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Low Reproductive Success of Mallards in a Grassland-Dominated Landscape in The Sandhills of Nebraska

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URBAN CANADA GEESE IN GEORGIA: ASSESSING A GOLF COURSE SURVEY AND A NUISANCE RELOCATION PROGRAM

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Abstract: Nuisance complaints about Canada geese (*Branta canadensis*), have risen in recent years. In Georgia, managers have responded by relocating some nuisance geese to rural areas. During 1993–1996, we used band recoveries of relocated geese to determine the efficacy of relocation as a management strategy. We also used data from a post-card survey of golf courses to monitor the urban subpopulation of Canada geese in Georgia during 1998–2001. Flocks considered by golf course superintendents to be a nuisance were larger (1998: 48.8 geese, 1999: 71.5, 2000: 73.2, 2001: 67.2) than nonnuisance flocks (1998: 13.1 geese, 1999: 16.7, 2000: 25.8, 2001: 18.1). In addition, golf courses within 0–40 km of large reservoirs in Georgia were more prone to have geese present during 1998 and 1999. These flocks were larger than flocks at greater distances from reservoirs, and were more likely to be a nuisance. Golf course managers used a variety of techniques in an attempt to reduce the carrying capacity of their golf courses. Relocation of geese appears to be a successful strategy for removing geese from the urban subpopulation to the hunted, non-urban subpopulation, as the average release and recovery locations were 134.8 km and 122.4 km, respectively, from the capture location.

Key words: animal damage management, *Branta canadensis*, Canada geese, Georgia, golf course, mail survey, movement, nuisance, relocation, urban wildlife.

Georgia's resident population of Canada geese has grown substantially during recent years, mirroring similar increases nationwide (Ankney 1996). In the mid-1970s, nuisance geese (mostly *B. c. maxima*) from Pennsylvania and other mid-Atlantic and northeastern states were used to restock the Georgia Canada goose population. Recently, nuisance complaints have increased rapidly (Conover and Chasko 1985), as geese became established in residential or other areas where recreational harvest was not an option. In Georgia, nuisance calls to U.S. Department of Agriculture Animal Plant Health and Inspection Service, Wildlife Services (WS) have increased from 50 in 1994 to 120 in 1999 (D. Hoffman, WS, personal communication), while the Georgia Department of Natural Resources (DNR) received 298 nuisance calls in 1998. Presently, some nuisance geese in Georgia are relocated, but their post-relocation fate is unknown.

Management of the urban portion of Georgia's Canada goose population is difficult as no effective monitoring tool has been available to determine the actual trend in population size and provide feedback to assess results of management strategies. Biologists need a cost-effective monitoring program to provide this critical information in a timely and relevant manner, so that management decisions can be updated.

Georgia's Canada goose population is a resident population, which provides potential for local management strategies to influence local goose populations. Georgia hunters have not recovered any banded, migrant geese during the last 10 years (Georgia DNR, unpublished data). Because no geese from the Atlan-

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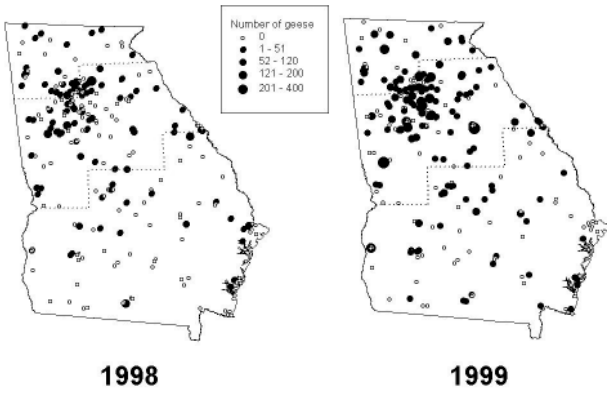

Fig. 1. Locations of golf courses that responded to a mail survey in Georgia during 1998 and 1999. Graduated markers indicate golf courses with geese (●) and those without geese (○). Dotted lines indicate general geographic strata in Georgia. North to south, the strata are Mountain, Piedmont, and Coastal Plain.

tic, North Atlantic, or Southern James Bay populations migrate to Georgia, the U.S. Fish and Wildlife Service has allowed Georgia to harvest geese without concern for migratory seasons.

Our goal was to develop a monitoring program for the urban portion of the resident Canada goose population in Georgia. Our objectives were to (1) design and implement the program, (2) assess trend information, (3) assess variation in nuisance complaints, and (4) determine the efficacy of translocating geese from urban populations as a management tool.

METHODS

Golf Course Survey

In 1998–2001, we mailed out 330 surveys to all golf courses in Georgia that belonged to the Georgia Golf Association. We chose golf courses as an index to nuisance geese because (1) they were geographically distributed across Georgia (Fig. 1), (2) nuisance complaints from golf courses were common, (3) golf courses were usually urban, and (4) addresses of golf courses were available from the Georgia Golf Association. In 1998–1999, survey respondents answered multiple choice and open-ended questions with regard to Canada geese use of a golf course, nuisance problems, control methods used to combat nuisance geese, flock size, and months that geese used a golf course. In 2000–2001, the survey was reduced to 3 questions: presence of geese, flock size, and nuisance problems. We asked superintendents to simply report the size of the largest flock using their courses during the year, as migratory geese were not a potential bias. However, we could not easily validate the superintendents' estimates. We analyzed survey results using frequency tables (SAS Institute 1990) and 95% confidence intervals (CI) around means (Johnson 1999).

During 1998–1999, we used golf course mail-survey responses to address the spatial attributes of nuisance problems from Canada geese in Georgia. Golf course location, goose population size, and nuisance information were compiled into a spatial database that was analyzed using ArcView version 3.2. We asked golf course superintendents whether they considered their flocks to be a nuisance; thereafter, we used the superintendents' responses to identify geese as "nuisance." Spatial coordinates of golf courses were determined from addresses using Street Atlas USA (DeLorme, Yarmouth, Maine). Proximity to large reservoirs in Georgia was determined using buffers placed around a point coverage of Georgia reservoirs (point coverage obtained from Ruddy and Hitt 1990).

Transport of Nuisance Geese

Relocated geese were taken by Wildlife Services and the Georgia Department of Natural Resources to either public Wildlife Management Areas open to hunting, or to private ponds where landowners had requested geese. Potential nuisance sites and present nuisance goose populations were avoided. Molting geese were relocated during June and July at least 160 km (100 miles) from their capture location.

We collected records for Canada geese that were captured, banded, wing-clipped, and released by WS from 1993 through 1996. We selected recovery records of geese that had both been relocated by WS and killed by hunters in Georgia during 1993–1996. We determined latitude and longitude values for the capture, release, and recovery locations of each goose. We defined a successful relocation as one where the goose was not recovered within the 10-minute latitude/longitude block (the smallest resolution of the database) surrounding the capture location.

We compared distances moved between capture and release sites, release and recovery sites, and capture and recovery sites using Mardia's U-statistic to test for differences in the centroid of the distribution of locations for captured, released, and recovered geese (Mardia 1967). Three pair-wise tests were performed using the program CENTROID (J. E. Hines, U.S. Geological Survey, personal communication): capture vs. release sites, capture vs. recovery sites, and release vs. recovery sites. We calculated the distances between the centroids for capture, release, and recovery distributions.

Table 1. Control measures for nuisance geese reported by golf course superintendents in Georgia during 1998 (*n* = 29 courses, 47 reports) and 1999 (*n* = 44 courses, 70 reports). Superintendents could report more than 1 control measure; proportions are from course totals (1998: 29, 1999: 44) and do not add to 100%.

Control measures	Number of reports 1998	1999
Harassment	22 (75.8%)	32 (72.7%)
Dogs	9 (31.0%)	17 (38.6%)
Wire/tape	4 (13.8%)	3 (6.8%)
Decoys	3 (10.3%)	2 (4.5%)
Grape drink	3 (10.3%)	0
Hunting	2 (6.9%)	6 (13.6%)
Chemicals	2 (6.9%)	3 (6.8%)
Natural buffers	1 (3.4%)	1 (2.3%)
Swans/hawks	1 (3.4%)	1 (2.3%)
Trapping/relocation	0	5 (11.4%)

RESULTS

Golf Course Survey

Golf course superintendents returned 152 of 330 (46.1%) surveys in 1998, 177 (53.6%) in 1999, 109 (33.0%) in 2000, and 148 (44.8%) in 2001. During 1998 and 1999, years of the more detailed survey, 94 (28.4%) superintendents returned surveys both years, and 235 (71.2%) returned surveys in either 1998 or 1999. In 1998, 70.4% (*n* = 107) of 152 responding courses reported geese present at least sometime during the year, and 76.7% (135 of 177) reported geese in 1999 (Fig. 1). This statistic continued to rise during 2000 (88 of 109, 80.7%) and 2001 (117 of 148, 79.1%). Of those courses reporting geese, 79.4% (85 of 107) considered them a nuisance in 1998. In 1999, this statistic was 68.8% (93 of 135), compared to 75 of 88 (85.2%) in 2000 and 85 of 117 (72.6%) in 2001. The proportion of courses using control measures to combat or prevent a nuisance problem increased substantially from 33.7% (29 of 86) in 1998 to 50.0% (47 of 94) in 1999. In 1998, goose flocks termed "nuisances" were larger ($\bar{x}$ = 48.8, 95% CI = 39.6–58.0) than nonnuisance flocks ($\bar{x}$ = 13.1, CI = 8.7–17.5). Nuisance flock size grew larger in 1999 ($\bar{x}$ = 71.5, CI = 52.9–90.1), and nonnuisance flocks averaged 16.7 geese (CI = 11.2–27.9). In 2000, average nuisance flock size was 73.2 (CI = 35.1–111.3), and nonnuisance flocks averaged 25.8 geese (CI = 17.7–33.8); in 2001, average nuisance flock size was 67.2 (43.5–90.9), and nonnuisance flocks averaged 18.1 geese (CI = 7.4–28.8). In 1998, the largest flock size reported was 250. The largest flock was 350 in 1999, 500 in 2000, and 200 in 2001.

Golf course superintendents using control measures often listed more than 1 technique. Therefore, in 1998 47 techniques were reported from 29 golf courses. In 1999, 70 techniques were reported from 44 courses. During both years, harassment from humans (including noise bombs, irrigation, slingshots, rock throwing, yelling, and pyrotechnics) and specially trained dogs topped the list of control measures (Table 1). However, in 1999, the number of golf courses that allowed hunting increased from 2 in 1998 to 6, and 5 golf course superintendents reported using trapping and relocation to help alleviate their nuisance problem.

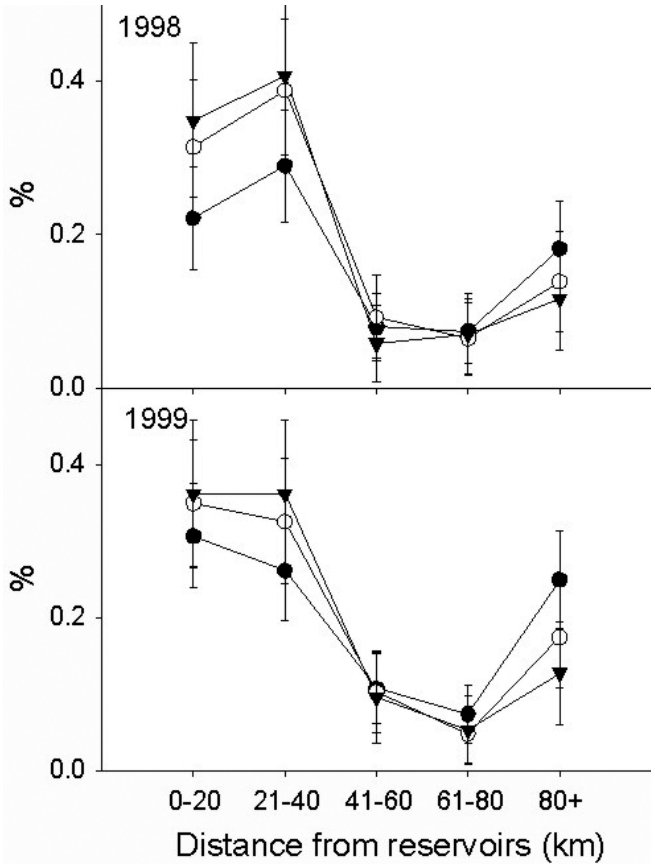

Fig. 2. Proportion of golf courses (●), golf courses with geese (○), and golf courses with nuisance problems (▼) among spatial buffer zones (km) from major reservoirs in Georgia during 1998 and 1999.

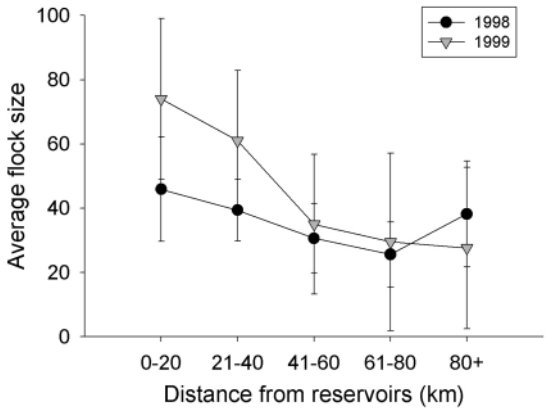

Fig. 3. Average flock size among spatial buffer zones (km) from major reservoirs in Georgia during 1998 and 1999.

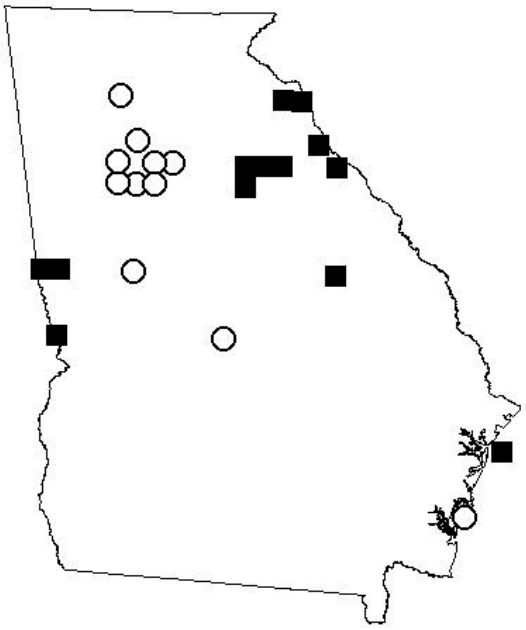

Fig. 4. Capture locations (O) and release locations (■) of nuisance Canada geese during 1993–1996 in Georgia. Locations for capture and release were reported to the Bird Banding Laboratory to nearest degree and minute.

Golf courses within 40 km of large reservoirs in Georgia were more prone to have geese present during 1998 and 1999. Within this distance, geese were more likely to be a nuisance (Fig. 2). Beyond 80 km from large reservoirs, geese were less likely to be present; if present, they were less likely to be a nuisance. The latter is probably directly related to flock sizes. During 1998, average flock size decreased from 45.9 (CI: 29.7–62.1) within 20 km of large reservoirs to 38.2 (CI: 21.7–54.7) beyond 80 km; flock sized decreased from 74.0 (CI: 48.9–99.1) within 20 km to 27.6 (CI: 2.5–52.7) beyond 80 km during 1999 (Fig. 3).

Transporting Nuisance Geese

Wildlife Services captured and relocated 1,282 geese from 1 October 1993 through 30 September 1996 (Fig. 4). Eighty-one of these geese were harvested and reported by hunters in Georgia during the 1994 through 1997 hunting seasons.

The mean distance between capture and release sites (134.8 km, CI = 122.9–146.6) and capture and recovery sites (122.4 km, CI = 108.6–136.2) was not different. The mean distance between release and recovery sites (32.5 km, CI = 0.0–72.3) was less than the mean capture-to-recovery distance and the mean capture-to-release distance. None of the geese in our sample were harvested at the capture location. In addition to the band recoveries, Wildlife Services recaptured 6 geese at their original capture sites during 1993–1996; 5 more geese were re-trapped at a site only 6 miles from their original capture site.

The centroids for the capture and release locations of the transported geese were different ($U = 83.09$, $P < 0.01$; distance between the centroids, 181.8 km). However, there was no difference in the centroids for the capture and recovery locations ($U = 1.15$, $P = 0.56$; distance, 97.6 km). On average, relocated geese were released northeast (centroid: 35°37'N, 83°12'W) of their capture location (centroid: 34°04'N, 83°54'W), and geese were recovered northwest (centroid: 36°28'N, 83°25'W) of their release site. The recovery sites, on average, were still northeast of the original location.

Mean time between banding and recovery was 0.5 yrs (SE = 0.08 yrs). The number of years between banding and recovery ranged from 0 to 3, but 96% of the geese were recovered ≤ 2 hunting seasons from the time of banding.

DISCUSSION

The golf course survey was an inexpensive monitoring tool that provided a large amount of information about a portion of Georgia's goose population that is otherwise very hard to quantify. Urban geese are widespread, but scattered. They are potentially hard to survey with aerial methods. Conover and Chasko (1985) reported widespread nuisance problems on golf courses in the 1980s, except in the southern United States; the high level of nuisance reports in our surveys provides further evidence of a growing southern population of resident Canada geese. The golf course survey remains a part of the Georgia DNR's Canada goose management program.

Current guidelines recommend moving free-flying nuisance Canada geese >300 km from their capture site to prevent them from returning (USDA 1995). Wildlife Services in Georgia wing-clipped (>10 cm from distal end of primaries) the transported geese. The mean distance from our capture sites to release sites was less than half of the recommended distance, yet, no geese were harvested near their capture location. Hunting may be a heavy mortality factor for relocated geese; the mean recovery time was approximately 0.5 yrs after release, and geese may not have had the opportunity to return to their capture site.

In addition to continuing the golf course surveys, we recommend that managers work with private, urban landowners to reduce the attractiveness of their land to the urban goose population (Smith et al. 1999). Relocation is not an option for all nuisance problems, because of resource constraints. Therefore, managers need to concentrate their efforts where they will be most effective. Our results suggest that managers could eliminate many nuisance problems by focusing efforts on urban geese near large lakes, where the largest flocks were reported in our survey. All large reservoirs in Georgia allow hunting in non-urban areas. Golf courses

built on these reservoirs represent the spread of urban development into rural areas of Georgia; more nuisance problems would be expected to occur in these areas because of the indistinct border between urban and rural habitats. Ecological remedies, such as those suggested by Conover (1992), Cooper (1998), and Smith et al. (1999) may have the best long-term results in these areas. At present, relocation appears to be working as a management tool for local sites, and we suggest that managers incorporate as much relocation of urban geese as resources allow.

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