

# Wildlife Session

## Differential Winter Distribution of Ross' Geese and Snow Geese in Texas

Douglas N. Harpole,<sup>1</sup> *Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, TX 77843*

Dale E. Gawlik,<sup>2</sup> *Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, TX 77843-2258*

R. Douglas Slack, *Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, TX 77843-2258*

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*Abstract:* Ross' goose and snow goose populations have increased in the last 20 years and now show extensive range overlap. Winter population surveys conducted by state and federal resource agencies in Texas do not distinguish between the 2 species, and their distribution and population trends are assumed to be similar. We examined the relative distributions of Ross' geese and snow geese in the rice-prairie and coastal marsh regions of southeast Texas. Our results indicate that both proportion and abundance of Ross' geese in the rice-prairie have increased in the last 20 years, and that white goose flocks in the coastal marsh region are comprised of relatively fewer Ross' geese than snow geese. We suggest that aerial winter population surveys should incorporate ground surveys to address species-specific differences in distribution.

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Ross' geese (*Chen rossii*) and snow geese (*C. caerulescens*) commonly associate on breeding grounds in arctic Canada (Ryder 1969, Kerbes et al. 1983) and wintering grounds in California, Texas, and Mexico (Prevett and MacInnes 1972, Bellrose 1980:130-132). Breeding populations of both species are reportedly increasing (Ryder 1969, Kerbes et al. 1983), and wintering ranges of the 2 species overlap considerably (Prevett and MacInnes 1972, McLandress 1979, Kraft and Funk 1990). However, coexistence of the 2 species in Texas may be recent; the first Ross' goose was reported in the rice-prairies of southeastern Texas in 1953 (Buller 1955). Snow geese have wintered in the Texas coastal marshes since the early 1900s (McIlhenny 1932). Distribution of geese wintering

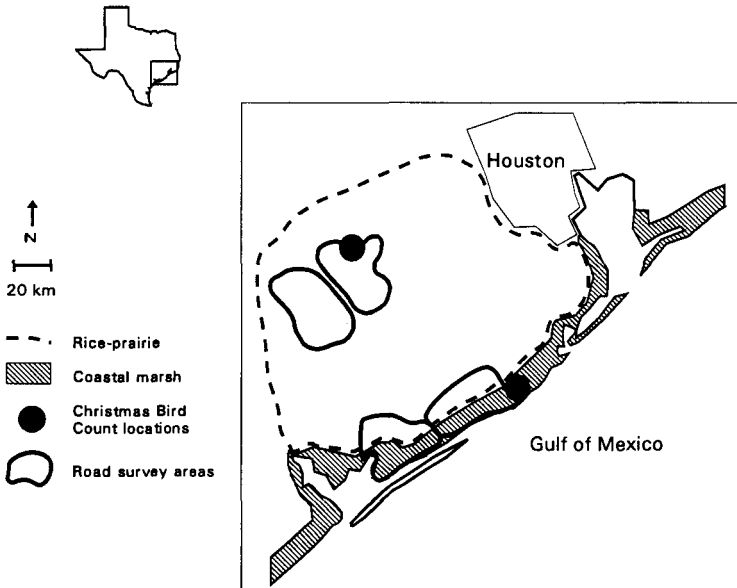
<sup>1</sup> Present address: Department of Fisheries and Wildlife Sciences, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061-0321.

<sup>2</sup> Present address: Everglades Systems Research Division, South Florida, Water Management District, P.O. Box 24680, West Palm Beach, FL 33416-4680.

in Texas changed following World War II when rice agriculture expanded, and large numbers of geese began exploiting this inland food source (Hobaugh 1984, Bateman et al. 1988, Hobaugh et al. 1989). Currently, geese wintering in southeast Texas occur primarily in 2 geographic regions: the coastal marshes and the rice-prairies (Fig. 1) (Bateman et al. 1988, Hobaugh et al. 1989). Collectively, these areas provide habitat for the largest winter concentrations of geese in the central flyway (Hobaugh et al. 1989).

Ross' geese occur most commonly within flocks of snow geese (Bellrose 1980), and goose hunters in the rice-prairie region of Texas reportedly harvested large numbers of Ross' geese during 1988-90 (W. C. Hobaugh, pers. commun.). In contrast, Ross' geese comprised only 0.2% of 3,310 white geese captured at a grit site in the coastal marshes of Texas, during the same period (R. D. Slack, unpubl. data). This evidence suggested that Ross' geese and snow geese may not be distributed throughout their Texas wintering range in the same relative proportions.

Understanding species-specific distribution patterns of geese increases reliability of population estimates. However, winter population surveys currently conducted by the Texas Parks and Wildlife Department and the U.S. Fish and Wildlife Service pool counts of Ross' geese and snow geese (Haskins 1992), thus losing information on distribution and population trends of the 2 species. An analogous problem exists in the Mississippi flyway where subspecies of Canada



**Figure 1.** Geographic regions, locations of Christmas bird counts (CBC), and areas of road surveys of Ross' geese and snow geese in southeast Texas, winter 1991-92.

geese are not differentiated by standard survey techniques; however, harvest information indicates that subspecies differ substantially in their vulnerability to hunting possibly from spacial and temporal segregation (B. D. Sullivan, pers. commun.). Therefore, managers are required to establish harvest strategies for Canada goose management areas without knowing which segments of the population are being impacted most severely.

In the central flyway, where species-specific distribution patterns of Ross' geese and snow geese are currently lacking, Ross' geese are harvested as part of the snow goose bag. In contrast, distribution and abundance information on Ross' geese in California were collected during the mid-1900s to assess their population status (McLandress 1979). Subsequent population estimates provided a basis for differential bag limits on Ross' geese relative to snow geese, thus contributing to an increase in the Ross' goose population (McLandress 1979).

In this study, we analyzed abundance data on Ross' geese and snow geese from 3 independent sources to test the null hypothesis that proportion of Ross' geese in the population of white geese was similar between the rice-prairies and the coastal marshes. Also, we developed a population estimate for Ross' geese in the rice-prairies and compared it to those of earlier studies to assess long-term population changes.

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## Methods

Our study area included coastal marsh and rice-prairie regions of southeast Texas (Fig. 1). Goose habitat in the coastal marsh region consists predominantly of salt marshes, brackish marshes, and row crops (Stutzenbaker and Weller 1989). Rice-prairie region goose habitat is dominated by cultivated rice and pastureland (Hobaugh 1984, Hobaugh et al. 1989).

We examined 3 independent data sets: (1) road observations along survey routes, (2) counts of hunter-harvested birds, and (3) the National Audubon Society Christmas bird count (CBC). Road surveys, our primary data base, were conducted from public roads to provide direct observation of the proportion of Ross' geese in snow goose flocks. Including data from hunter-harvested geese and the CBC allowed us to compare trends among 3 data sets for consistency, thus reducing our chance of basing conclusions on incongruous data.

Two survey routes of approximately 160 km each were chosen within each

region to maximize amount of potential goose habitat adjacent to roads. From November 1991 to February 1992, each route was surveyed from a vehicle 4 times, alternating in sequence between regions. Surveys, which were conducted weekly, began at sunrise and usually were completed by sunset; however, several surveys extended to a second day. All flocks visible from the road were viewed with a spotting scope. When flock visibility was obscured by vegetation, flocks were approached on foot.

Each flock was sampled by counting geese within the field of view of a spotting scope and repeatedly moving the field of view until the entire flock had been scanned (McLandress 1979). We estimated total flock size and counted precisely those individuals positively identified as either Ross' geese or snow geese. For most flocks, number of individuals positively identified as either snow or Ross' geese was less than total flock size. McLandress (1979) suggested that snow geese may be slightly more observable than Ross' geese; however, a sensitivity analysis on our data (J. L. Eltinge and D. S. Jang, unpubl. data) indicated that expected observability differences based on body size did not affect proportion of Ross' geese estimated. Ross' geese were distinguished from snow geese by their more rounded head and shorter bill and neck (Prevett and MacInnes 1972). Hybrids of Ross' geese and snow geese (Trauger et al. 1971) were excluded from counts. Thirteen flocks were excluded from the analysis because interspecific differences could not be discerned, or flocks contained <2 white geese.

We assumed that each flock provided 1 independent sample of the proportion of Ross' geese relative to snow geese. We believe flocks were independent within surveys because flocks were rarely flushed by the observer and therefore were unlikely to be resighted. Flocks were assumed to be independent among surveys within routes, because snow geese do not exhibit regional site fidelity within years (Robertson 1991), and therefore probability of resighting flocks is not affected by repeated visits to an area. Thus, we estimated the proportion of Ross' geese in each region by calculating a mean proportion weighted by flock size (Equation 1).

$$\hat{p} = \frac{\sum(k_i p_i)}{\sum k_i} \quad (1)$$

where:

$$\begin{aligned} k_i &= \text{estimated flock size} \\ p_i &= \text{proportion of Ross' geese observed in flock} \\ &= \frac{\text{number of Ross' geese}}{\text{(number of Ross's geese + number of snow geese)}} \end{aligned} \quad (2)$$

We tested for regional differences in proportion of Ross' geese by constructing 95% confidence intervals around the proportion estimates for each region. Non-overlapping intervals indicate regional differences at  $\alpha = 0.05$ .

We determined proportions of Ross' geese harvested by hunters by examin-

ing geese at 4 commercial goose processing stations within survey areas. Each station was monitored 4 times, and we identified all geese brought in to be processed. Data were collected on the day before or after road surveys. Hunter-harvest data were analyzed using a 1-tailed chi-square test for differences in probabilities based on the standard normal distribution (Conover 1980:144–146). We assumed that each goose brought into check stations represented 1 independent datum. We deemed significance at  $\alpha = 0.05$ . Species membership represented the class variable and geographic region represented the population from which the samples were obtained.

We examined data from the 1991 CBC for each region to determine proportions of Ross' geese observed by participants. We initially intended to analyze CBC data using a chi-square test for differences in probabilities; however, only 1 CBC occurred within each region. This limited spatial coverage precluded formal statistical testing (Bock and Root 1981). Thus, CBC data are presented only for qualitative comparison with other data sets.

**Results**

Based on survey routes, proportion of Ross' geese was higher in the rice-prairies ( $\bar{x} = 0.099$ , 95% CI, 0.088–0.121,  $N = 71$ ) than the coastal marshes ( $\bar{x} = 0.008$ , 95% CI, 0.001–0.016,  $N = 41$ ). Likewise, proportion of Ross' geese seen on the 1991 CBC was higher in the rice-prairies than coastal marshes; however, the estimates for both regions were lower than those of other data sets (Table 1). Proportion of Ross' geese among hunter-harvested birds did not differ between regions ( $X^2 = 1.5$ , 1 df,  $P > 0.05$ ,  $N = 315$ ), but estimates were consistent with trends observed in road surveys (Table 1).

**Discussion and Management Implications**

Greater proportions of Ross' geese in the rice-prairie region than in the coastal marsh region suggest that rice agricultural habitats receive high use by

**Table 1.** Percentages of Ross' geese and snow geese along survey routes, at commercial goose processing stations, and in National Audubon Society Christmas bird counts (CBC) in coastal marsh and rice-prairie regions of Texas, 1991–92.

Region	Survey routes <sup>a</sup>				Hunter-harvest <sup>b</sup>				CBC <sup>b</sup>			
	Snow		Ross'		Snow		Ross'		Snow		Ross'	
	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>	%	<i>N</i>
Prairie	90.1	71	9.9	71	89.2	249	10.8	30	99.6	5,431	0.3	19
Coast	98.2	41	0.9	41	97.2	35	2.8	1	100.0	28,945	0.0	5

<sup>a</sup>Percentages calculated from weighted proportions described in text (Eq. 1); *N* represents number of flocks.

<sup>b</sup>Percentages based on standard calculation (Eq. 2); *N* represents number of individual geese.

Ross' geese wintering in Texas. However, continuing use of these habitats by Ross' geese is uncertain. Landuse patterns of rice agriculture and pastureland in the region are currently determined by compliance requirements associated with government agriculture programs and rising production costs from increased competition for irrigation water (Rister et al. 1989, E. Rister, pers. commun.). In the last 15 years, rice production has decreased in the region by 50%, with land conversion predominately to pasture (U.S. Dep. Commerce 1989). Bateman et al. (1988) indicated that as rice agriculture declines in southeast Texas, loss of habitat could result in both chronological and geographic redistribution of goose populations. This possibility emphasizes the importance of species-specific population estimates for management purposes.

Current surveys of wintering geese in Texas combine counts of Ross' and snow geese due to difficulty in differentiating the species during aerial surveys. In previous studies where population estimates of Ross' geese were conducted, the procedure consisted of applying an estimated proportion of Ross' geese based on ground observations from a sampled area to a larger region (Prett and MacInnes 1972, Kerbes et al. 1983). An implicit assumption was that distribution of Ross' geese was uniform throughout the inhabited regions. Whereas this may be effective in areas with homogeneous habitats and distributions of geese, our data suggest that population samples should be stratified by geographic regions.

From 1968 to 1970, Prett and MacInnes (1972) estimated that Ross' geese increased from 103 to 541 individuals and comprised from 0.1% to 0.3% of all reported snow geese in the rice-prairie region. They calculated their estimates by obtaining a ratio of Ross' geese to snow geese from ground surveys and applying it to the total number of snow geese reported in the mid-winter aerial waterfowl inventory for that region. Prett and MacInnes (1972) accounted for differential distributions of Ross' geese and snow geese among most regions. However, due to the difficulty in approaching flocks, they applied rice-prairie ratios to a portion of the coastal marsh region. Our data indicate that Prett and MacInnes (1972) may have produced biased estimates of the Ross' goose population in the coastal marsh region.

We suggest applying ratios of Ross' geese and snow geese derived from ground surveys to the corresponding aerial surveys within regions of the mid-winter aerial waterfowl inventory. This approach would provide a population estimate of Ross' geese which is currently lacking in Texas, and it enhances and preserves the value of the mid-winter waterfowl inventory as a standardized long-term data base. For example, we applied our estimate of the proportion of Ross' geese based on ground surveys to the 1991-92 mid-winter waterfowl inventory and calculated the population of Ross' geese in the rice-prairies as 27,407. This indicates a 50-fold increase in the Ross' goose population in Texas since the 1970 surveys. In comparison, Ross' goose breeding populations have increased 6-fold from an estimated 34,000 breeding adults in 1965 to 188,000 breeding adults in 1988 (R. H. Kerbes, pers. commun.). Thus, our data indicate

that while both proportion and abundance of Ross' geese in the rice-prairie region of Texas have increased, rate of increase is greater in the Texas population than the total population. This may indicate a shift in Ross' goose wintering populations from traditional wintering grounds in California to southeast Texas.

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