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Effect of Artificial Nest Density and Wetland Size on Canada Goose Clutches in Constructed Wetlands near Cave Run Lake, Kentucky

Brian C. Reeder and Teresa L. Caudill

Department of Biological and Environmental Sciences, Morehead State University, Morehead, Kentucky 40351

ABSTRACT

Artificial nesting structures have commonly been used to increase the breeding success of Canada geese, *Branta canadensis*, in wetland habitats. We examined the effects of nest density and wetland size on brood size and hatching success in recently constructed wetlands (mean = 10 years old) near Cave Run Lake, Kentucky. Wetland basins were 0.2–16.1 ha; nest densities ranged from 0.2–7.4 structures per hectare. The average clutch was smaller than most previous researchers have found (3.6). The percentage that hatched (62%) was in the normal range. Density did not affect the number of eggs laid (r^2 = 0.09, P = 0.09, n = 33) or the percentage that hatched (r^2 = 0.07, P = 0.13, n = 33). Larger wetlands had larger clutches (r^2 = 0.13, P = 0.04, n = 33), but the percentage of eggs that hatched was not significantly greater (r^2 = 0.08, P = 0.01, n = 33). We surmised that these young constructed wetlands may not yet be providing sufficient food for egg laying, but that larger wetlands can provide better habitat, even at nest densities up to 7/ha. These constructed wetlands with artificial nests do not provide the same resources and habitat to Canada geese as natural wetlands.

INTRODUCTION

The number of waterfowl is directly related to the amount of suitable wetland habitat in a region (Merendino et al. 1995). Wetland habitat is rare in Daniel Boone National Forest; therefore, 110 wetlands with a combined area of almost 69 ha were constructed by the U.S. Forest Service to enhance populations of wetland flora and fauna. As part of this effort, artificial nesting structures were placed in these wetlands in an attempt to increase breeding success of Canada geese (*Branta canadensis*).

Artificial structures have been found to produce more goslings than natural shoreline nesting sites (Ball 1990). When these nests are placed in wetlands at higher densities than the habitat can support, density dependent theory suggests that some factor should cause population growth to decline. One way birds can accomplish this is to reduce reproductive output—for example by laying fewer eggs or by nest abandonment. High nest densities can result in nest desertion due to aggressive conflicts between neighboring breeding pairs (Ewaschuk and Boag 1972; Lokemoen and Woodward 1992).

The size of the wetland also affects reproductive success. Larger wetlands should have more loafing sites for ganders and more available food. The objective of our research was to determine if nest density and wetland size affect two factors of Canada goose reproductive success: clutch size and the percentage of eggs that hatch.

MATERIALS AND METHODS

The 33 wetlands assessed are located in northeastern Kentucky in Daniel Boone National Forest. The watershed of the study area is dominated by mixed-mesophytic forest in sparsely populated regions of Rowan, Bath, Menifee, and Rowan counties near Cave Run Lake.

All the constructed wetlands were relatively young: some were built 24 years before our study, some less than 2 years (mean = 9.7 ± 8.6; ± SE). The wetlands were built by digging out and sometimes diking suitable sites. All had some water control structure to allow filling and draining. Wetland sizes ranged from 0.2 to 16.2 ha. Most wetlands were 0.4 to 2.4 ha; only three were larger than 3 ha. All the wetlands were roughly rectangular and about 1–2 meters deep. There was little variation in shape or water depth among sites. We assessed 56 artificial nests placed in open water. Artificial nest densities ranged from 0.2 to 7.4 structures/ha (mean = 2.1 ± 1.6). Emergent vegetation never covered more than 30% of any wetland (mean = 6%). The landscape around each basin was similar: forest and open water. The amount of forest directly adjacent

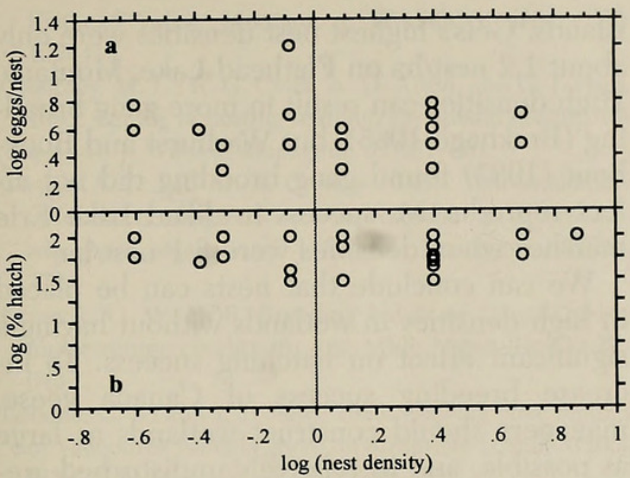

Figure 1. Relationship between artificial nest density (nest/ha) and clutch size (a) and hatching success (b) among Canada geese in constructed wetlands near Cave Run Lake, Kentucky.

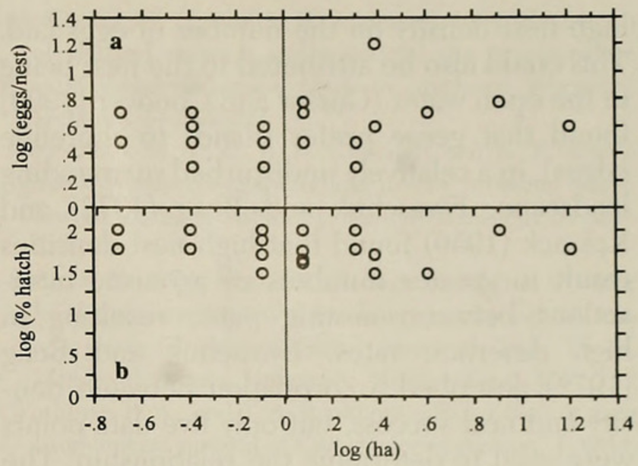

Figure 2. Relationship between wetland size (ha) and clutch size (a) and hatching success (b) among Canada geese in constructed wetlands near Cave Run Lake, Kentucky.

to the wetland had no significant affect on reproductive success.

Field data were collected from 11 Mar–5 May 1996. Each nesting structure was observed, from cover, for 30 minutes at least six times. Clutch counts (number of eggs/nest) were obtained 23–27 Apr 1996; egg survival (percentage of eggs that successfully hatched) was surveyed 17–23 May 1996. Normal biases in calculating egg success (Mayfield 1975) were not applicable because success was not measured as a minimum of one hatch per nest and no nests were abandoned or destroyed.

Because the data included counts, densities, and percentages, they were log transformed to fit the assumptions of parametric statistical models (Zar 1984). Effects of density-dependence and habitat size are usually assumed to be linear (Colinvaux 1993); therefore, we used a simple linear regression model, with nest density and wetland size as independent variables, and eggs/nest and hatching success as dependent variables. Analysis of variance testing was used to determine if regressions were significant (Zar 1984). We chose 95% confidence as our significance limit for all analyses.

RESULTS

All structures studied were used by Canada geese. Out of the 226 eggs laid during the breeding season, 62% produced live goslings. The average clutch had 3.6 ± 2.6 eggs. Two structures were used by more than one mating pair at the same time (gang nesting). No eggs hatched from those nests. All other nests had at least one egg hatch (93.9% nest success).

Geese nesting closer together laid fewer eggs, but the effect of density was insignificant (r^2 = 0.09, P = 0.09, n = 33, Figure 1a). The percentage of eggs that hatched was not significantly influenced by nest density (r^2 = 0.07, P = 0.13, n = 33, Figure 1b). Larger wetlands had larger clutches (r^2 = 0.13, P = 0.04, n = 33, Figure 2a). Larger wetlands also seemed to have a greater chance of having a successful hatch, but the effect was insignificant (r^2 = 0.08, P = 0.10, n = 33, Figure 2b).

DISCUSSION

Our geese laid fewer eggs per nest than most other researchers have found, but our hatching rates are within the range of other studies (3.6 eggs/nest with 63% hatching). Geis (1956) found a mean clutch size of 5.4, with 2.9 eggs hatching (54%). Data summarized by Lebeda and Ratti (1983) indicated an average clutch size of 4.4 and 62% brood success—with 1 or more eggs hatching from 56% of all nests observed. Brakhage (1965) compiled data from previous studies and found an average clutch of 5.1, with 73–93% successfully hatching. Brakhage (1965) studied Canada geese in artificial nests at high densities (about 60 meters between nests). He reported open-water nesters had an average clutch of 5.5 eggs with 72% hatching.

Although our clutches were smaller than normal, we did not find a significant effect of high nest density on the number of eggs laid. This could also be attributed to the nest being in the open water (Gosser and Conover [1999] found that geese prefer islands to shoreline edges), in a relatively undisturbed surrounding landscape. Ewaschuk and Boag (1972) and Kossack (1950) found that high nest densities result in greater numbers of agonistic interactions between nesting pairs, resulting in high desertion rates. Ewaschuk and Boag (1972) described a correlation between density and nest success, but only five data points were used to determine the relationship. The lake island they studied had densities ranging from an extraordinary 20–23 nests/ha (an order of magnitude greater than our average density). They found some of the lowest success rates compared to other studies (averaging 52% of nest hatching one or more eggs), which they attributed mostly to agonistic interactions and predation. Gloutney et al. (1993) found that human disturbance influences nest fate, especially in the early stages of egg laying.

Agonistic interactions, predation, and human disturbance were not significant in our study; no nests were deserted. This was probably because all of our wetlands are in low population areas surrounded by intact forests. Therefore, some other factor must have reduced the brood size. Young geese typically have smaller clutches (Brakhage 1965); so a possible explanation is the geese we examined were younger.

A more plausible explanation is that the geese could not obtain sufficient food (Martin 1987). All wetlands had some forest nearby providing adequate cover, but they may not have had sufficient forage. Dense growth of emergent vegetation can increase nesting success (Ewaschuk and Boag 1972; Poly 1979). Our sites averaged 6% emergent vegetative cover. Recently constructed ecosystems are not providing the functions and values of natural habitats (McKinstry and Anderson 1994; Weller 1990). Further support of this theory is that larger wetlands (presumably with more resources) had larger broods and somewhat higher hatching rates.

We found a significant effect of island size on clutch size. Geis (1956) noted that large islands (>10 ha) had an order of magnitude more nests per unit area than small (<0.5 ha) islands. Geis's highest nest densities were only about 1.2 nest/ha on Flathead Lake, Montana. High densities can result in more gang brooding (Brakhage 1965), but Warhurst and Bookhout (1983) found gang brooding did not affect reproductive success in diked Lake Erie marshes when densities were 3.1 nest/ha.

We can conclude that nests can be placed in high densities in wetlands without having a significant effect on hatching success. To increase breeding success of Canada geese, managers should construct wetlands as large as possible, and in relatively undisturbed areas. Building fewer large wetlands could have a negative effect on biodiversity. Brown and Dinsmore (1986) found that wetland complexes with many small wetlands supported a higher diversity of waterfowl than a single large area. Landscape position should also affect success. Sites with nearby sources of food would be favorable. We did not examine surrounding landscape in detail because of our lack of surrounding land use diversity. We did find it is important to encourage the growth of emergent aquatic macrophytes to provide a suitable habitat and food.

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