, the average number of Mallards observed on the BBS increased from less than one per route during the first five years of the survey (1966-1970), to six per route during the most recent five-year period

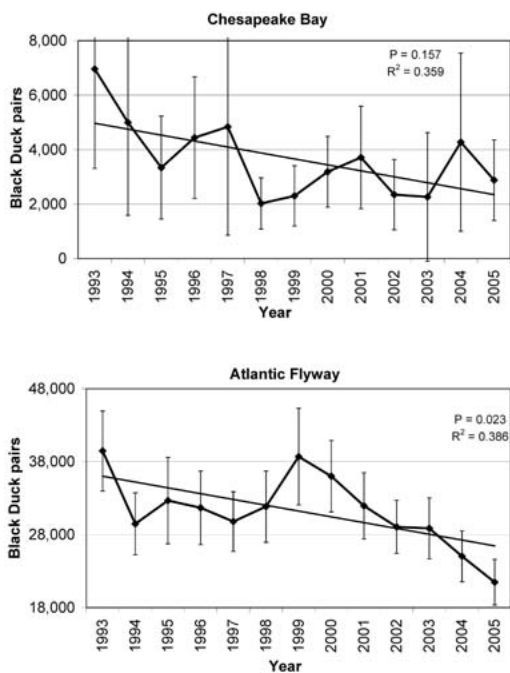


Figure 2. Estimated number of Black Duck pairs in the Chesapeake Bay Region and in the Atlantic Flyway (error bars represent \pm SE). Data obtained from the Atlantic Flyway Breeding Waterfowl Plot Survey, 1993-2005.

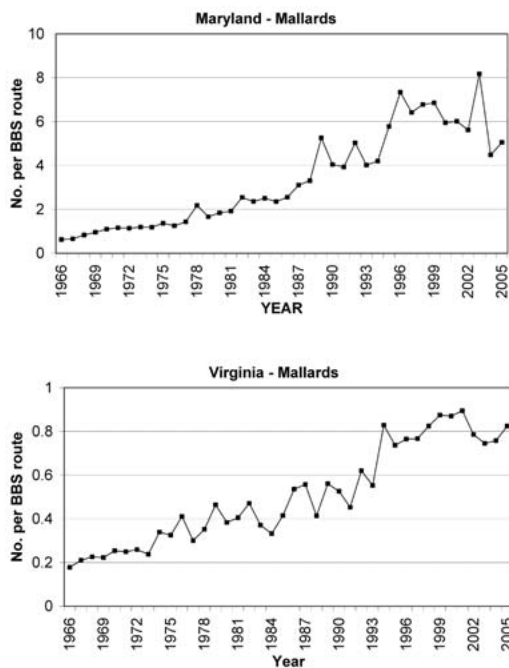


Figure 3. Average number of Mallards observed per Breeding Bird Survey (BBS) route in Maryland (top) and Virginia (bottom) 1966-2005.

(2001-2005). In Virginia, the average number of Mallards per route has risen from 0.21 during the five-year period 1966-1970, to 0.80 during the past five years (2001-2005).

Short-Term Trends.—In the short-term, Mallard numbers have been relatively stable. Results from the Plot Survey indicate no significant trend in Mallard numbers from 1993 to 2005 in the Atlantic Flyway ($P > 0.10$) (Fig. 4). Similarly, there has been no significant change in Mallard numbers in the Bay Region ($P > 0.10$), although the data suggest a downward trend in the past several years. The estimated number of breeding pairs of Mallards has averaged 43,575 in the Bay Region and 382,909 in the Atlantic Flyway from 1993-2005.

Wood Ducks

Long-Term Trends.—Wood Ducks also appear to have increased over the long-term in the Bay Region (Fig. 5). Breeding Bird Survey numbers in Maryland show an increasing trend in the number of breeding Wood Ducks (trend = 6.0% per year, $P < 0.05$), which have risen from an average of 0.137

ducks per route from 1966-70 to an average of 0.528 ducks per route from 2001-05. Breeding Bird Survey numbers also indicate an increasing trend for Wood Ducks breeding in Virginia (trend = 3.76% per year, $P < 0.10$), although the trend is not as strong as in Maryland. In Virginia, the average number of Wood Ducks counted per route has increased from 0.194 for the five-year period 1966-1970, to 0.525 for the 2001-05 period.

Short-Term Trends.—Short-term trends, however, appear to be a bit conflicting. Data from the Plot Survey indicate a significant increasing trend ($P < 0.05$) in the Atlantic Flyway from 1993-2005, but a declining trend ($P < 0.10$) in the Bay Region for the same time period (Fig. 6). The estimated number of breeding pairs of Wood Ducks has averaged 15,343 in the Bay Region and 175,668 in the Atlantic Flyway from 1993-2005.

Canada Geese

Long-Term Trends.—Breeding populations of Canada Geese (also referred to as resident geese) have increased substantially

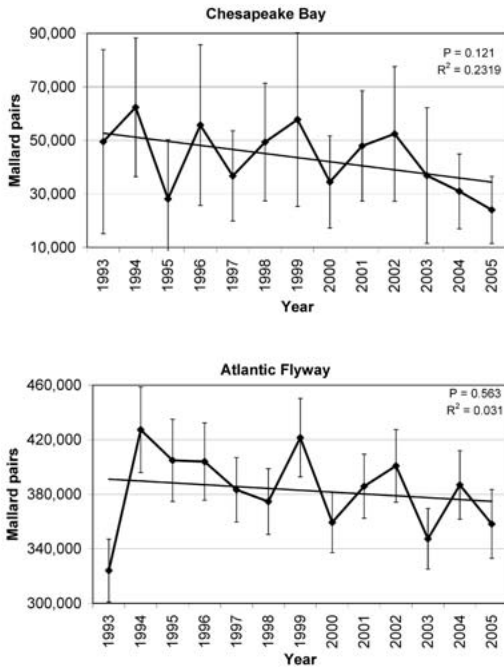


Figure 4. Estimated number of Mallard pairs in the Chesapeake Bay Region and in the Atlantic Flyway (error bars represent \pm SE). Data obtained from the Atlantic Flyway Breeding Waterfowl Plot Survey, 1993-2005.

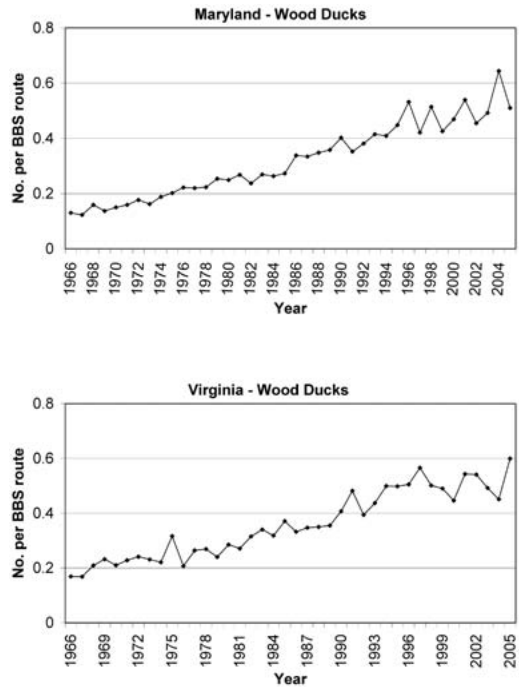


Figure 5. Average number of Wood Ducks observed per Breeding Bird Survey (BBS) route in Maryland (top) and Virginia (bottom) 1966-2005.

in the Bay Region over the past 40 years (Fig. 7). Breeding Bird Survey numbers in Maryland show an increasing trend (16.5% per year, $P < 0.05$), and the number of breeding pairs of Canada Geese have risen from an average of 0.651 geese per route during the 1966-70 period, to an average of 48.2 geese per route during the 2001-05 period. Similarly, BBS numbers indicate a large increase in breeding pairs in Virginia (20% per year, $P < 0.05$). The average number of Canada Geese counted per route in Virginia has increased from 0.182 during the 1966-1970 period, to 34.5 during the most recent five-year period, 2001-2005.

Short-Term Trends.—Short-term trends from the Plot Survey (1993-2005) continue to show a significant increase in breeding Canada Goose numbers in the Atlantic Flyway, and 410,544 pairs were counted in 2005. In the Bay Region, although goose numbers still appear to be increasing, survey results are more variable and the trend is not as strong ($P = 0.103$) (Fig. 8). The estimated number of breeding pairs of Canada Geese has averaged

24,273 in the Bay Region and 340,757 in the Atlantic Flyway from 1993-2005.

Mute Swans

Long-Term Trends.—The number of Mute Swans counted in the Chesapeake Bay Region has increased significantly over the past 40 years. The BBS in Maryland indicates a large increase in the number of Mute Swans between 1966 and 2005 (31.2% per year, $P < 0.05$) (Fig. 9). No BBS estimates are available for Mute Swans in Virginia for this time period, as few to no swans have been seen on the survey in Virginia.

Short-Term Trends.—The Atlantic Flyway Mute Swan Survey indicates a significant increase in Mute Swan numbers in the Bay Region during recent years (Fig. 9). There were fewer than 500 Mute Swans counted in the region when the first survey was conducted in 1986. Mute Swan numbers have increased steadily since that time, and more than 4,000 were estimated on both the 1999 and 2002 surveys.

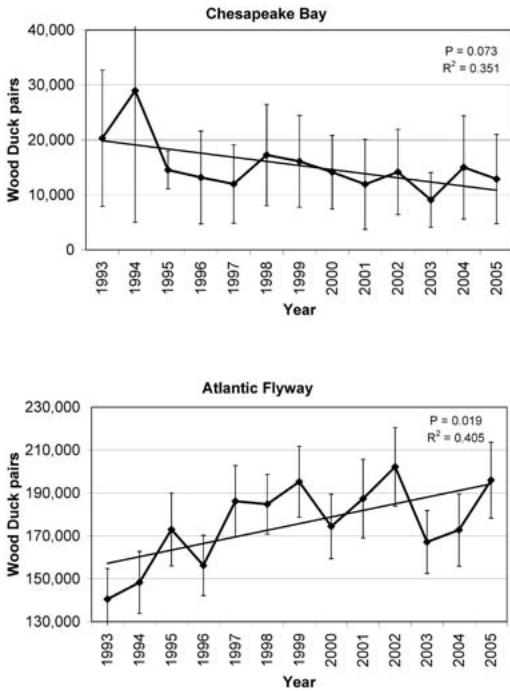


Figure 6. Estimated number of Wood Duck pairs in the Chesapeake Bay Region and in the Atlantic Flyway (error bars represent \pm SE). Data obtained from the Atlantic Flyway Breeding Waterfowl Plot Survey, 1993-2005.

DISCUSSION

Populations of breeding waterfowl have changed considerably in the Bay Region over the past 40 years. There have been general long-term increases in the numbers of Mallards, Wood Ducks, Canada Geese, and Mute Swans. These species are quite adaptable and have benefited from habitat and landscape changes in the region over the past 40 years. These changes, many of which are the result of an increase in the human population in the region, include an increase in urban and residential areas, and a decline in the number of natural wetlands (Tiner *et al.* 1994). Three of these four species (Mallards, Canada Geese, and Mute Swans) have only started breeding in the Chesapeake Bay Region in relatively recent times (the last 30-40 years). In addition, many of the Mallards, Canada Geese, and Mute Swans that nest here are non-migratory or resident waterfowl, and spend the entire year in the Chesapeake Bay Region. They are accustomed to human ac-

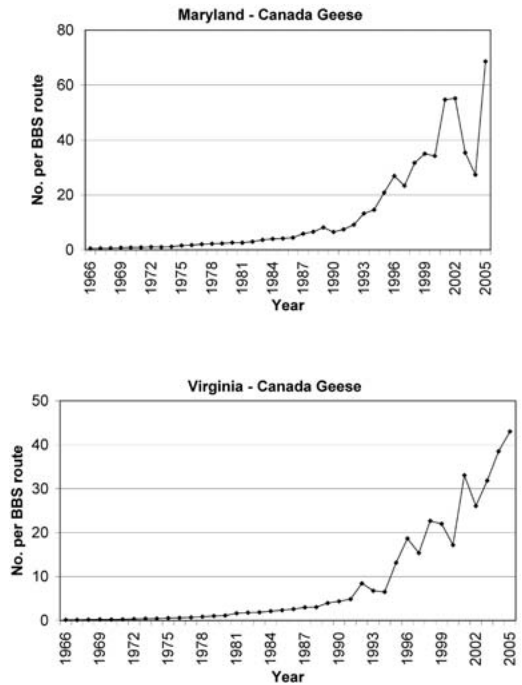


Figure 7. Average number of Canada Geese observed per Breeding Bird Survey route in Maryland (top) and Virginia (bottom) 1966-2005.

tivities and disturbance and have adapted to the changes that have occurred.

Mallards were historically considered a prairie nesting species, although some Mallards did nest in the eastern U.S. (Bellrose 1978). Over the past 40-50 years, Mallards have dispersed eastward, where they have taken advantage of human induced habitat changes. Mallards are very adaptable and can nest in a variety of both natural and human-altered habitats including urban areas, housing developments and city parks. In addition, many captive-reared Mallards have been released in the Chesapeake Bay Region (Hindman *et al.* 1992) and throughout the Atlantic Flyway by landowners or hunt clubs. In Maryland alone, over one million mallards have been released during the past 20 years (LJH, personal observation). These birds have likely contributed to the large increase in breeding Mallard numbers in the east. The recent stabilization in Mallard breeding population estimates over the short term in the Bay Region and the Atlantic Flyway are a bit surprising. However, the

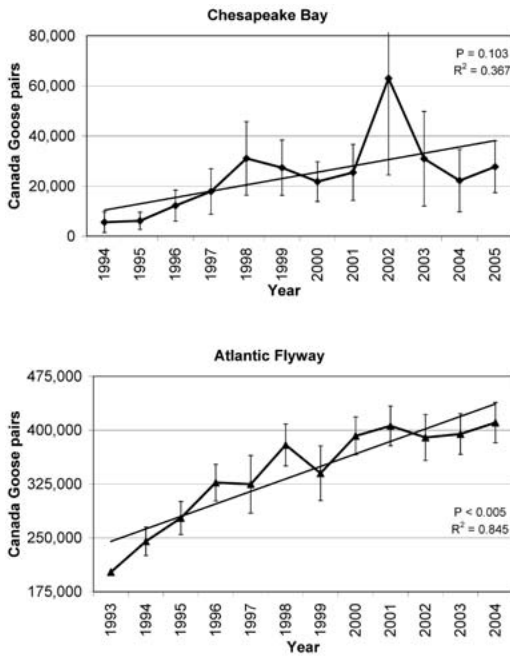


Figure 8. Estimated number of Canada Goose pairs in the Chesapeake Bay Region and in the Atlantic Flyway (error bars represent \pm SE). Data obtained from the Atlantic Flyway Breeding Waterfowl Plot Survey, 1993-2005.

number of captive-reared Mallards released on state-licensed shooting areas in Maryland has been scaled back in recent years. In addition, the state-mandated duck release program that was operational in Maryland since 1974 was halted in 1990. These changes may have contributed to the stabilization of breeding Mallard numbers. It is also possible that density-dependent factors are limiting population growth through a reduction in productivity or adult survival. In addition, liberal hunting seasons since 1995 have increased the harvest of mallards, which may be contributing to the stabilization in Mallard numbers in the region.

Breeding populations of local or resident Canada Geese were very small 40 years ago. These populations originated from a variety of sources including releases from private landowners and hunt clubs, and translocations and reintroductions by federal and state wildlife agencies. Resident goose populations increased slowly during the 1970s and 1980s, then much more rapidly in the 1990s. Resident geese are very adaptable

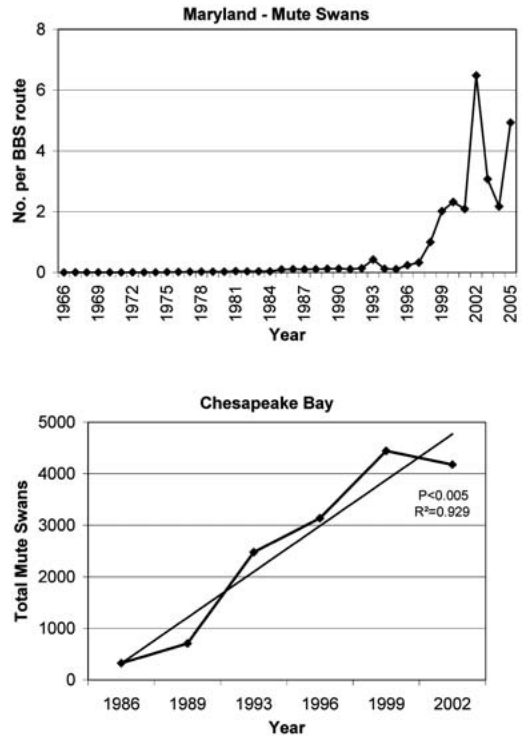


Figure 9. The average number of Mute Swans observed per Breeding Bird Survey route in Maryland 1966-2005 (top) and the number of Mute Swans counted on the Atlantic Flyway Mute Swan Survey in the Chesapeake Bay, 1986-2002 (bottom).

and tolerant of human development and activities. They nest in nearly all habitats including residential and urban areas, golf courses, rural farmlands, and native habitats. Results from this study indicate that Canada Goose breeding populations increased significantly over the long-term in the Bay Region. That increase has continued in both the Bay Region and the Atlantic Flyway in the short-term, although goose population growth appears to have slowed in the last several years. Special hunting seasons with liberal bag limits were established in the 1990s, and have been expanded since then. Harvests during these September seasons have doubled or tripled in some areas, and these seasons have been effective in controlling resident Canada Goose numbers, especially in agricultural and more rural areas. In addition, other goose control measures such as culling birds and destroying nests, have been employed to control goose numbers in ur-

ban areas or where they cause conflicts with human activities.

The Mute Swan is a non-native species that was introduced into the Bay Region in the 1950s and 1960s (Costanzo 2004; Hindman 2004). They have established breeding populations in the Bay Region and throughout the Atlantic Flyway, and have increased significantly over both the long and short term. Similar to mallards and resident Canada Geese, Mute Swans have taken advantage of the habitat and landscape changes that have occurred in the Bay Region over the past 40 years. They can be found breeding on large estates, urban parks, and residential areas, as well as in native habitats in the Chesapeake Bay. Mute Swans have detrimental effect on aquatic vegetation and native wildlife species (Allin *et al.* 1987; Tatu 2006), and have caused ecological and public safety problems in the Maryland portion of Chesapeake Bay (Hindman 2004). Mute Swans have benefited from state and federal policies that have not allowed hunting season on these birds. Population control efforts were initiated by state wildlife agencies and federal national wildlife refuges in the 1990s, but these efforts were halted in 2002 due to legal action from animal rights activists. New federal rules enacted in 2005 removed the Mute Swan from the list of species protected under the Migratory Bird Treaty Act. Their continued population growth and range expansion has prompted many states to initiate new Mute Swan management programs in the past several years. Control efforts in the Bay Region are being conducted to reduce Mute Swan population growth rates and limit their impacts on native wildlife and Chesapeake Bay habitats (Atlantic Flyway Council 2003).

Wood Duck populations have increased in the Bay Region over the long-term. Wood Duck numbers were quite low in the early 1900s because of unregulated harvest and the loss of nesting habitats (Bellrose 1978). The Migratory Bird Treaty Act of 1918 eliminated most market hunting and helped establish modern waterfowl management harvest strategies. These developments along with the recovery of Beaver (*Castor canadensis*) populations have helped Wood Duck populations re-

bound. Beavers have helped create new habitats for Wood Duck nesting and brood rearing. In addition, the development and use of man-made nest boxes has provided alternative nesting cavities, one of the limiting factors for Wood Duck breeding populations. Short-term population trends show a continued increase in breeding Wood Duck numbers the Atlantic Flyway but a declining trend in the Bay Region. The trend in the Bay Region is more variable and is driven by a couple of high counts in the early years of the survey (1993 and 1994, see Fig. 6). Breeding population estimates appear fairly stable over the last ten years. However, this trend should raise a concern for waterfowl managers. As human development pressure continues to increase, and forested wetlands continue to be lost or degraded in the Bay Region, Wood Duck population may be put at risk.

Black Duck populations have declined over the long-term in both the Atlantic Flyway and in the Bay Region. Unlike most of the other species discussed above, the Black Duck is not very tolerant of environmental disturbance and human encroachment, and has been negatively impacted by the changes that have occurred over the past 40 years (Bolen *et al.* 2002). In the short-term, the decline has continued in the Atlantic Flyway. In the Bay Region, the data are more difficult to interpret. There are only a small number of black ducks that breed in the Bay Region, far fewer than the number of Mallards that now breed here. The number of Black Ducks counted on the breeding surveys is small and the data are quite variable. Although results indicate a declining breeding population, the trend is not statistically significant ($P > 0.10$). However, other information on Black Duck productivity in the Bay Region provides evidence to support a declining trend (Stotts 1987; Costanzo 2002; Haramis 2002). In contrast to Mallards, Black Ducks are less tolerant of disturbance and generally do not nest in human-altered habitats such as urban or residential areas. Black Duck nesting is limited mostly to coastal marshes or offshore islands where there has historically been little human disturbance and few mammalian predators (Stotts 1987). However, the quanti-

ty and quality of even these habitats is declining. Many of the small islands in the Chesapeake Bay where Black Ducks nest are eroding rapidly due to sea-level rise. These islands, which have only limited amounts of high ground, are increasingly prone to flooding during spring tides and storm events. Flooding is the main cause of nest loss for Black Ducks on these islands (Costanzo 2002; Haramis *et al.* 2002). Other nesting islands are experiencing increased use by recreational boaters. This increase in disturbance could also be contributing to the decline in Black Duck productivity. In addition, predators such as Raccoon (*Procyon lotor*), Red Fox (*Vulpes vulpes*), and some gull species have moved into these nesting areas. These predators are the second most important factor contributing to the loss of Black Duck nests on the Chesapeake Bay Islands (Haramis *et al.* 2002). Active management of predators must be considered to maintain these islands as viable nesting areas for Black Ducks and other ground-nesting species including shorebirds, colonial nesting birds and Diamondback Terrapins (*Malaclemys terrapin*).

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