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Effects of Nest-Box Visibility and Clustering on Wood Duck Brood Parasitism in Illinois

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ABSTRACT

We studied the effects of nest box visibility and clustering on the frequency of intraspecific brood parasitism (IBP) in wood ducks (*Aix sponsa*) at Lake Shelbyville Fish and Wildlife Area (LSFWA) in Moultrie County, IL from 2 March - 22 June 1992. Sixty-eight percent of the 68 nest boxes were used, and IBP was documented in 54% of the active wood duck nests. Mean clutch size of parasitized nests was greater ($\bar{x}$ = 15.3 eggs, SE = 1.10, n = 21) than unparasitized nests ($\bar{x}$ = 9.2 eggs, SE = 0.59, n = 18). Neither nest box visibility nor clustering significantly affected the rate of IBP. However, more visible boxes tended to be parasitized at a higher rate than less visible boxes. Eggs in unparasitized nests were more likely to hatch (91%) than those in parasitized nests (73%). A clutch size criterion of >11 eggs gave the best estimate of the percentage of parasitized nests (49% a 5% underestimate), and correctly classified 77% of the nests.

INTRODUCTION

Nest box programs for wood ducks often encourage artificial conditions such as clumped dispersion, high visibility, and high densities of nest sites (Haramis 1990). Such conditions can increase nest predation rates (Bellrose et al. 1964, Leopold 1951, Haramis and Thompson 1985) and increase intraspecific strife between female wood ducks leading to an increased frequency of nest abandonment (Bellrose and Holm 1994, Haramis and Thompson 1985, Clawson 1975, Jones and Leopold 1967). In addition, decreased hatchability of eggs can result from ineffective incubation of large clutches due to high levels of intraspecific brood parasitism (IBP) (Semel et al. 1988).

An estimated 100,000 nest boxes have been erected to enhance wood duck production in North America and these boxes annually contribute approximately 150,000 young to the fall population east of the Great Plains (Bellrose 1990). However, many nest box programs were established using management recommendations that create semicolonial nesting conditions (Bellrose et al. 1964) which may negatively influence nesting wood ducks (Semel and Sherman 1986). Semel et al. (1988) investigated the effects of nest box placement on the rate of brood parasitism in wood ducks and found highly visible and clumped nest boxes have increased IBP rates. This prompted us to assess a nest box

program at LSFWA for the effects of nest box visibility and clustering on the rate of IBP. We also determined the optimum clutch-size criterion, as investigated by Semel and Sherman (1992), to ascertain IBP.

STUDY AREA AND METHODS

This study was conducted at LSFWA which consists of 2 management units; the 1093 ha West Okaw Unit located 1.9 km southeast of Bethany and the 1497-ha Kaskaskia Unit located 2.5 km southeast of Sullivan. Overall, LSFWA consists of 1234 ha of shrub habitat, 809 ha of woodlands, and 526 ha of cropland (P. Brewer, Ill. Dept. Nat. Resour., pers. commun.). Approximately 125 nest boxes have been erected since 1974 to facilitate wood duck nesting. Both areas are managed by the Illinois Department of Natural Resources in conjunction with the U.S. Army Corps of Engineers.

Nest Box Monitoring

Fifty-three nest boxes were checked between 0900 and 1330 hours every other day (Breckenridge 1956) from 2 March to 22 June 1992. On 10 April, we began checking an additional 15 boxes for a total of 68 boxes. Nest boxes consisted of 56 metal, nine plastic (Ducks Unlimited), and three wooden. Boxes were checked by inserting a mirror into the entrance and reflecting light from a flashlight into the nest box. This procedure allowed detection of a female on the nest with minimal disturbance. All eggs were uniquely marked with a permanent marker while the hen was absent. Once incubation began, boxes were not checked again until two to three days after hatching to evaluate the number of eggs hatched (based on the number of membranes, caps, and dead ducklings; Semel et al. 1988). We considered nests that acquired ≤ 1 egg/day to be unparasitized and those nests gaining ≥ 2 eggs/day to be parasitized. The presence of non-term embryos after hatching also indicated a parasitized nest. Drop nests were defined as nests with 1-6 eggs that were not covered or incubated (Morse and Wight 1969). These nest were eliminated from further data analysis. Successful nests were defined as those in which at least one egg hatched. Hatchability was defined as the total number of ducklings leaving the nest divided by the total number of eggs laid (Semel et al. 1988).

Nest Box Characteristics and Data Analysis

Nest box visibility was determined prior to the budding of trees (6 March 1992) to approximate the time when most female wood ducks select nest sites. Visibility readings were taken at 30, 40, and 50 meters from (1) the front of the box, (2) both sides of the box, and (3) the direction of the nearest body of water (the presumed flyway for females searching for nest sites). Box visibility was estimated using the following classification scheme: 0 = box completely visible, 1 = less than half of box visibly obstructed, and 2 = greater than half of the box obstructed, and 3 = completely hidden nest box.

Distances were measured between each nest box used by a hen wood duck and (1) the nearest nest box used by another wood duck, (2) the nearest parasitized nest box, (3) the nearest nest box (whether used or not), and (4) the nearest body of water.

Parasitized and unparasitized nests were compared to clutch sizes of >10 to >15 eggs/nest to determine which clutch size criterion most closely estimated the observed IBP rate based on the rate of egg deposition. Mann-Whitney U-tests, Analysis of Variance, and

Student's t-tests were performed using the Statistical Analysis System (SAS Inst. Inc. 1988).

RESULTS

Nest Box Use and Egg Hatchability

A total of 46 (68%) wood duck nests were initiated from the 68 boxes that were monitored. Three nests were deleted because they were drop nests and four others were deleted because of incomplete laying chronologies; thus, thirty-nine of these 46 nests were used in subsequent data analysis. Twenty-one nests (54%) were parasitized and 18 (46%) were unparasitized. Hatchability was greater ($X^2 = 11.9$, df = 1, $P < 0.01$) for eggs in unparasitized nests (91%) than for parasitized nests (73%) (Table 1). The average clutch size in parasitized nests ($\bar{x} = 15.3$, SE = 1.10, n = 21) was greater (t = 3.39, df = 37, $P < 0.01$) than that of unparasitized nests ($\bar{x} = 9.2$, SE = 0.59, n = 18).

Nest Box Visibility and Clustering

Visibility indices from the nearest body of water comparing parasitized and unparasitized nests were not significant (Mann-Whitney U-tests, $P > 0.10$ for all tests). However, the mean visibility index at 40 meters for unparasitized nests ($\bar{x} = 1.2$) was twice that for parasitized nests ($\bar{x} = 0.6$, $P = 0.10$), suggesting that more visible boxes were more likely to be parasitized. Visibility variables from the fronts of the boxes had less relationship to the rate of nest parasitism (Mann-Whitney U-tests, $P > 0.25$ for all tests).

Distances to the nearest box, nearest used box, nearest parasitized box, and to the nearest body of water all had no significant effect on the rate of nest parasitism (Mann-Whitney U-tests, $P > 0.16$ for all tests). In fact mean interbox distances for parasitized nests were actually greater than those for unparasitized boxes (Jansen 1993).

Clutch Size Criterion

Thirty-nine of 46 nests were used in determining a clutch size criterion useful for distinguishing parasitized from unparasitized nests. Seventeen (81%) of the 21 parasitized nests acquired no more than 2 eggs/day with a mean clutch size of 14.8 eggs (SE = 3.57). Four (19%) parasitized nests gained a maximum of 3 eggs/day and had a mean clutch size of 17.5 eggs (SE = 5.80). The observed parasitism rate in our study was 54%. Using clutch size criteria similar to Semel and Sherman (1992), we estimated parasitism rates of 62% using > 10 eggs as the cut-off for IBP, 49% for >11 eggs, 44% for >12 eggs, 38% for >13 eggs, 33% for >14 eggs and 23% using >15 eggs. Thus, all clutch sizes, except >10 eggs, underestimated the observed parasitism rate. However, >11 eggs most closely estimated the parasitism rate determined by nest checks.

DISCUSSION

Current Status of Nesting

Typically, the incidence of IBP increases as the population density of wood ducks increases, leading to a decrease in egg hatchability (Haramis and Thompson 1985, Semel et al. 1988). For example, Haramis and Thompson (1985) had a parasitism rate of only 14% and nesting efficiency (ducklings exiting nests/total eggs laid) of 79% for wood ducks in a greentree impoundment when only 44% of the boxes were being used. Such

low parasitism rates and high hatchabilities are indicative of low population densities. However, four years after nest boxes were erected the parasitism rate increased to 65%, nesting efficiency decreased to 22%, and box occupancy increased to 94% (Haramis and Thompson 1985). Data from our study support this general pattern of relatively low wood duck densities (68% box usage) coupled with high hatchability of eggs (79%). We can not explain why occupancy rates have remained low at our study site. Perhaps nest predation may keep wood duck densities low although our predation rates were similar to those found by Miller (1952). Bellrose and Holm (1994) indicate a greater proportion of wood ducks in a local breeding population may nest in natural cavities and only a few in boxes. The low occupancy rate may be the result of sufficient natural cavities, however, natural cavity density is unknown at LSFWA.

Visibility

Our results are somewhat consistent with others who have found that well hidden nest boxes experience less IBP than highly visible boxes. Studies by Keran (1978) and Lacki et al. (1987) have cited the importance of nest box placement near water to maximize use by wood ducks. Other studies (Robinson 1958, Morse et al. 1969, Semel and Sherman 1986, and Semel et al. 1988) have revealed that highly visible nest boxes over water have higher IBP and larger clutches than less visible boxes. Parasitism may be prevalent in more visible boxes because of the ease with which the nest box is found by female wood ducks. McLaughlin and Grice (1952) also found that visible nest boxes located over water had mean clutch sizes of 13.1, whereas, nest boxes located over land had a mean clutch size of 10.6. However, the frequency of brood parasitism was only having a minor negative effect on the nest box program at LSFWA despite its long-term history. Parasitized nests were actually hatching more eggs (11.1) than unparasitized nests (8.4). Consequently, decreasing the visibility of nest boxes at LSFWA probably would not substantially improve recruitment of wood ducks.

Clustering

Studies on eastern bluebirds (*Sailia sailis*, Gowaty and Bridges 1991), house wrens (*Troglodytes aedon*, Price et al. 1989), and wood ducks (Semel and Sherman 1986, Semel et al. 1988) concluded that nest box clustering was positively correlated with IBP. The study by Semel et al. (1988) had nest boxes mounted back to back on the same pole which created the closest possible nest proximity. Our study indicated parasitized nest were actually more isolated (51-75 meters) from other nest boxes than unparasitized nests (26-50 meters). Thus, nest proximity may not be an important correlate of IBP for wood ducks until boxes become highly clustered and/or wood duck densities increase.

Clutch Size Criterion

Our results are similar to the findings of Semel and Sherman (1992) in which they suggested that >12 eggs most accurately estimated the true parasitism rate. Since most wood duck studies have used clutch sizes of 16 or more eggs to infer IBP (Semel and Sherman 1992), our results as well as Semel and Sherman's (1992) suggest that rates of IBP have been grossly underestimated.

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Table 1. Summary of wood duck nesting in boxes (n=68) at Lake Shelbyville Fish and Wildlife Area (Moultrie County, IL) in 1992.

	Unparasitized	Parasitized	Total
Boxes used[a] (%)	18(26)	21(31)	46[b](68)
Mean clutch size	9.2	15.3	12.6
Hatchability of successful nests[c] (%)	$^{84}/_{92}$ 91%	$^{133}/_{181}$ 73%	$^{217}/_{273}$ 79%
Depredated nest (%)	7(39)	6(29)	13(33)
Abandoned nests (%)	1(6)	4(19)	5(13)

[a] Nest box use defined as the presence of at least one wood duck egg (Morse and Wight 1969).

[b] Includes 7 nests which were eliminated from the data analysis.

[c] Successful nests defined as those nests in which at least one wood duck egg hatched (Semel et al. 1988).