Human–Wildlife Interactions 4(2):207–212, Fall 2010

Nest-site selection and nesting ecology of giant Canada geese in central Tennessee

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Abstract: Little information is available on giant Canada goose (*Branta canadensis maxima*) nest-site selection on isolated nesting ponds. We monitored 46 island and 72 shoreline nests in the Upper Cumberland (UC) region of central Tennessee during 2002 and 2003. We measured 6 habitat variables at nesting ponds and randomly-selected non-nesting ponds. We used logistic regression to determine which habitat variables were important in nest-site selection. Presence of an island was the most important variable, but it was excluded from the final analysis because of quasi-separation (i.e., geese nested on all known islands in the study area). Geese that nested on shorelines generally selected larger ponds that may have offered a larger foraging base and more escape options from predators. Nest success rates were similar for island and shoreline nests. Management actions in the UC region and similar areas should be concentrated on ponds with islands because of higher goose nesting densities and ease in finding nests.

Key words: *Branta canadensis*, Canada goose, human–wildlife conflicts, Tennessee

MOST EARLY EFFORTS to establish populations of giant Canada geese (*Branta canadensis maxima*) were aimed to increase hunting opportunities because of decreasing migratory Canada goose populations, and these efforts were successful. During the 2002 early September goose-hunting season alone, an estimated 31,700 giant Canada geese were harvested in Tennessee, and 300,900 were harvested throughout the Mississippi Flyway (Tennessee Wildlife Resources Agency 2003). However, giant Canada geese cause nuisance problems in localized areas. They often congregate in urban-suburban environments, resulting in complaints about accumulation of fecal material on parks, playgrounds, beaches, golf courses, corporate complexes, and residential lawns (Conover and Chasko 1985, Conover and Kania 1991). In some cases, heavy grazing of cover crops (e.g., rye, wheat) increases soil erosion and decreased crop production (Conover 1988). Collisions with aircraft and possible human health problems (i.e., exposure to pathogens in areas of goose concentration) have led to serious complaints (Bucknall 2004, Converse et al. 2004). In New Jersey, financial loss from human health and safety problems and damage claims associated with Canada geese was estimated to be $10.6 million in 2002 (Bucknall 2004).

This study was conducted in an environment where geese nested primarily on small, isolated ponds. Although several previous studies have described goose nesting characteristics on islands in reservoirs (Giroux 1981, Sovey and Ball 1998, Zenner and LaGrange 1998, Anderson and Combs 2004), few studies have described habitat characteristics of isolated nesting ponds and adjacent land surrounding them. Determination of pond characteristics correlated with nest-site selection is useful in developing management strategies that either promote or deter goose nesting in specific areas. Alterations of ponds may provide long-term effectiveness in controlling nuisance Canada geese in specific locations. Our objectives were to determine nest site characteristics of Upper Cumberland (UC) region of central Tennessee goose flocks, compare these characteristics to non-nest sites, and determine success rates of geese that nested on different pond types.

Study area

We conducted this study primarily in Putnam County, Tennessee, with a few nests

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being located in adjacent areas in White, Jackson, and Overton counties. The study area was comprised of 40% farmland (mostly pastures), 40% forestland, and 20% urban environments (Van West 1998); it was relatively sparsely populated, with 71,160 inhabitants in Putnam County (U.S. Bureau of the Census 2008). National Wetland Inventory (NWI) maps indicated that there were 2,292 ponds in Putnam County, and most of these ponds were <1 ha, but a few were ≥5 ha. Three larger water bodies (14-, 23-, 37-ha) occur within the study area, but nests from these areas were not included in this study because they were not representative of common nesting habitat.

Methods

We located ponds using NWI maps, U.S. Geological Survey topographic maps, aerial photographs, and a motor vehicle survey. We established a 389-km driving route during 2002 to monitor 337 ponds weekly, searching for pairs of Canada geese. We visited sites multiple times throughout the week to determine consistent use by the same pair of geese, as verified by alpha-numeric neck collars that had been used to mark geese in the UC since 1998. In 2003, the route was expanded to 428 km and 390 ponds because we located additional ponds after the first field season. We classified ponds as nesting or non-nesting sites, based on the presence or absence of at least 1 egg in a nest bowl, respectively. We located nests by searching shorelines and islands in areas near sentinel ganders or by directly observing females on nests.

We checked each nest weekly throughout the nesting season to determine its status. Successfully hatched nests were those in which shell fragments and membranes were found in the nest after hatching and direct observations of marked pairs with their broods. We considered other nests unsuccessful. Depredated nests were those that contained broken or damaged eggs and visual signs of nest disturbance; flooded nests were those observed to be inundated with water; and nests destroyed by humans were those in which landowners informed us that they had purposefully removed or destroyed eggs to deter nesting activity. Abandoned nests were those in which eggs did not hatch, but no reason could be determined based on the criteria previously discussed. We determined annual nest site fidelity for marked geese by comparing nest sites between years.

Habitat data collection

We measured 6 variables at nesting ponds and randomly selected non-nesting ponds. Variables included: presence of island(s); perimeter of pond (m); amount of woody vegetation surrounding the perimeter (m); maximum herbaceous vegetation height (cm); amount of emergent vegetation surrounding the perimeter (m); and distance to the next nearest pond (m). We used standard measuring tapes to measure these variables while walking the perimeter and between ponds. We recorded maximum height of the dominant herbaceous plant species at a location 10 m from the shoreline. We measured variables at nesting sites during egg-laying or incubation to ensure that habitat conditions did not change from nest initiation to the time of data collection. We selected and evaluated non-nesting sites during the same period to ensure equal representation of seasonally variable pond characteristics (e.g., herbaceous vegetation).

Habitat analysis

We used logistic regression to determine which habitat variables were important in nest-site selection. We excluded ponds with islands from the final analysis because of quasi-separation (i.e., geese nested on all islands that we located in the study area). The final analysis was an attempt to determine habitat characteristics important for nest-site selection as secondary nest sites (i.e., those used once all available island sites were used). We examined multicollinearity between variables, using the variance inflation factors (VIFs; Kutner et al. 2005), with values >2.5 indicating potential collinearity (Allison 1999). We selected models based on the 95% Wald Confidence Limits (CL) for the odds ratio estimate of the global model (i.e., model containing all predictor variables). Confidence limits that do not include 1 are generally considered meaningful. For habitat analysis, we used individual ponds and not individual nests as the sampling units (i.e., ponds with >1 nest were treated as 1 nest site). We pooled habitat data from 2002 and 2003 for habitat analysis.

Results

Nest-site selection and fidelity

We located 19 island and 37 shoreline nests on 41 different ponds in 2002, and 27 island and 35 shoreline nests on 46 different ponds in 2003. Some ponds supported >1 pair of nesting geese, and some ponds were used in both years. Increased number of island nests in 2003 can be attributed to our greater familiarity with the study area because we located 10 additional islands between field seasons. All shoreline nests were within 5 m of the shoreline, except at 2 locations where landowners kept domestic animals and where there was some evidence of hybridization with domestic geese. When these 2 sites were excluded, geese nested on average 1.6 m from the shoreline ($n = 52$).

We marked >1 member of nesting pairs in 39 cases in 2002 and 49 cases in 2003. Only 37% of marked shoreline nesting pairs and 73% of marked island nesting pairs were known to nest in both years. All marked nesting pairs that we observed in both years (9 island nesters and 10 shoreline nesters) nested at the same location in both years.

Nest fate

Fate was determined for 115 nests in this study. Island and shoreline nest-success rates were similar in 2002 ($\chi^2 = 0.01$, $P = 0.94$) and 2003 ($\chi^2 = 0.07$, $P = 0.79$). Predation rates on islands (5%) were lower than for shoreline nests (18%; $\chi^2 = 4.54$, $P = 0.03$), but other combined causes of failure resulted in similar success rates. One island nest and 1 shoreline nest were flooded during both years. Only 1 nest was known to be destroyed by a landowner. Apparent nest success rates were calculated as 69% in 2002 and 78% in 2003, and these rates did not differ significantly ($\chi^2 = 1.27$, $P = 0.26$).

Habitat analysis

We analyzed pooled habitat data from 143 different ponds (55 nesting and 88 non-nesting sites). Predictor variables were not strongly correlated among themselves (max VIF values <2.5; Kutner et al. 2005). Probability of use increased with wetland perimeter. More specifically, the estimated odds of wetland use increased by 0.5% (95% CL: 0.2–1.0%) with each additional meter of wetland perimeter. Mean perimeter size was 322 m and 192 m for nesting and non-nesting ponds, respectively. No other habitat variable was significant.

Discussion

The importance of islands to nesting geese in the UC region is consistent with other studies (Cooper 1978, Combs et al. 1984, Perkins and Klimstra 1984, Gosser and Conover 1999). Most researchers have concluded that geese prefer island nest sites to reduce depredation risks from mammalian predators. Although depredation rates were greater for shoreline nests in the UC region, similar success rates between island and shoreline nests indicate that nesting on islands does not confer a large advantage.

Based on the high success rates of shoreline nests, a larger number of ponds lacking islands in the UC region should be used by nesting geese. Similar to the Old Hickory Reservoir nesting study (Anderson 1996), only a small percentage of marked nesting geese in the UC region appeared to nest during the subsequent spring, perhaps indicating that some geese may nest only on alternate years. Consequently, it appears that many individuals capable of reproducing in the UC flock are not doing so, perhaps because of a shortage of island nest sites. Although some nests were undoubtedly undiscovered during this study, few broods from unknown nest sites were captured during summer molt drives, indicating that we located most nests. Factors that deter reproductive-age geese from nesting justify additional study.

Nesting on shorelines is probably a learned behavior that provides an alternative when islands are limited. Nest-site selection is highly dependent on success rates from previous nesting attempts (Brakhage 1965, Anderson 1996, Gosser and Conover 1999, site fidelity data from this study), and Canada geese that nest successfully on shorelines are likely to return to the same site in subsequent years, even if islands become available (Gosser and Conover 1999). Geese exhibit elaborate social systems, and immature geese remain with their parents for almost a full year following hatch (e.g., Raveling 1967, 1969; Combs 1989; Christensen et al. 2004), and sometimes longer (Ely 1993, Sykes 1997). It is plausible that young geese learn from their parents that ponds without islands are suitable nesting sites. Dominance relationships, well-known in Canada goose flocks (Raveling 1969, 1970; Hubbard 1976; Christensen et al. 2004), may also influence which geese acquire island nest sites and which geese nest on shorelines.

Large ponds provide more foraging options around the perimeter before and after hatch, perhaps helping to explain why geese preferred large ponds in the UC region. Female geese are unable to complete incubation without replenishing body reserves through short, but intense, daily feeding bouts (Collias and Jahn 1959, Brakhage 1965, Harwood 1977). After hatch, broods in the UC region generally remained in the vicinity of the natal pond (Dunton 2004). Increased foraging opportunities may enhance gosling growth and survival. A large forage base near open water may also help decrease predation risks. Flightless geese generally flee to open water when threatened (Conover and Kania 1991, Gosser and Conover 1999). Escape is more likely at a large pond because the birds can feed closer to the shoreline, and escape options are more diverse (e.g., they can flee directly to the water or along the shoreline).

Recent information, especially what has been disseminated through popular outlets (e.g., newspapers and Internet sites), have indicated that giant Canada geese are increasing at an almost exponential rate, and population control requires drastic measures. Although problems associated with urban environments are well-documented (Smith et al. 1999), these problems often are portrayed as occurring nationwide and in all environments. As a result, many agencies have increased bag limits substantially. However, many of these measures are ineffective because geese that cause problems in urban environments often are different from those that are being harvested by conventional means because of different habitat use patterns (Anderson 1996, Lane 1996, Sykes 1997, White and Combs 2004). Consequently, management at a flock or a subflock level is necessary to ensure that hunting opportunities are not impaired in the effort to reduce problems with nuisance geese.

If population reduction is the objective and hunting alone is not sufficient, egg addling (i.e., shaking or oiling eggs) can be an effective way to control productivity because nesting geese will continue to incubate dead eggs, thereby depleting their body reserves and reducing the chance of renesting (Dow 1943, Kossack 1950, Hanson and Browning 1959, Brakhage 1965). However, this approach is cost effective only when a high percentage of nests is concentrated and can be located easily. During this study, the only pond characteristic that was a strong indicator of goose nesting activity was the presence of islands. Widespread egg addling should be concentrated on island nests.

Herbaceous vegetation that is high and thick on islands may deter goose nesting, especially since geese in the UC region prefer islands and use only shorelines as secondary nesting habitats. Stimulating such vegetation growth may depress population expansion and discourage nesting at sites where landowners find geese objectionable (Smith and Craven 1997). Semi-permanent exclosures around ponds or islands may also deter nesting geese, but this approach will require extensive effort and maintenance, and is feasible only at critical locations (Smith and Craven 1997). Effective ways to manipulate islands to deter geese is likely to be an efficient management tool and deserves additional study.

Acknowledgments

We thank J. Fieberg and J. Giudice of the Minnesota of the Department of Natural Resources for providing assistance habitat analysis. We also thank the private landowners in Putnam County, Tennessee, who allowed us to access their land for this study. Funding for this project was provided by the U.S. Fish and Wildlife Service, Tennessee Wildlife Resources Agency, and Tennessee Technological University.

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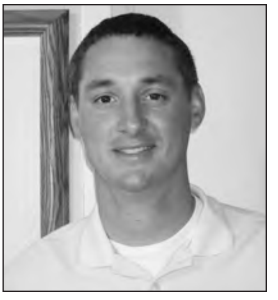

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