Evaluation of a Tundra Swan Season in North Carolina

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Abstract: In 1984 North Carolina opened the first tundra swan (*Cygnus columbianus*) hunting season in modern times in the Atlantic Flyway. During this first season, 1,000 permits were issued. Subsequently, 6,000 permits/year were allowed and issued. A 4-year study using aerial, ground, and hunter surveys was established in 1984 to monitor this hunting season. Estimated total annual kill beginning with the 1984–85 season was 334, 2,783, 2,579, and 3,007 for each year of the study, respectively. The harvest averaged slightly over 5% of the state's and about 3% of the Flyway's midwinter population. The ratio of permits issued to swans harvested was 2.2, and was comparable to results reported from Utah. Crippling rates ($\bar{x}$ = 11.3) were less in the North Carolina season than those reported elsewhere. Hunter success rates were not related to immature/adult ratios. Hunting under a permit system at current quota levels is not adversely affecting the Eastern population (EP) of tundra swans and probably will not reduce the number of swans wintering in North Carolina.

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In 1984 the U.S. Fish and Wildlife Service (USFWS) authorized an "experimental" season on Tundra swans (*Cygnus columbianus*) in North Carolina. The term "experimental" refers to certain administrative requirements placed upon the participating state by the USFWS in order for the season to be approved. In this case, these requirements included assessing the effects of this "experimental" hunting season annually through population and hunter surveys using methodology outlined in a memorandum of understanding (MOU) between the USFWS and the North Carolina Wildlife Resources Commission (NCWRC).

Populations of tundra swan, formerly known as whistling swan, have been increasing steadily in North America since at least 1948. Two separate populations of

tundra swans are recognized, Eastern and Western, with those wintering in the Atlantic Flyway comprising the Eastern population (EP). Between 1960 and 1964, the EP averaged 56,000 birds. This increased to an average of 89,000 in the most recent 5-year period (1983–87). In 1970–72, only 27% of the EP wintered in the state of North Carolina. By 1982–84 this number had increased to 57% of the population and averaged >45,000 birds annually (Bartonek et al. 1980*a*; F. Ferrigno, unpubl. rep., Atl. Flyway Counc. Tech. Sect., Orlando, Fla., 1987).

The increase in numbers of swans wintering in the Atlantic Flyway and North Carolina in particular, brought demands for more intensive recreational use. Waterfowl hunters noted both continuing increases in swans and declines in duck and goose numbers and requested state and Federal agencies to allow swan hunting. Farmers, alarmed by increased feeding activity in croplands by swans, urged that numbers of these birds be stabilized or reduced. Citing these justifications, the Technical Section of the Atlantic Flyway Council recommended a hunting season on swans in the Atlantic Flyway in 1979. Limited hunting of Western population (WP) swans had been permitted since 1962 in Utah and parts of Nevada and Montana with an annual average harvest of about 1,200 birds (Bartonek et al. 1980*b*). Despite repeated endorsement by the Atlantic Flyway Council, the USFWS was reluctant to approve the hunting of EP swans because of anticipated opposition from the nonhunting public and lack of a management plan.

In 1982, an Ad Hoc Whistling Swan Committee consisting of representatives of the 3 eastern flyways was formed and was charged with development of a management plan for EP whistling (currently tundra) swans. The plan was completed in June 1982, and recommended that the EP be stabilized at 60,000 to 80,000 birds. At that time, the latest 3-year winter average for swans in the Atlantic Flyway was just over 76,000 birds. Hunting of EP tundra swans was permitted in 1983 in Central Flyway states of Montana, South Dakota, and North Dakota. The first hunting for swans in the Atlantic Flyway was authorized for North Carolina in 1984 as a 3-year "experimental" season. In 1984 the State issued 1,000 permits each for 1 swan. Number of permits were increased subsequently to 6,000 in 1985 and 1986. For 1987, the "experimental" period was extended to allow evaluation of the 6,000-permit hunt for a third year. The initial goal was to harvest ≤5% of the most recent 3-year average population in North Carolina based on midwinter survey results. A harvest of 1 swan for every 2 permits issued was anticipated. The season was to run concurrently with the snow goose season (90 days, early November through early January).

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Methods

Hunter Surveys

A hunter questionnaire mail survey, following techniques outlined in the MOU, was used to determine numbers of swans harvested and to obtain information on

hunter effort and performance. Questionnaires were mailed to each permit holder at the end of the 1984–85 season. In other years the questionnaires were mailed with the hunting permit before the season opened. A second mailing of a questionnaire was made to those hunters not returning completed questionnaires within 3 weeks of the last day of the season. Questions included number of days hunted, number of swans harvested, and whether or not the harvested swan was gray or white. Permit holders who reported hunting swans were asked to indicate if they had "knocked down" swans that could not be retrieved. Those answering in the affirmative were then asked to report how many.

Hunters not responding to either mailing of the questionnaire were assumed to be similar to hunters responding to the second mailing. While this technique may not be the best established method to analyze these data, it was considered adequate by the USFWS for making administrative decisions. These estimates for the non-respondents were then added to results reported in both mailings and were presented as the "estimated total."

Informal field contacts were made with a small number of hunters and guides to determine type and location of swan hunting activity. Formal bag checks were not practical because of the length of the swan season and because much of the hunting for swans was incidental to hunting for other waterfowl.

Ground Surveys

A sample of at least 1,000 swans was observed annually to determine age composition. Flocks were selected at random and observed with a spotting scope to determine the proportion of immature (gray) to mature (white) swans. These age ratio surveys began when birds arrived on the wintering grounds and continued into December. Every effort was made to complete the surveys prior to the onset of hunting activity. Surveyed areas included Mattamuskeet, Pungo, Pea Island, and Currituck National Wildlife Refuges and adjacent agricultural fields. Similar surveys were conducted in other wintering states in the Flyway. We believe these surveys were representative of EP age ratios because few of these birds winter outside the Atlantic Flyway.

Aerial Surveys

Aerial surveys were used to estimate numbers and distribution of tundra swans in North Carolina and in the Atlantic Flyway. Survey flights have routinely covered cropland areas since the late 1970s because of extensive use of agricultural areas by feeding swans in North Carolina. Flyway-wide aerial surveys of swans have been limited to 1 flight in mid-November and the mid-winter waterfowl survey in early January. A mid-December flight was added in North Carolina in 1984, and additional flights were conducted in October, late January, and February, during 1985–87.

Results and Discussion

Hunter Surveys

Response to the questionnaire survey was excellent (Table 1) except for 1984–85. Only 43% of the permit holders in 1984–85 returned completed questionnaires. In 1985–86, 1986–87, and 1987–88, however, completed forms were received from 89%, 88%, and 93% of the permit holders, respectively. Reasons for the differences in response rates between 1984 and latter years could have resulted from the addition of a warning on the permit that failure to respond could result in failure to receive a permit the following year. Also questionnaires were mailed at the end of the season the first year, but mailed with the permit at the beginning of the season for latter years. The high response rates for the latter 3 years should tend to reduce the magnitude of the non-response bias.

Eighty-four percent of the permit holders over the 4-year period hunted swans (Table 1). The average number of days that each hunter spent hunting swans increased slightly each year. This may have resulted from increasing wariness of the birds. The swan kill per active hunter in the 1984 season required 3.0 permits to harvest each swan. In the latter years the number of permits issued/swan harvested declined to 2.1, 2.4, and 2.2, respectively.

The North Carolina season was the first large-scale experience of hunting EP tundra swans and some interesting comparisons can be made with the first 3 seasons (1962–64) of WP hunting activity in Utah. The average of 2.4 permits issued for each swan harvested in Utah (J. C. Bartonek, D. Childress, B. Conant, T. H. Pro-

Table 1. Hunter effort and harvest in the North Carolina experimental tundra swan season from hunter questionnaire surveys.

	1984–85	1985–86	1986–87	1987–88
		Effort		
N permits issued	1,000	6,000	6,000	5,968
N respondents	428	5,326	5,258	5,583
Reported hunting	371	4,510	4,340	4,706
Total estimated hunters	867	5,080	4,888	5,014
Total hunter-days	2,523	15,189	14,811	16,847
$\bar{x}$ days hunted	2.91	2.99	3.03	3.36
		Harvest		
Reported retrieved harvest	136	2,362	2,103	2,498
Estimated total retrieved harvest[a]	313	2,523	2,302	2,684
Estimated total kill[b]	334	2,783	2,579	3,007
Harvest/hunter-day	0.12	0.17	0.16	0.16

[a]Corrected for non-response bias by assuming non-respondents have similar responses to those respondents of the second mailing.

[b]Estimated total retrieved harvest plus crippling loss.

van, and T. E. Retterer, unpubl. rep., Pacific Flyway Study Comm., Reno, Nev., 1984) was comparable to the 2.2 in North Carolina. Hunters averaged 10.9 days/harvested swan in Utah during the third year of that state's swan hunt. Approximately 36% fewer days were required in the corresponding season in North Carolina. Tundra swans in Utah were becoming wary after only 1 year of being hunted (A. M. Kinsky, unpubl. rep., Utah Fish and Game Dep., 1964). Utah swans began to abandon all-day movement patterns in favor of 2 daily feeding flights of shorter duration. In contrast, all day feeding and movement of swans in North Carolina continued with no apparent change from previous years.

In 1984–85, the crippling rate was 6.7%. It was computed to be 10.3%, 12.0% and 12.0%, for 1985–86, 1986–87, and 1987–88, respectively. Crippling rate in the first 3 Utah hunting seasons (16 to 26%; J. C. Bartonek, D. Childress, B. Conant, T. H. Provan and T. E. Retterer, unpubl. rep., Reno, Nev., 1984) was nearly twice that in North Carolina. Florschutz (1968) reported a crippling rate for Canada geese at Mattamuskeet NWR of 22.3% in fields and 17.3% in the lake. This is again about twice the 4-year average of 11.3% for swans in North Carolina.

Field contacts revealed that swans were taken while hunting Canada (*Branta canadensis*) or snow geese (*Anser caerulescens*). Little mention was made by hunters of stalking or jump shooting swans. A number of swans were taken over water with decoys incidental to duck hunting. This method was not thought to comprise a large portion of the harvest, however. Most of the swan hunting activity occurred in the agricultural areas adjacent to Lakes Mattamuskeet, Pungo, Phelps, and New Lake in Washington, Hyde, Tyrrell and Beaufort counties. Other significant hunting activity occurred in Bertie, Currituck, Camden, Perquimans, and Pasquotank counties.

Ground Surveys

The age ratio of swans in the North Carolina harvest was lower than that observed in North Carolina or in the Atlantic Flyway populations (Table 2) although

Table 2. Percent immature birds in the "experimental" season harvests and observed ratios in the North Carolina and Atlantic Flyway tundra swan populations, 1981–82 through 1987–88.

Year	Harvest % immature	Observed			
		North Carolina		Atlantic Flyway	
		% immature[a]	*N*	% immature[a]	*N*
1981–82		30.2	1,015	30.2	1,479
1982–83		10.0	3,105	11.4	5,576
1983–84		25.9	2,537	19.8	7,537
1984–85	24.3	17.7	6,915	19.8	8,913
1985–86	28.9	18.2	4,431	23.6	11,395
1986–87	14.8	8.5	7,856	9.2	9,926
1987–88	16.7	10.0	5,843	10.0	8,210

[a]J. Goldsberry, unpubl. rep., Off. Migratory Bird Manage., Laurel, Md., 1987.

no significant differences were observed using a chi-square test ($P = 0.977$). Productivity of EP tundra swans was well above the 11-year average of 14.2% young in 1984 and 1985 and below the average in 1986 (F. Ferrigno, unpubl. rep., Atl. Flyway Counc. Tech. Sect., Orlando, Fla., 1987). During the 3 years prior to the swan season, the observed age ratios in North Carolina tended to be slightly higher than those of the flyway overall, although, again, not significantly different ($P = 0.728$).

Harvest success for Canada geese on the wintering grounds appeared to be related to the number of young produced (V. D. Stotts, unpubl. rep., Can. Goose Manage. Plan, Atl. Flyway Counc., 1983). The success rate on swans in North Carolina did not appear to correspond well with the proportion of immature birds observed in the population. Hunter success remained stable among years (Table 1) despite annual differences in age ratios (Table 2).

Martin (unpubl. rep., Off. Migratory Bird Manage., Laurel, Md., 1964) defined the relative vulnerability of the various age classes of swans to hunting as the age ratio in the bag divided by the population age ratio. Immature swans in North Carolina were twice as likely to be harvested as adults. Using age ratio data provided by Heath (R. G. Heath, unpubl. rep., Utah Dep. Fish and Game, 1963) immature swans in Utah's 1962 season were 3.6 times as likely to be harvested as were adults. No questions were provided in the mail survey which could be used to determine whether North Carolina hunters preferred to harvest either young or adult swans. Informal discussions with hunters in the field indicated that many were looking for a large all-white adult to have mounted. This was especially true in the 1984 season. Some hunters indicated that they were hoping for a "tender" young bird to eat. The tendency for young birds to be bagged was probably more a function of vulnerability to hunting rather than an intentional selection by hunters.

Aerial Surveys

Thirty aerial surveys of swan populations were conducted in North Carolina from the 1981–82 season through 1987–88 (Table 3). Swan numbers in 1981–82

Table 3. Counts of tundra swans in periodic aerial surveys in North Carolina, 1981–82 through 1987–88.

Year	Mid-Nov	Mid-Dec	Early Jan[a]	Late Jan	Mid-Feb
1981–82	9,347	38,459	42,200(58)[b]	NS[c]	55,406
1982–83	33,390	42,897	51,065(59)	55,010	60,519
1983–84	1,563	49,835	44,100(54)	NS	NS
1984–85	92,335	60,500	61,500(65)	NS	NS
1985–86	14,960	53,113	52,505(58)	50,729	40,154
1986–87	51,635	49,949	53,127(56)	44,800	33,544
1987–88	27,908	46,388	46,800(61)[d]	54,046	48,149[d]

[a]Mid-winter survey.
[b]Figures in parenthesis indicate percent of Atlantic Flyway total.
[c]No survey conducted.
[d]Incomplete survey.

and 1982–83 increased steadily through the season and peaked in February. Swan numbers in 1983–84, 1985–86, and 1986–87 typically would peak in late December and early January, declining thereafter. In 1984–85, an unusually strong cold front pushed many swans southward in November resulting in the highest number ever recorded in the state. Numbers of swans declined following passage of the front and were 34% lower by the December survey.

North Carolina has wintered >50% of the Atlantic Flyway population of tundra swans over the last 6 years (Table 3). Estimates of swans wintering in North Carolina in January 1988 were 7% below the 7-year average and 11% above the number recorded in 1982. Flyway estimates in 1988 were 10% below the average and 6% above the 1982 estimate. However, snow cover in important swan wintering areas reduced visibility of birds and may have prevented a complete swan count in 1988.

Swan hunting may have had some effects on numbers (Table 3) and distribution of swans in North Carolina and the Atlantic Flyway; however, this can not be determined from existing data. During the latter 3 years of the hunt, the harvest was slightly over 5% of the mid-winter population of swans and 3% of those counted in the Flyway. Swan populations in the state in 1981–82 and 1982–83 built up steadily until at least mid-February when the last survey flights were made. Following introduction of the hunting seasons, populations were highest from mid-November to early January followed by declines thereafter. Some changes in distribution may have occurred in response to hunting pressure or food availability or a combination of the two.

Conclusions

The results of the "experimental" swan season in North Carolina indicate that hunting under a permit system at current permit quotas is not having an adverse effect on the EP tundra swans. Maintaining the current allocation of 6,000 permits should allow a continued increase in the number of swans wintering in North Carolina. Expanding the harvest to other Flyway states based on permits equal to 10% of the swans wintering there also should allow EP to remain at or above current levels. If a heavier level of harvest is deemed appropriate at some future time, consideration should be given to the effect of additional hunting activity on wariness of swans and the potential for a reduced harvest.

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