

Status and Population Affiliation of Canada Geese Wintering in North and South Carolina

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Abstract: Numbers of Canada geese (*Branta canadensis*) wintering in North and South Carolina have continued to decline since the mid-1960s. Observations ($N = 2,027$) from 2,563 neckbanded geese, marked during fall and winter 1983-85, indicate that birds from eastern North Carolina are distinct in migration pattern from birds wintering in South Carolina and probably the Piedmont region of North Carolina. Most sightings (85%) of eastern North Carolina birds, reported from outside the state, were from Maryland, Delaware, and Virginia. Geese in these areas are subject to harvest and may represent a component of the population that is weakly philopatric to North Carolina as a wintering site. Within North Carolina, harvest rate indices for the last decade have increased as the population declined. We suggest that geese in South Carolina are affiliated with both the Mid-Atlantic population in the Atlantic flyway and the Tennessee Valley population in the Mississippi flyway, migrating along 2 routes through at least 9 states and a province. Although the hunting season is closed on Canada geese in South Carolina, movement patterns of these birds indicate a high probability of harvest outside the state.

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Changes in the status of Canada geese have occurred over much of North America during the past 25 years. In the Atlantic flyway, numbers of geese have increased substantially while dramatically shifting their winter distribution (Trost and Malecki 1985). Once harboring major flocks, North Carolina (NC), South Carolina (SC), and Florida no longer comprise the primary wintering areas for geese in the flyway. Population declines in these states occurred in the late 1960s (Hankla and Rudolph 1967, Florschutz 1968) when numbers of geese at the Mattamuskeet National Wildlife Refuge (NWR) in NC fell from 135,000 birds in 1959-60 to

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39,700 in 1966–67, and the St. Mark's flock in Florida was reduced from about 25,000–30,000 birds to 6,300. Only SC reported more wintering geese during the 1960s (about 25,000) than were present at any time prior to 1950.

Traditionally referred to as the "South Atlantic" and "Southeast" populations (Hanson and Smith 1950, Hansen and Nelson 1964), little information on the status of southern wintering flocks has been published since the late 1960s. Today, only NC and SC maintain wintering numbers in excess of a few thousand birds. Our objective was to update available information on these populations to allow a more complete look at future options for their management.

We are indebted to state and federal personnel involved in banding geese and observing marked birds. Appreciation is due W. Kendall, S. Sheaffer, and K. Combs for assistance in data compilation and analysis. This work was funded by the U.S. Fish and Wildlife Service (USFWS) Office of Migratory Bird Management in cooperation with the states of New York (NY), Pennsylvania (PA), New Jersey (NJ), Maryland (MD), Delaware (DE), Virginia (VA), NC, and SC and the USFWS Division of Refuges as part of a cooperative study of migration and survival of Canada geese in the Atlantic flyway.

Methods

During October through February 1983–85, 2,563 geese were captured in NC and SC and marked with individually coded yellow neckbands in addition to standard USFWS aluminum legbands. Each neckband was engraved with a black, 4-digit, alpha-numeric code that could be read with a spotting scope from up to 200 m away. Observations were made from October through February 1984–86 by personnel from each of the cooperating agencies. In addition, reports of neckbanded geese were solicited from the general public and other agencies in the United States and Canada.

We tested the null hypothesis that the distribution of observations of geese neckbanded at locations in NC and SC was similar using a non-parametric technique developed by Mardia (1967) (Munro and Kimball 1982) that involves the computation of the centroid or center of gravity for a combined 2-sample distribution. Vectors from the centroid to each observation point (latitude and longitude coordinate) are ranked according to vector direction, and the test statistic calculated using the vector sum. Geese neckbanded in northern states as part of this study but observed at southern banding locations were considered affiliated with these wintering areas and included as part of their banded sample. Only observations unique to each 1-degree block, made prior to 31 January of each year, and reported outside the banding location were used.

To assess the pattern of fall movement of NC and SC geese through the flyway, we divided cooperating states into 3 groups: (1) the Mid-Atlantic Region (NY, PA, and NJ); (2) the Chesapeake Region (DE, MD, and VA); and (3) the Southern Region (NC and SC). We estimated changes in the numbers of neckbanded geese

in these 3 regions at 2-week intervals following procedures described by Jolly (1965) and Seber (1973) (Trost et al. 1981).

Mid-winter inventories and harvest estimates for 1976–86 were obtained from the USFWS Office of Migratory Bird Management, Washington D.C. We derived an index of harvest rate by dividing the harvest estimate by an estimate of the fall flight (i.e., harvest estimate/[harvest estimate + mid-winter population estimate]).

Results

North Carolina

The decline in the number of Canada geese reported for NC in the late 1960s has continued into the 1980s. Mid-winter estimates for 1974–86 (Fig. 1) show a downward trend, with present numbers (about 20,000 geese) the lowest ever documented.

In 1983–85, 1,915 geese were captured and fitted with neckbands. There have been 1,423 observations of 956 individual geese of this group with affiliated eastern NC wintering areas reported from 14 states and 2 provinces (Table 1). The majority of sightings are from geese neckbanded near the Mattamuskeet NWR, and coastal areas of NC where large wintering concentrations occur. A total of 104 observations came from 305 birds neckbanded near the Pee Dee NWR in south-central North Carolina. Thirty-five observations of these birds, reported from areas outside the degree block of banding, showed a strong affinity to the region encompassed by western PA (6), northeastern Ohio (2), eastern Michigan (3), and southern Ontario (7) (Table 1). Another 10 observations came from MD, DE, and VA. These regions apparently serve as stop-over sites during migration. Of neckbanded geese affiliated with banding locations in eastern NC, most sightings (85%) from outside the state came from the MD, DE, and VA region. An additional 10% were reported from NY and PA.

Bi-weekly estimates of neckbanded geese in NC (Fig. 2) provide an index to the proportional distribution of these birds through time as they occur in major

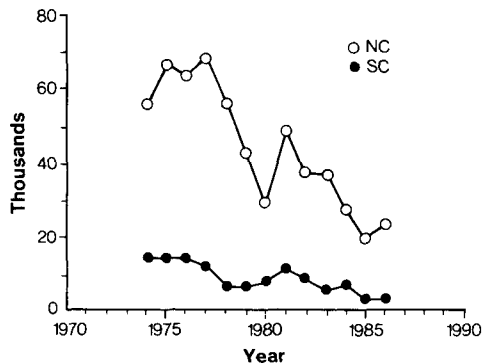


Figure 1. Mid-winter estimates of Canada geese from North and South Carolina, 1974–86.

Table 1. Distribution of observations of neckbanded Canada geese affiliated with wintering areas in North and South Carolina reported during October through January 1984–86.

Location	Wintering areas		
	Eastern North Carolina	North Carolina Piedmont	South Carolina
Atlantic Flyway			
Nova Scotia	3		
Ontario ^a	3		
Connecticut	7		
Massachusetts	2		
New York	54	1	31
Pennsylvania	42	6	26
New Jersey	19		3
Delaware	109	1	17
Maryland	659	5	160
Virginia	60	4	75
North Carolina	443	70	29
South Carolina	2	2	119
Mississippi Flyway			
Ontario ^b	4	7	5
Michigan	1	3	4
Wisconsin	2		1
Ohio	9	2	25
Illinois	1	1	
Iowa	1		
Kentucky			1
Tennessee	2	2	2
Alabama			2
TOTAL	1,423	104	500

^aObservations reported from eastern Ontario.

^bObservations reported west of Toronto.

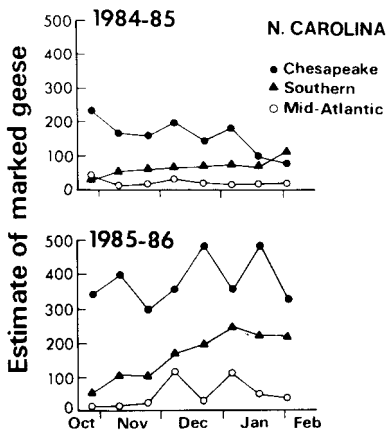


Figure 2. Estimates of the number of North Carolina neckbanded Canada geese present in 3 regions of the Atlantic flyway during 2 week intervals from 21 October to 23 February, 1984–86. Average coefficients of variation were 0.26, 0.07, and 0.09 for the Mid-Atlantic, Chesapeake, and Southern regions, respectively.

regions of the flyway. The sum of neckbanded geese, estimated in these regions, represents the number of individuals from our neckbanded sample that we can account for in any given 2-week interval. The percentage of this sum, in any 1 region, is an estimate of the proportional distribution of this sample in the total area examined. During fall and winter 1984–85 and 1985–86, 9%, 64%, and 27% of our neckbanded sample occurred in the Mid-Atlantic, Chesapeake, and Southern regions, respectively.

In 1984–85, 24 geese were reported in northern states or provinces prior to being observed at wintering areas in NC. Of these, 16 were seen previously in MD, 3 in DE, 2 in NY, 1 in PA, 1 in VA, and 1 each in MD and VA. In 1985–86, 31 geese were observed prior to reaching wintering areas in NC; 21 in MD, 6 in VA, 1 in DE, 1 in PA, and again 1 each in both MD and VA. The mean midpoint date between the last observation in the northern location and the first observation in NC was 27 December (SE = 5.3 days) in 1984–85, and 9 November (SE = 2.5 days) in 1985–86, suggesting a peak movement of geese into the state from northern locations at this time.

The mean midpoint date presented above did not account for geese that migrated directly to NC. Monthly aerial surveys conducted in NC during the past 5 years indicated that 75–80% of the mid-winter population estimate was present by mid-November. This number tends to be relatively stable into February (D. Luszcz, pers. commun.). Few data are available concerning the harvest of NC neckbanded geese, but our estimates of harvest rate (Fig. 3) suggested an increased rate of kill within the state as the population declined.

South Carolina

In SC, mid-winter estimates of wintering Canada geese have declined dramatically over the past 10 years (Fig. 1). During 1983–85, 500 geese were fitted with neckbands on wintering areas in SC; 469 at Santee NWR, and 31 at Carolina Sandhills NWR. Few observations (13) have come from the Carolina Sandhills' neckbanded birds and all were from SC. Of the 500 observations reported for geese affiliated with SC, 74% of those from outside the state came from MD, DE, VA,

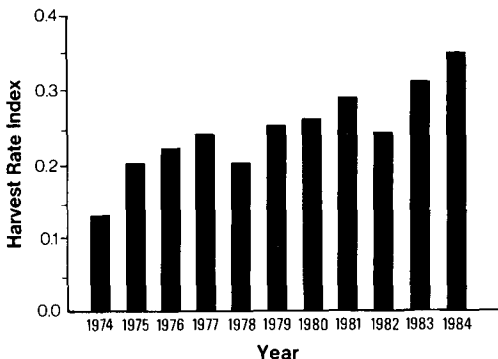


Figure 3. Annual harvest rates for Canada geese in North Carolina, 1974–84. (See text for calculation of harvest rate.)

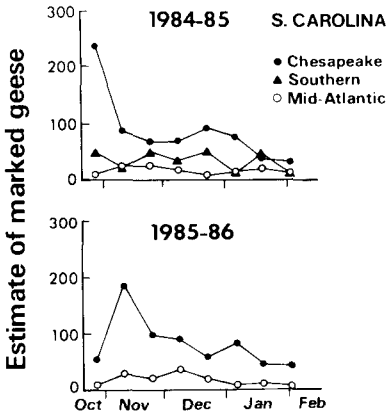


Figure 4. Estimates of the number of South Carolina neckbanded geese present in 3 regions of the Atlantic flyway during 2-week intervals from 21 October to 23 February, 1984–86. Average coefficients of variation were 0.21, 0.18, and 0.23 for the Mid-Atlantic, Chesapeake, and Southern regions, respectively. No estimates are given for the Southern region in 1985–86 due to low reporting rates.

and the coastal area of NC (Table 1). Fifteen percent were from southern Ontario, western PA, northern Ohio, and eastern Michigan.

Our data suggest that 2 possible migration routes exist for SC geese: (1) a fall movement through central NY to MD, then along the coastline from MD south through NC; and (2) a movement west of the Appalachian range through southern Ontario, western PA, northern Ohio, and eastern Michigan.

Bi-weekly estimates of SC neckbanded geese by region within the Atlantic flyway (Fig. 4) indicated that a component of the population remained in the Mid-Atlantic and Chesapeake regions (13% and 62%, respectively) during fall and winter, 1984–86. Limited numbers of observations from outside the Atlantic flyway (i.e., Ohio, Michigan, and Ontario) precluded estimation of the number of marked birds in these areas. Observation dates indicated that geese were present in these areas from mid-September through late-October. Monthly counts of geese at the Santee NWR, for the past 5 years, indicated that peak numbers were not present before January. Goose hunting has been closed in SC since 1984–85.

Population Affiliation

A comparison of the distribution of observations of neckbanded geese in eastern NC and SC indicated that wintering flocks from these states differed ($X^2 = 105.3$, $P < 0.01$). The distribution pattern of observations for geese affiliated with wintering areas in eastern NC was typical of migration areas identified for the Mid-Atlantic population in the Atlantic flyway (Bellrose 1976). Observations for neckbanded geese affiliated with SC wintering areas also showed this pattern but additionally demonstrated a relationship to migration areas associated with the Tennessee Valley population (Bellrose 1976). Evidence for a relationship between the Tennessee Valley population and the formerly recognized "Southwest" population has been demonstrated (Koerner et al. 1974, G. Cummings, unpubl. rep., 1976, Kasul and Wright, unpubl. rep., Miss. Flyway Council, 1984). We suggest that this association, with respect to wintering geese in SC, still exists. Therefore, although

overlap occurred in the movement of geese through the flyway, we regarded these wintering flocks as distinct for management purposes.

The distribution of observations of neckbanded geese in the vicinity of Pee Dee NWR were different from banding locations in both SC and eastern NC ($X^2 = 34.2$ and 30.8 , respectively; $P < 0.01$). However, this difference may reflect the small number of sightings (35) from outside the degree block of banding used in the centroid analysis. Our evidence, to date, suggests that these geese distributed themselves in a pattern similar to that of geese wintering in SC.

Discussion

Winter flocks of Canada geese in NC continue to decline as portions of this population frequent MD, DE, and VA, and harvest rates within NC increase. With a major portion of the mid-winter estimate present in NC by mid-November, one method to improve survival of these birds is to restrict harvest. Southern goose populations in the Mississippi flyway have increased with restrictive harvest regulations or season closure in recent years (D. Orr, USFWS, unpubl. rep.). The extended presence of NC geese, primarily in the Chesapeake Region, indicates additional harvest of these birds. However, our data suggest that a segment of the population frequenting NC in a given year fails to return to this wintering location in succeeding years. More work is needed to identify this group before further recommendations can be made to enhance the survival rate of geese outside NC.

The distribution data for SC Canada geese presents a complex problem with respect to management. At least 9 states and 1 province, within 2 flyways, have a potential impact on this population. Goose hunting is closed in SC, but the majority of sightings (>75%) are from northern locations, and a large proportion of these occur after the opening of northern goose hunting seasons. Although this component of the population is present and available for harvest in 2 flyways, the magnitude of that harvest and where and when it occurs is uncertain. Additional work in documenting harvest rates, band recovery rates, and band reporting rates is needed to assess the proportional distribution and timing of harvest of these birds. Subsequently, steps may be taken to optimize management strategies for their protection.

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