The Condor 91:807–812

NEST PROSPECTING BY COMMON GOLDENEYES[1]

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Abstract. We studied nest prospecting by Common Goldeneye (*Bucephala clangula*) females in north-central Minnesota. Adults unsuccessful in nesting, those with broods, and nonnesting yearlings were captured in nests while prospecting. Prospecting began in late May and continued into early July. Active nests received up to 25 prospecting visits per day with most visits occurring between 06:00 and 09:00 CDT. Adults appeared to prospect more ($P < 0.05$) in nest boxes that had contained successful nests during the current season than in those where nests were abandoned or destroyed or those that were unused. Nest-box status had no apparent effect on prospecting by yearlings. Body mass of prospecting adults that were unsuccessful nesters and yearling nonnesters was similar and was significantly less ($P < 0.05$) than that of females still incubating nests or those with broods. Our observations support the claim that prospecting females are preparing for the next breeding season, and we suggest that prospecting is a means of confirming information already gained during the current season. Prior knowledge of successful nest sites could explain the preferential use of previously successful nest boxes observed in a Swedish study.

Key words: Common Goldeneye; Bucephala clangula; *nest prospecting; nest boxes; post-breeding activity.*

INTRODUCTION

Selection of a good nest site is obviously important to successful reproduction, and nest-site searching behavior prior to egg laying has been described for many ducks (e.g., Bennett 1938, Sowls 1955, Mendall 1958, Bellrose 1976). Another form of nest-site examination occurs near the end of the nesting period in hole-nesting *Bucephala* and *Tadorna* species (Bellrose 1976, Patterson and Makepeace 1979, Eadie and Gauthier 1985) and has been labelled "nest prospecting." Eadie and Gauthier (1985) discussed possible information gathered while prospecting, how it might be obtained, and the evolutionary significance of the behavior. They proposed that prospecting helped *Bucephala* females prepare for the next nesting season. By doing so, hens could determine availability and suitability of scarce nest sites and possibly past history of the site. They suggested that hens could obtain information by visits to active nests, by following incubating females to their nests, or perhaps by detecting the presence of shell fragments and membranes in hatched nests. Except for the work of Eadie and Gauthier (1985) and Patterson and Makepeace (1979), virtually no data have been published concerning prospecting behavior in cavity-nesting ducks.

After reviewing 22 years of nesting data, Dow and Fredga (1985) concluded that Common Goldeneye (*B. clangula*) females tended to nest in sites that were occupied in previous years, especially successful sites. The tendency was apparent even after subsequent reuse of a site by the same female was eliminated from their analysis. It was not clear how females were able to choose nests with a past history of success. We hypothesized that females might learn about a site's success during the current nesting season and that prospecting might be a means of confirming this information. If so, then we predicted that more prospecting would occur in successful nests than unsuccessful or unused ones. We report data related to this prediction as well as additional information about the timing of and participation in nest prospecting by Common Goldeneyes.

METHODS

Our study was conducted in north-central Minnesota near the southern edge of the species' range (Bellrose 1976). From 1982–1985, we worked on Island Lake, a 1,250-ha lake having moderate to heavy year-round and summer residential development. From 77 to 90 nest boxes were present along the shoreline, and goldeneyes laid eggs

[1] Received 21 December 1988. Final acceptance 12 June 1989.
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in approximately 70% of the boxes each year. Beginning in April, we inspected nest boxes weekly and recorded nesting activity. When present, females were caught in the box, leg-banded with U.S. Fish and Wildlife Service bands, weighed to the nearest 5 g, and released.

We collected nest prospecting data from 47 nest boxes to which we had easy access. All but two of these nest boxes contained eggs in at least 1 year during 1982–1985. From 13 to 24 June 1984 and 18 to 28 June 1985, we set nest traps (Zicus 1989) in boxes not containing active nests. Traps were set in individual boxes for 3 to 6 days each year and were checked twice daily between 09:00–12:00 and 18:00–21:00 CDT. Nest boxes having traps were classified as (1) successful if a brood had departed, (2) abandoned/destroyed, or (3) unused if no eggs had been laid in the box that season.

Ducks captured while prospecting were weighed, leg-banded if not already banded, and released at the site. Common Goldeneyes do not nest as yearlings, and at least the Juvenal wing is retained into June or even July while the Basic I and Alternate I plumages are being acquired (Palmer 1976, p. 377). Because of these traits, we found Carney's (1983) descriptions contrasting adult and immature wing plumage in fall useful to separate adult and yearling females in spring. Adult females were distinguished from yearlings by the presence of a distinct black band across the end of greater secondary coverts along with several rows of white lesser secondary coverts. These characteristics appeared as two white wing bars, separated by a dark bar, ahead of the white secondaries. In contrast, wing patterns of yearling females appeared as a single grayish-white patch ahead of the white secondaries. Adults and yearlings could also be distinguished in flight by these patterns. Reproductive status of most females we caught was known from our weekly checks of all boxes on the lake. Females were classified as (1) unsuccessful if they had lost a nest through abandonment or predation, (2) with a brood if they had hatched a nest we had been observing or if we observed them rejoin a brood after having been trapped, or (3) yearling nonnesters.

Daily and hourly visitation rates to boxes having active nests were estimated during June and early July for prospecting females using remote recording sensor systems (Cooper and Afton 1981). These devices allowed us to record activity in the nests at all hours. Because the systems simultaneously used an event recorder at the box entrance and a thermistor in the nest bowl, we could distinguish departure and return by incubating females from "visits" by other birds or mammals based on consistent patterns of temperature change recorded on the strip chart. Although we could not be certain that all visits recorded were by prospecting goldeneye hens, we never observed any species other than goldeneyes entering nest boxes at this time of year, and we only once caught a species other than a goldeneye with our traps. Thus, we believe virtually all recorded visits were by prospecting goldeneyes.

Daily capture rates for the three different nest-box classifications were examined using a one-way analysis of variance (ANOVA) after testing for equal variances and normality. Individual means were compared using Fisher's LSD procedure (Milliken and Johnson 1984). The first capture of a bird was used in the analysis, and we performed separate ANOVAs for adults and yearlings. Body mass of all females weighed between 13 and 28 June and having a different reproductive status was also compared using a one-way ANOVA and Fisher's LSD procedure. In addition to those females captured while prospecting, we compared body mass of incubating hens from Island Lake and those accompanying broods and captured by entanglement netting (Johnson 1972) on all area lakes during 1982–1985.

RESULTS

Seventy-four female Common Goldeneyes and one female Hooded Merganser (*Lophodytes cucullatus*) were caught prospecting during 310 trap days. Individual females were captured as many as five times in the same season (Table 1). Thirty of the 44 unsuccessful nesters had been banded as adults prior to the year during which they were caught prospecting and were at least 3 years old. The remainder was captured for the first time during the current nesting season. Five previously banded goldeneye hens had successfully hatched broods in nests we had been observing earlier in the season. We were not certain that these hens still had broods when they were trapped while prospecting. The sixth brood hen was unbanded when caught, but called ducklings from the shoreline vegetation and led them away after being released. Two yearlings had been

TABLE 1. Same-season capture frequency of female Common Goldeneyes trapped prospecting in nest boxes on Island Lake, Minnesota, between 13 June and 28 June, 1984–1985.

Female status	Frequency 1	2	≥3
Unsuccessful nester	28	11	5
Yearling nonnester	16	2	0
With brood	6	0	0
Unknown (adult plumage)	6	0	0

banded as flightless young in the previous year. Unsuccessful nesters tended to be recaptured more frequently than yearlings or brood hens.

Adult females were trapped at different rates in boxes having different classifications ($F = 9.26$; df = 2, 68; $P < 0.001$). The daily capture rate of adult females was higher in successful nest boxes than either those having abandoned/destroyed nests or those that were unused (Table 2). Clutch size in the 14 successful nests ranged from 9 to 19 ($\bar{x} = 13.5$) and was not correlated with adult daily capture rates ($r = -0.01$, df = 12, $P = 0.974$). In contrast to adults, no differences were apparent among nest-classification capture rates ($F = 0.82$; df = 2, 68; $P = 0.45$) for yearlings, and the rate averaged 0.06 birds/day.

Field observations indicated that visits to nest boxes by prospecting females began in late May, when loose flocks comprised primarily of adult females began forming. These flocks of females flew around and vocalized while visiting different nest boxes in a manner similar to that reported and discussed by Eadie and Gauthier (1985, p. 531). Eight nests being incubated by goldeneyes were monitored with recording systems from 2 June to 8 July. Each day, from one to five nests were monitored and a total of 109 complete nest days of data was obtained. From zero to 25 prospecting visits per day (median = 2) occurred in a monitored nest (Fig. 1). Visits to these nests were frequent throughout June, but rates appeared to decline in July (Fig. 2) as unsuccessful females and yearlings left the study area. Incubating females often were present during prospecting visits (Zicus, unpubl. data), and most visits occurred between 06:00 and 09:00 CDT with a smaller peak in the evening (Fig. 3). One nest received 15 prospecting visits between 06:00 and 07:00 during one morning. Sunrise and sunset occurred at about 05:30 and 21:30, respectively, at this time of year. Except for one nest in which the entire clutch of five eggs was infertile, all monitored nests hatched successfully.

TABLE 2. Capture rates (birds/day) of prospecting adult female Common Goldeneyes on Island Lake, Minnesota, 1984–1985.

Nest classification	n	Rate $\bar{x}$[a]	SE
Successful	14	0.41 A	0.06
Abandoned/destroyed	39	0.17 B	0.03
Unused	18	0.12 B	0.04

[a] Means having different letters are different (Fisher's LSD procedure, $P < 0.05$).

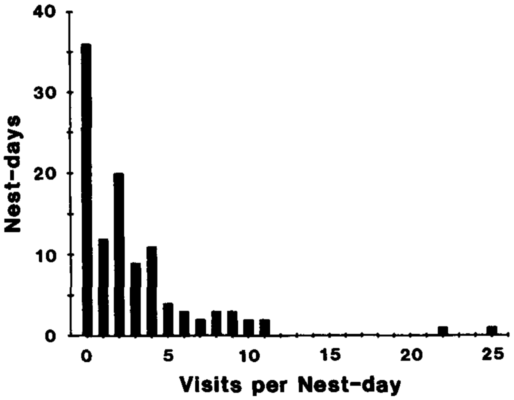

FIGURE 1. Prospecting visits by female Common Goldeneyes on Island Lake, Minnesota, to eight active Common Goldeneye nests monitored for a total of 109 complete nest days, 1984–1985.

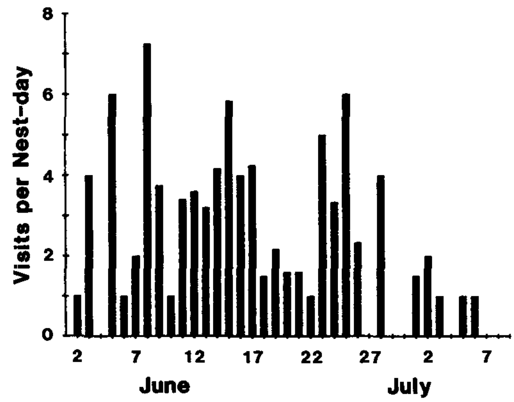

FIGURE 2. Average daily visitation by prospecting female Common Goldeneyes on Island Lake, Minnesota, to eight active Common Goldeneye nests. From one to five nests were monitored daily 2 June to 8 July, 1984–1985.

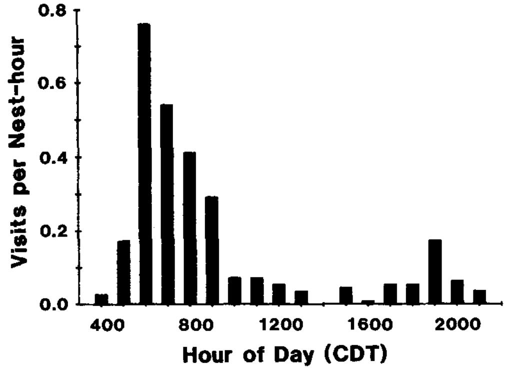

FIGURE 3. Average hourly visitation by prospecting female Common Goldeneyes on Island Lake, Minnesota, to eight active Common Goldeneye nests monitored for a total of 109 complete nest days, 1984–1985.

TABLE 3. Body mass (g) of female Common Goldeneyes trapped on Island Lake, Minnesota, between 13 and 28 June, 1984–1985.

Female status	n	Mass $\bar{x}$[d]	Mass SE
Incubating[a]	19	659.7 A	6.6
Unsuccessful nester	44	577.4 B	3.1
Yearling nonnester	18	580.8 B	5.5
With brood[b]	6	613.3 C	13.3
With brood[c]	12	612.5 C	10.8

[a] Trapped 1 to 22 days before hatching (median = 4 days).
[b] Trapped while prospecting.
[c] Also includes females trapped by entanglement netting on several other nearby area lakes, 1982–1985.
[d] Means having different letters are different (Fisher's LSD procedure $P < 0.05$).

Body mass of females trapped between 13 and 28 June varied with their reproductive status ($F = 37.26$; df = 4, 94; $P < 0.001$). Prospecting unsuccessful nesters and yearlings were lightest, whereas females trapped late in incubation were heaviest (Table 3). Females that we believed had broods and that we retrapped while prospecting did not differ in weight from those captured with broods by entanglement netting on several nearby area lakes.

DISCUSSION

Results of our study should be interpreted cautiously. Females often, but not always, prospected in flocks, and we frequently observed different individuals inspecting the same nest box one after another. As evidenced by the active nests we monitored, some boxes were visited by prospecting hens many times in one day. Occasionally, we observed two females occupy a box simultaneously. With the trapping method we used, a maximum of two birds per nest box could be caught each day. Once a hen was trapped in a particular nest, the box was no longer available for inspection by other females until we removed the bird and reset the trap. Because of this limitation, capture of adult and yearling females or those having a different reproductive status cannot be considered independent events. We also do not know how unavailability of certain nest sites for part of the day might have changed the attractiveness of those remaining available for prospecting. Certainly, the temporary elimination of the nest box prevented other females from inspecting what might otherwise have been a very attractive site.

Adult Common Goldeneye hens appeared to prospect more in nest boxes that had successful nests during the current year than in those that did not. We believe this selection would be unlikely if prospecting was the only means a female had to obtain information about a nest site. More likely, prospecting females were searching for potential future nest sites and at the same time confirming information about current nest use by other females already gained during the nesting season. Apparently, this information is not acquired early in the season because adult capture rates were not higher in successful nests that had been parasitized during laying, and abandoned nests often had large clutches (i.e., >15 eggs) but low capture rates. These nests, used by several females, would have received much activity early in the season. If this activity was the source of information for prospecting females, it should have influenced capture rates.

Our observations support the belief that prospecting females are preparing for the next nesting season (Grenquist 1963, Eadie and Gauthier 1985), and may explain why Dow and Fredga (1985) observed a tendency for females to nest in boxes that had been used the previous year. Subsequent use was evident even when reuse of the same nest by the same female was eliminated from their analysis; use was especially high for boxes having successful nests the previous year. Predation was a significant factor, and Dow and Fredga (1985) believed that females nesting in previously successful nest sites benefited because they were less likely to lose nests to predation. They also speculated that females might recognize these sites through "familiarity" with the area.

The status of a nest box apparently did not influence the daily capture rate of yearlings. If this contrast with adults is real, and not an artifact of our trapping, it further supports our suppositions about how information is obtained and about the function of prospecting. We suspect that prospecting adults become aware of the status of a particular site by observing the activities of other females at the site throughout the season. Most season-long activity would occur at sites having active or successful nests, thus more prospecting would be expected at these sites if females were able to differentiate boxes receiving much use from those receiving little or no use. We did not observe yearling goldeneyes in our study area until the end of May when prospecting was beginning. Unlike adults that had been residing on the lake all spring, yearlings would have no way of knowing, except by association with adults, of past activity indicative of the status of different nest boxes. However, some other mechanism might be operating, and we cannot rule out the possibility that adult females prospect more than yearlings and that capture of adults in successful nest boxes precluded a higher yearling capture rate than we observed.

Prospecting dates and the actual rates will likely vary among lakes and years depending on geographic location, numbers of breeding females, potential nest sites available, and current nesting success. Perhaps because of a more southerly latitude, prospecting began at an earlier date in our study than in British Columbia (Eadie and Gauthier 1985). However, we observed similar morning and evening peaks in activity. Unlike Eadie and Gauthier (1985), we caught at least one prospecting female that had a brood. We also observed goldeneye females leave broods and enter nest boxes (Zicus, unpubl. data). Our data suggest that unsuccessful hens may prospect the most, but that prospecting by brood hens is more common than Eadie and Gauthier (1985) concluded. They reasoned that brood hens had no need to prospect because of the tendency for successful goldeneye females to subsequently nest in the same site (Johnson 1967, Eriksson 1979, Dow and Fredga 1983). We believe females with broods would also profit from nest prospecting because of the probable loss of some cavity trees from year to year. Prospecting by brood hens may be less frequent because of the need to balance time spent prospecting with that spent caring for broods. However, knowledge of the location and suitability of potential nest sites would be an obvious advantage to all females nesting in an environment where the existence or condition of nest sites might change yearly.

Unsuccessful females caught prospecting in our study had body masses nearly identical to that of prospecting yearlings and to those reported for all prospecting females by Eadie and Gauthier (1985). In contrast, incubating females and hens with broods weighed during the same period were significantly heavier than prospecting females. We do not know if body condition contributed in any way to loss of nests or whether lower body mass was the result of increased activity, particularly flight, while prospecting. We suspect that prospecting may subject females to greater energy demands than those faced by incubating hens or those rearing broods because many unsuccessful females had body masses similar to those of successful hens when weighed earlier in the year (Zicus, unpubl. data).

Eadie and Gauthier (1985, p. 533) suggested that nest prospecting and delayed maturity were traits that evolved in relation to the scarcity of nest sites used by North American cavity-nesting ducks. Finding suitable cavities is likely a function of: (1) cavity abundance, (2) ease with which cavities are found, and (3) time available to search for nests. Besides the *Bucephala* species, nest prospecting has been reported in Hooded Mergansers (L. Fredrickson in Bellrose 1976, p. 444, this study), but prevalence of the behavior is unknown. Prospecting by Common Mergansers is also problematic; Bellrose (1976, p. 444) mentioned it as being "noticed once." The behavior has not been described in Wood Ducks (*Aix sponsa*) or Black-bellied Whistling-Ducks (*Dendrocygna autumnalis*), which are species that nest as yearlings. Prior knowledge of nesting sites would be an obvious benefit in short, northern nesting seasons. Thus, prospecting might be more common in species having a northern distribution. Common Mergansers (*Mergus merganser*) have delayed maturity, a more northerly nesting distribution than Wood Ducks and whistling ducks, and nest both on the ground and in cavities. Because Common Mergansers are not obligate cavity nesters, prospecting may be less prevalent in this species. In comparison, Hooded Mergansers have delayed maturity but a wide distribution. Determination of the extent of prospecting by both mergansers as well as investigations into the energy costs of all post-breeding activities in prospecting species might further advance our understanding of the evolutionary significance of the behavior.

ACKNOWLEDGMENTS

We thank personnel of the Chippewa National Forest Blackduck District and many private land owners on Island Lake for permission to work with their waterfowl nest boxes. We acknowledge the help of numerous individuals employed as summer duck banders by the Wetland Wildlife Populations and Research Group for weighing brood hens while entanglement trapping. R. M. Pace, III, S. J. Maxson, R. E. Lake, J. W. Barrett, and J. McA. Eadie made helpful comments on the study and manuscript. L. N. Hamilton typed several revisions of the manuscript.

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