Distribution and Habitat Use of Snow and White-fronted Geese in Arkansas

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Abstract: We used winter aerial survey data to evaluate abundance, distribution, and habitat use of snow (*Chen caerulescens caerulescens*) and white-fronted geese (*Anser albifrons*) wintering in Arkansas' Mississippi Alluvial Valley (MAV). Long-term survey data indicate that numbers of both species have increased more than 10-fold during the past decade, with recent maximum survey counts of 503,000 and 19,000 for snow and white-fronted geese, respectively. During our study (1985–89), snow geese were distributed throughout Arkansas' MAV, but most white-fronted geese were observed in the southern portion of the region. In agricultural settings, 65% and 55% of snow and white-fronted geese, respectively, were observed in harvested rice fields; 28% and 37%, respectively, were observed in harvested soybean fields; and 7% and 8%, respectively, were observed in winter wheat. Harvested rice was the only agricultural habitat that both species used in percentages greater than availability during all years of our study. We believe that the magnitude of rice acreage in Arkansas (>0.4 million ha) will support the continued growth of wintering goose populations if current agricultural policy does not change appreciably.

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Historically, lesser snow and white-fronted geese migrated through Arkansas (Howell 1911) en route to their traditional wintering grounds along the coastal marshes of Louisiana and Texas (McIlhenny 1932). Few birds of either species apparently overwintered in the state. Although little is known from the early 1900s, band recovery data during 1954–71 suggested that Arkansas was east of the main migration corridor for both species (Dzubin 1974).

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The chronology of migration and wintering distribution of mid-continent snow and white-fronted geese began to change in mid-century, probably influenced by the alteration of natural plant communities. Rice grown on lands formerly dominated by prairie grasses was used by snow geese as early as 1920 in Texas (Bateman et al. 1988), although white-fronted and Canada geese (*Branta canadensis*) evidently used rice in Louisiana prior to its use there by snow geese in the late 1940s (Lynch 1975). In the early 1970s, large numbers of snow geese began to spend at least the early part of the winter near the Missouri River (Bellrose 1976:118), where waste corn was used heavily for food (Frederick and Klaas 1982).

Since the late 1970s, Arkansas has experienced a rapid and continuing increase in the number of wintering snow and white-fronted geese (James and Neal 1986, Gamble 1990). Although both species were known to rely on agricultural habitats, little was known about habitat use or population distribution. The objectives of this study were to use operational aerial waterfowl surveys to examine population distribution, to quantify habitat use, and to evaluate crop damage potential.

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Methods

The study area was the Mississippi Alluvial Valley (MAV) of Arkansas (Fig. 1). Approximately ⅓ (3.25 million ha) of the 10-million ha, 800-km long MAV (Reinecke et al. 1989) is in Arkansas. While the study area was originally bottomland

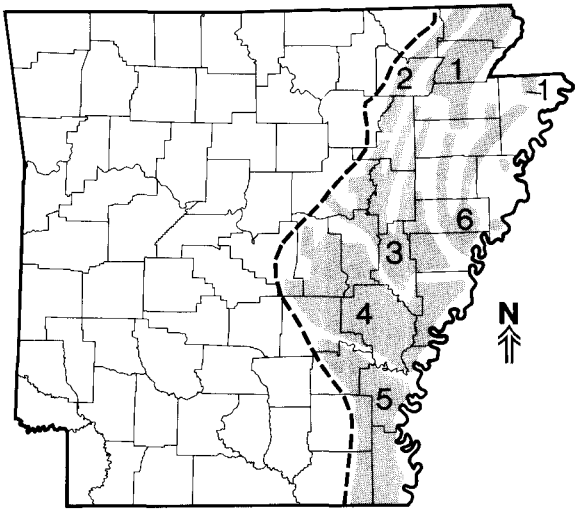

Figure 1. Map of Arkansas showing the western limit of the Mississippi Alluvial Valley (dashed line) and the 6 areas surveyed for snow and white-fronted geese.

hardwood forest (3 million ha), >90% has been cleared for agriculture (MacDonald et al. 1979). Over 2.4 million ha are presently in row crops. Soybeans (>1.2 million ha), rice, and winter wheat (>0.4 million ha each) were the principal crops harvested statewide during our study (Ark. Agric. Stat. Serv., misc. unpubl. rep.). Other major crops included cotton and grain sorghum, with minor acreages devoted to corn and oats. During 1964–88, >85%, >90%, and >95% of Arkansas' winter wheat, soybeans, and rice, respectively, were harvested in the MAV. In 1987, 40% of the rice harvested in the United States was produced in Arkansas (Hobaugh et al. 1989).

Waterfowl surveys have been conducted in Arkansas since 1955 (Gamble 1990). We used these data to evaluate population trends of snow and white-fronted geese in Arkansas and to compare Arkansas' population to mid-continent wintering goose populations. In our study, standard techniques (observations from small fixed-wing aircraft flying <250 m above ground level between 0800 and 1600 hours) were used to survey 109 units in Arkansas' MAV (Fig. 1) over 4 years (1985–86 through 1988–89, variable YEAR). Two trained observers collected data; 1 during 1985–88 and another during 1988–89. We restricted our study to the MAV, because <5% of snow and white-fronted geese were normally observed outside this area. We compiled data for complete surveys (variable SURVEY) in mid-November, mid-December, early January, and late January for all 4 years; in mid-February for 3 years; in early March for 2 years; and for miscellaneous other times in all years. On each survey, the species, location, number of flocks, flock size, habitat type, water condition, and agricultural post-harvest treatment were recorded. Hereafter, flock is defined as any individual aggregation of geese, regardless of size. Location (variable AREA) was assigned to 1 of 6 areas subjectively created by grouping the 109 survey units (Fig. 1) and used in geographic and temporal analyses. Habitat type (variable HABTYPE) was recorded for each flock located in a single habitat and included the following categories: rice, soybean, winter wheat, grain sorghum, set-aside fields, and reservoirs; we also included geese classified as unknown and in-flight as categories of "habitat type." Birds categorized as unknown included flocks that became airborne near the interface of 2 habitat types prior to overflight, flocks in fields tilled so that the former crop was not distinguishable, and flocks for which an observer failed to record habitat data. In agricultural fields, water conditions (variable WATER) were subjectively categorized as dry (including non-continuous sheet water), shallow flooded, deep flooded (>0.5 m estimated), and unknown (through omission). Post-harvest habitat treatment categories included standing stubble, rolled stubble, disced stubble, and unknown.

Habitat use was compared within and between species using Chi-square goodness-of-fit tests (Sokal and Rohlf 1981). Some characteristics of intra-species mean flock size were examined using analysis of variance and Duncan's New Multiple Range Test. A standard habitat-use index (HUI = % use/% available) was calculated to determine the relative preference of snow and white-fronted geese for each agricultural habitat.

Results

Populations

Numbers of snow geese increased >10-fold in Arkansas in the past decade, with 250,000 to 500,000 geese routinely observed during recent surveys (Table 1). Mid-winter survey data indicate that Arkansas' share of the Mississippi Flyway wintering population increased from (<1 % during the early 1970s to approximately 20% during the late 1980s (Gamble 1990). Almost 50% of the increase in overall mid-winter Mississippi Flyway snow goose numbers for the same period resulted from increased Arkansas populations. White-fronted goose numbers increased moderately since 1982–83, with >10,000 geese observed in recent years (Table 1). Mid-winter survey data show that Arkansas' share of Mississippi Flyway white-fronted goose populations increased from <1% to approximately 10% from 1970 to 1988 (Gamble 1990). Overall, approximately 20% of increased Mississippi Flyway populations can be attributed to increased populations in Arkansas, and nearly 80% attributed to increased populations in Louisiana.

Snow geese normally began to arrive in Arkansas in late September, but most did not arrive until after mid-December with peaks in late January (Table 1). White-fronted geese usually were observed in good numbers by mid-December, but peaks normally were in January (Table 1).

Survey data from the 1960s and 1970s suggest that southeast Arkansas (Area 5, Fig. 1) was the first area of the state where snow geese began to winter in significant numbers. In our study, however, we counted 32%, 23%, and 23% of total snow geese in Areas 3, 4, and 5, respectively. Numbers of snow geese

Table 1. Numbers (×1,000) of snow and white-fronted geese observed in Arkansas from 1969 to 1990 during aerial surveys conducted between mid-November and late January.

	Snow geese survey[a]				White-fronted geese survey			
Year	1	2	3	4	1	2	3	4
$\bar{x}$ 1969–79		2.0	6.1			tr.[b]	tr.	
1979–80		21	29			tr.	0.0	
1980–81		5	75			0.1	tr.	
1981–82		37	178			0.4	0.1	
1982–83		75	95			3.0	6.3	
1983–84		89	104			8.1	0.7	
1984–85	29	154	152	97	2.4	5.4	5.6	5.8
1985–86	59	150	189	161	0.9	8.3	14	13
1986–87	76	111	218	249	0.7	5.6	8.1	8.8
1987–88	64	166	60	249	0.8	6.8	3.4	3.7
1988–89	213	272	360	504	3.8	15	15	19
1989–90	191	212	480		3.9	7.9	13	

[a]1 = mid-November, 2 = mid-December, 3 = early January, and 4 = late January.
[b]tr. = <100.

and numbers of flocks observed remained relatively constant from mid-December through late January for Areas 4 and 5 (Fig. 1), but both numbers of snow geese and numbers of flocks in Areas 1, 2, 3, and 6 increased significantly (for flocks, $\chi^2 = 3.14$, 15 df, $P = 0.008$), particularly in late January. Limited February and early March surveys indicated a continuous and more pronounced trend toward increased numbers in northeast Arkansas during all 4 years of study.

Survey data from the 1970s indicate that white-fronted geese also used southeast Arkansas before other areas of Arkansas' MAV. Our data suggested that white-fronted geese still were associated predominantly with Area 5 (39% of total geese observed), although substantial numbers also were observed in Area 4 (29%) and Area 3 (25%). White-fronted goose numbers tended to increase only slightly from mid-December through late January (Table 1), and unlike snow geese, no increase in the number of flocks occurred in any area ($\chi^2 = 5.637$, 15 df, $P = 0.985$).

Mean flock size for snow geese was 4,230 (range: 1,924 in 1985–86 to 9,270 in 1988–89). Mean flock size for white-fronted geese was 369 (range: 251 in 1987–88 to 439 in 1988–89).

Habitat Use

Nineteen percent of 4.7 million snow geese in 1,107 flocks and 30% of 180,000 white-fronted geese in 514 flocks were classified as unknown (Table 2). However, we have no reason to believe that observations in this category would have been

Table 2. Numbers (×1,000) and flock sizes of snow and white-fronted geese observed in various habitats during aerial surveys in Arkansas, 1985–89.

Habitat type	Total geese (% total geese)	Total flocks (% total flocks)	Mean flock size[a]
Snow geese			
Rice	2,176 (46%)	353 (32%)	6,265A
Soybean	924 (20%)	172 (15%)	5,595AB
Wheat	220 (05%)	58 (05%)	3,833BC
Unknown	902 (19%)	320 (29%)	2,120C
Reservoir	133 (03%)	57 (05%)	2,238C
In-flight	292 (06%)	138 (12%)	2,052C
Set-aside	31.5 (01%)	3 (00%)	10,500
Sorghum	4.1 (tr.)[b]	6 (01%)	692
White-fronted geese			
Rice	51 (28%)	145 (28%)	361B
Soybean	34 (19%)	87 (17%)	407B
Wheat	7.5 (04%)	31 (06%)	241B
Unknown	54 (30%)	174 (34%)	292B
Reservoir	22 (12%)	36 (07%)	647A
In-flight	9.6 (05%)	34 (07%)	283B
Set-aside	2.0 (01%)	5 (01%)	404
Sorghum	0.3 (tr.)	2 (tr.)	175

[a]Means with the same letter are not significantly different ($P < 0.05$).
[b]tr. = <1%.

non-randomly distributed among other HABTYPEs. Although many geese were classified in unknown, reservoir, and in-flight categories, 72% of total snow geese and 52% of total white-fronted geese were observed in agricultural fields (Table 2).

Both snow and white-fronted geese were observed in harvested rice fields more than any other kind of agricultural field in all years, except in 1987–88 when slightly more white-fronted geese were observed in soybean fields. Both species were observed in soybean fields in moderate numbers (20% and 19% of total geese, respectively), and observations in winter wheat averaged <10% for all years (Table 2). Grain sorghum and set-aside fields were used by <2% of total geese of either species and are excluded from any further comparisons of habitat use due to small sample sizes. Overall, no difference ($\chi^2 = 2.234$, 2 df, $P = 0.326$) was found between the number of flocks of snow and white-fronted geese using rice, soybean, or winter wheat fields.

The HUI for snow geese averaged 3.0 for rice throughout Arkansas' MAV (range: 2.6 to 3.4 over YEARs, 2.0 to 4.6 over AREAs; Table 3). Winter wheat was the only other agricultural HABTYPE with a HUI > 1 for snow geese, but that occurred in only 1 year (1.1 in 1985–86). The HUI for white-fronted geese averaged 2.5 for rice (range: 1.9 to 3.1 over YEARs, 2.2 to 3.3 over AREAs; Table 3). No other agricultural HABTYPE had a HUI >0.8 during any year for white-fronted geese.

Because harvested rice fields were used heavily by both species of geese, we examined use relative to post-harvest stubble treatment. Fifty-four percent of snow goose flocks were in rolled stubble, 21% were in standing stubble, 15% were in disced fields, and 10% were unknown. For white-fronted geese, the figures were 51%, 18%, 14%, and 17%, respectively. The number of flocks of each species did not differ in their use of different stubble treatments ($\chi^2 = 0.108$, 2 df, $P = 0.947$). We also examined use of rice fields relative to water depth when flocks of geese were observed. Both species were observed predominantly in rice fields that were shallowly flooded (60% and 70% of all flocks overall, respectively), but overall, relatively more flocks of snow geese were observed in dry rice fields ($\chi^2 = 14.678$, 2 df, $P = 0.001$).

Table 3. Habitat use indices (HUI) for agricultural habitats used by lesser snow geese and white-fronted geese in Arkansas' MAV, 1985–86 through 1988–89.

		Snow geese		White-fronted geese	
Habitat type	% of area[a]	% Use[a]	HUI[b]	% Use	HUI
Rice	22%	65%	3.0	55%	2.5
Soybean	56%	28%	0.5	37%	0.6
Wheat	22%	07%	0.3	08%	0.4

[a]Relative to total rice, soybean, and winter wheat habitats only.
[b]HUI = % use/% available.

Harvested soybean fields were used by 28% of all snow geese and 37% of all white-fronted geese in agricultural fields (Table 3). Greater than 90% of the above observations of both species were in soybean stubble, with little use of disced stubble. Snow geese exhibited no preference for dry over shallow-flooded soybean fields (42% to 41%), respectively), but white-fronted geese used shallow-flooded fields more than dry ones (55% to 31%, respectively). When observations for both rice and soybean fields were combined, snow geese used significantly dryer habitats than white-fronted geese ($\chi^2 = 13.565$, 2 df, $P = 0.001$).

Mean flock size of snow geese in different HABTYPEs varied significantly ($F = 13.71$, $P = 0.0001$; Table 2). Although mean flock size for white-fronted geese also varied significantly among habitats ($F = 3.25$, $P = 0.0068$), Duncan's New Multiple Range Test indicated only that flocks on reservoirs were larger than flocks using all other habitats (Table 2).

Discussion

Arkansas's MAV has become a major wintering area for snow geese and has experienced a significant increase in white-fronted geese in recent years. Increased numbers of snow geese also have been recorded for adjacent MAV areas, particularly northeast Louisiana (R. Helm, pers. commun.) and southeast Missouri, mainly late in winter (D. Humburg, pers. commun.). However, there are little data for continental populations or distributions of either snow or white-fronted geese to compare with Arkansas' wintering populations. Limited band return data and available survey data suggest that Arkansas' increasing populations may be a combination of geographic population shifts and increases of continental populations (at least for snow geese). Mid-winter survey data indicate that wintering populations of snow geese along the Missouri River and snow and white-fronted geese in coastal Louisiana are relatively stable, although wintering populations in Texas may be declining. Hobaugh (1984) and Hobaugh et al. (1989) expressed concern for geese wintering in the rice prairie area of coastal Texas due to reductions in available food (mainly rice) during the 1980s. However, no overall reduction of snow and white-fronted goose numbers seems to be occurring in coastal Texas, although the area east of Houston may be wintering fewer geese (R. Jessen, pers. commun.). Whether Arkansas is now wintering portions of this population is unknown; however, neck collaring efforts recently undertaken on arctic breeding grounds of both species may provide information regarding the derivation and migration patterns of geese using Arkansas.

Shallow-flooded rice fields with rolled stubble were used throughout the winter by snow and white-fronted geese in Arkansas more than any other habitat type. Hobaugh (1984, 1985) reported that snow geese in Texas primarily used rice fields, but food availability and food habits studies indicated that geese depleted waste rice by early January, while natural green vegetation was used late in winter. White-fronted geese in Louisiana also were observed mainly in wet rice fields early in winter, but switched to cultivated fields late in winter, presumably to consume green vegetation (Leslie and Chabreck 1984).

Although there are no food habits data for either species in Arkansas, we believe that rice is a major food for snow and white-fronted geese, and that rice may be used later in winter here than in coastal areas. The magnitude of rice acreage in Arkansas, dispersion of that acreage over the MAV, and normal progression of artificial and natural flooding results in the consistent availability of quality habitat for snow and white-fronted geese throughout normal winters. We have documented waste rice availability through at least January in some fields.

Although moderate numbers of snow and white-fronted geese were observed in soybean fields, we are unsure of the value of this habitat type. Snow geese in Texas were observed in soybean fields, but food habits studies indicated little consumption of soybean (Hobaugh 1984, 1985). Migrating snow geese in Nebraska also fed little on soybeans (Frederick and Klaas 1982).

Only minor use of winter wheat was observed for snow or white-fronted geese in Arkansas. Animal Damage Control (USDA-APHIS) personnel in Arkansas have investigated instances of damage to winter wheat by snow geese in recent years. This damage normally has occurred during periods of snow, ice, extreme cold (most often January), or very late in winter (A. Bivings, pers. commun.). However, our limited data for February and early March do not suggest a shift to winter wheat late in winter. In Nebraska, snow geese were frequently observed in winter wheat, but further study revealed that these geese were primarily loafing (Frederick and Klaas 1982). Because winter wheat appears to be of minor importance to snow and white-fronted geese in Arkansas, and because conditions resulting in actual crop damage are uncommon, we expect that instances of crop damage will remain few and site-specific.

Use of soybean and winter wheat fields by snow and white-fronted geese may partially reflect disturbance patterns, although hunting pressure on both species in Arkansas probably is among the lightest of major wintering states. Harvest data indicate that <15,000 snow geese and <1,500 white-fronted geese normally are harvested by 30,000 to 40,000 waterfowl hunters in Arkansas each year. Arkansas waterfowl hunters have a tradition of mallard (*Anas platyrhynchos*) hunting and are responding slowly to liberal hunting opportunities (70 day seasons; 5–7 bird limits during our study) and increasingly abundant snow and white-fronted geese. One reason for this slow response may be that flocks of snow geese usually average several thousand birds in Arkansas. Because these large flocks are inherently difficult to decoy, are widely dispersed, and have good habitat conditions abundantly available, snow goose hunting is difficult in the state, as suggested by low harvest figures for the species. However, shortened duck seasons, increasing goose populations, and some commercial goose hunting has increased hunter interest and activity in snow and white-fronted geese, which hopefully will continue to grow in future years.

The clearing of >90% of the bottomland hardwoods in Arkansas' MAV and conversion of that land to agricultural crops has produced abundant, quality habitat for wintering snow and white-fronted geese. Although the future of continental populations of both species is impossible to predict, it appears that a wintering

habitat base is available in Arkansas to support many more geese than now are using the state.

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