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Leon L. Johnson
Minnesota Department of Conservation

The Common Goldeneye Duck and the Role of Nesting Boxes in its Management in North-Central Minnesota

LEON L. JOHNSON[1]

ABSTRACT — Evaluation of use of nesting boxes of two kinds by the common goldeneye duck (*Bucephala clangula americana*) in a wooded area of north-central Minnesota, where these ducks are fairly abundant, shows 69 to 80 percent of the usable boxes were eventually used. Wooden boxes were better accepted than metal boxes, but the latter provided greater protection from predators. Calculations from band recoveries indicate a hunting bag of about 36 percent for birds during their first year. This is a high rate of harvest, especially since goldeneyes do not breed until their second year. After the first year, however, mortality is low, probably because adults frequent large open water lakes which provide some protection from hunting. Considerable homing by adult hens to previously-used nesting boxes was noted.

The common goldeneye duck, or whistler (*Bucephala clangula americana*), breeds in northern forests across North America and ranges as far north as the Arctic tundra. In Minnesota it is found in summer on waters of the coniferous and mixed coniferous and hardwood forests in the northern part of the state, the boundary of its nesting range extending from southern St. Louis County westward to Hubbard County and thence northward to Lake of the Woods. It is a tree-nesting duck of moderate size, males having an average weight of about 2 pounds 2 ounces and females about one pound 12 ounces. In the field the mature male can be recognized by a blackish head, glossed with metallic green and on which there is a conspicuous white spot between the eye and the base of the bill. Other details concerning this duck can be found in *Waterfowl in Minnesota* by Forrest B. Lee and co-workers (1964).

Under natural conditions the goldeneye hen commonly nests in tree cavities, and in this respect is similar to the wood duck. Although it is not among the common Minnesota ducks it is valued as a sport bird by waterfowl hunters. It is of special interest to waterfowl managers because its breeding range is outside the prairie pothole region on which many of our ducks are produced—a region in which waterfowl habitat is becoming scarcer each year because of agricultural drainage. Forest regions contain much public land that is less subject to change and for this reason the development of management methods that foster forest ducks are of considerable importance. One method which shows considerable promise, and which will be discussed here, is the provision of artificial nesting boxes to supplement the supply of natural tree cavities and to supply nesting sites where natural tree cavities are lacking because of mature timber cutting.

There are only so many breeding birds available each year, and because goldeneyes do not breed until two years old, they must maintain a high nesting success to survive. Nests in natural cavities can be vulnerable to predation and weather; but nesting boxes can be constructed to exclude some predators and offer greater protection from weather, thus increasing nesting success.

In addition to information on the design and use of nesting boxes the present paper also presents information on breeding density (abundance) and population trends of the goldeneye, especially as affected by hunting. The information used was gathered during the nine years, 1958-1966 and the writer wishes to thank Robert L. Jessen and Forrest B. Lee for encouragement and guidance during the course of the study.

[1] Game Biologist, Minnesota Department of Conservation.

The Study Area

The study area, herein called the Blackduck Study Area, occupies 203 square miles in eastern Beltrami and western Itasca counties near the village of Blackduck. Three-fourths of the study area is in the northwest corner of the Chippewa National Forest. The remainder is in the Buena Vista State Forest or on private lands. Soils consist of sandy loam and silt loam. The topography ranges from undulating to strongly rolling, with peat bogs occupying many depressional areas. The upland forest is predominantly aspen and balsam fir. However, maple, elm, and oak are common on ridges. Annual mean precipitation is 24.6 inches.

The study area has 73 permanent areas of standing water and 5 rivers. These water areas can be categorized as follows: 9 large sand-bottomed fish lakes; 12 small, deep, muck-bottomed lakes; 38 small, shallow, productive boggy dystrophic lakes, and 14 highly acid, non-productive bog lakes. A large part of the study concerned goldeneye activities on six of the large, sand-bottomed lakes. These lakes were: Blackduck (2,500 acres), Moose (640 acres), Gilstead (265 acres), Gull (2,075 acres), Medicine (470 acres) in Beltrami County, and Dixon (590 acres) in Itasca County. There are summer homes and resorts on these lakes, and they are all moderately used for fishing and boating.

Methods

Because of the known tree nesting habits of this duck and because some success has been had in use of nesting boxes by the closely related European goldeneye (*Bucephala clangula clangula*) in northern Europe (Siren, 1952), it was decided to design and evaluate the use of nesting boxes on the study area.

In 1957, 11 wooden nest boxes (12 inches x 12 inches x 24 inches tall) with a 4- x 5-inch rectangular entrance, with the long dimension horizontal, were put up near the

six study lakes. The following year, 16 metal oil drums (12 inches in diameter and 30 inches high) were converted to nest boxes and also erected around the six study lakes. In March 1959, 94 new wooden boxes were constructed and erected. These boxes were again 12 inches x 12 inches x 24 inches tall but instead of having a rectangular entrance, had an elliptical entrance 3½ by 4½ inches located 6 inches from the top of the box. Thirty-two of these boxes were placed around the six study lakes. The nest boxes were installed at various heights and distances from water and in various surroundings to determine preferences and nesting success. Nest boxes on the six study lakes were under intensive surveillance during three breeding seasons, 1958-60. Many of the active nests were checked 7 or 8 times during May and June.

The remaining 62 new wooden nest boxes were installed near 11 other lakes over a large area in Beltrami and Itasca counties in 1959. These nest boxes were checked to determine usage in 1959, 1960, 1961, and 1965. Throughout this evaluation, a nest box was considered used if it contained one or more goldeneye eggs. The check in 1965 was incomplete but included some of the new wooden boxes near the six study lakes. Selection, however, was made so as to have some lakes with high nest box usage and others with low usage, as recorded previously in 1961.

Concurrent with the study of nesting boxes the size of the local breeding population was ascertained by the following methods: In 1961 the breeding population of goldeneye ducks on the entire 203 square mile study area was determined by counts made from airplane, boat, and foot. All water areas were censused at least once during the period May 4-26. We determined the breeding population on the six selected lakes by two surveys in May and one in early June during 1959-1964. In 1958 and 1965-66 these lakes were censused only once, about the third week in May. Additional, weekly census data was obtained on Blackduck Lake from April 15 to August 1, 1959. For our purposes, groups of more than 4 lone males and yearling goldeneyes of either sex were not considered as breeding ducks.

To obtain information on mortality of birds from one year to the next, especially hunting mortality, and on movement, migration, and homing patterns, flightless young goldeneyes on the six study lakes and a few other lakes in eastern Beltrami and western Itasca counties were banded each year during 1956-1966 period, except in 1960 and 1961. Most of the trapping was done by a four-man crew, using drive-traps during the first week in July. Using this method, we banded 1,406 flightless young goldeneyes. In addition 68 adult females were caught while attending broods or in nest boxes. Nasal markers (Lindmeier, 1960) were attached to 171 young females and 13 adult females to facilitate future identification in the field.

Results

Population Data—As indicated from breeding pair counts (Table 1) the goldeneye breeding population was quite high on the six selected lakes within the Blackduck Study Area, ranging from 62 to 89 pairs in the several years and competition for nesting sites could be expected to be fairly keen. The number of breeding pairs increased from 1958 to 1960, leveled off for three years, and then gradually decreased through 1966. The 1958 and 1966 breeding populations were about the same. Other diving and dabbling ducks (except wood ducks) using these same lakes showed a steady downward trend during the nine years of survey.

TABLE 1. Indicated goldeneye breeding pairs and nesting success on six selected lakes in the Blackduck Study Area, 1958-1966.

Year	Indicated breeding pairs	Number of nests under observation in nest boxes	Percentage of nests hatched	Number of broods observed	Percentage of hens successful
1958	67	14	71	—	—
1959	79	27	59	62	78
1960	89	39	62	76	85
1961	85	—	—	62	72
1962	86	—	—	—	—
1963	75	—	—	—	—
1964	73	—	—	—	—
1965	69	—	—	—	—
1966	62	—	—	—	—

Collectively, the six lakes have 10.2 square miles (6,540 acres) of surface water and 49 miles of shoreline. In 1960 we found 89 breeding goldeneye pairs, an average of 8.7 pairs per square mile of water or 1.81 pairs per linear mile of shoreline. In 1961, on the entire 203 square mile Blackduck Study Area, 109 goldeneye pairs or 0.53 pairs per square mile were recorded. This is probably a relatively high breeding density; however, Carter's (1958) work in New Brunswick indicated about 3 pairs per square mile in a block type study area. Because 87 per cent of the goldeneyes counted on our 1961 survey were found on the large sand-bottom fish lakes, it is evident that they prefer this type of water area over the several others present. In this year three-fourths of the goldeneyes were found on the six selected lakes.

Use of Nesting Boxes—Acceptance of artificial nesting boxes by goldeneyes was found to be very high in this study. By 1960, two years after most of the nest boxes were installed and four years after the first boxes were installed, 39 of 57 available boxes (69 per cent) were used by goldeneyes on the six study lakes. During June 1-3, 1965, a sample check coverage of 59 new wooden nest boxes installed in 1959 over a large area in Beltrami and Itasca counties, showed 80 per cent of the usable boxes used by goldeneyes. Eighteen of the 59 boxes were no longer suitable because: (1) covers had blown off; (2) boxes had fallen off trees; or (3) they had been destroyed by human activity (Johnson, 1965).

Goldeneyes indicated a preference for the wooden box over the metal nest box (Table 2). They also had a higher hatching success in the wooden boxes if all nests (with one or more eggs) are considered. However, if only those nests that reached incubation are considered, 91 per cent hatched in the metal nest boxes compared to 82 per cent in the wooden-type boxes. Apparently a

higher proportion of nests in metal boxes were deserted during the egg-laying period because of unnatural conditions – perhaps greater warmth or unnatural odor – but if the hens continued to use the nest box, hatching was better in the metal box because these offered more precarious footing to predators and, therefore, more security.

Nest boxes placed 18-20 feet above the ground were often used before those at 10-12 feet. Boxes placed away from the shore and partially hidden among the trees had a lower percentage of use but a higher hatching success. Conceivably these boxes are less apt to be found and used by more than one hen. If a box is used by more than one hen a large number of eggs is often deposited in it and a "dump nest" formed. Often such clutches of eggs are eventually deserted. Dump nests (nests in which 2 or more hens lay eggs in one nest box) accounted for 20 per cent of the unsuccessful nests during the study.

In spite of these preferences as to nest sites, goldeneye hens seem not to be too particular where they nest, or at least will investigate any posible nesting cavity. As evidence, prior to the nesting study several female goldeneyes died when attempting to nest in, or explore, chimneys and old buildings. Local residents around Blackduck Lake reported that on 41 occasions goldeneyes became trapped in their chimneys and 13 of these had died in them. This nesting trait probably best explains why goldeneyes have so readily accepted artificial nest boxes and are responsive to this type of management.

Although we did not determine the activity by goldeneyes in chimneys around Blackduck Lake after nesting boxes had been established, it is our opinion that nesting boxes considerably reduced chimney mortality. Many yearling females were observed attempting to enter nest boxes and probably substituted this activity for exploration of the precarious chimneys. Only three chimney incidences were reported to the author after 1958.

Hatching Success for All Boxes – Nesting success data were obtained from observations of a total of 80 goldeneye nests during the period 1958-1960. Fifty of the 80 nests (62.5 per cent) hatched (Table 2). About half of the unsuccessful nests were deserted before incubation for unknown reasons or were dump nests. Predation was considered the cause of 20 per cent of the unsuccessful nests, and it occurred mostly in the nest boxes with 4- x 5-inch rectangular entrances (Table 3). Raccoons were the most common nest predator (Table 3).

Hatched clutches averaged 10.2 eggs. Thirteen hens laid 66 eggs in 90 days, indicating an ovulation every 32 hours. Incubation periods of 11 hens ranged from 28 to 32 days. A recording thermometer recorded 30 days incubation for one hen. In four cases, ducklings spent 42, 31, 29, and 24 hours in the nest box after hatching (Johnson, 1962).

Homing of wood ducks, another tree cavity nester, has been found to be very high (Bellrose, 1964). We found that adult female goldeneyes also possess a strong desire to return to the same nest site and nesting area (Table 4). Fifty per cent of the available goldeneye hens returned to the same nest box. Many other hens probably returned but could not be caught to verify their band numbers.

Band Recoveries and Hunting Bag – Analysis of banding data indicates a high hunting harvest rate for immature goldeneyes. Direct band recoveries (bands returned by hunters the first year) of normal wild flightless young banded during 1956-1959 averaged 18.8 per cent. During the later period of banding, 1962-1965, direct band recovery rates were lower, average 11.3 per cent. How-

TABLE 2. Comparison of nesting box usage and nesting success by goldeneye ducks near six selected lakes in the 203 square-mile Blackduck Study Area, 1958-1960.

Type of nest box	Year checked	Number of nest boxes available and checked	Number used	Percent used	Number of successful nests	Percent hatching success
Old wood						
(4"x5" rec-	1958	11	10	91	6	60
tangular	1959	11	10	91	7	70
entrance)	1960	11	11	100	7	63
		33	31	94	20	64.5
Metal						
	1958	15	4	27	4	100
	1959	15	7	46	3	43
	1960	14	9	64	3	33
		44	20	45	10	50.0
New wood						
(3½"x4½"	1959	32	10	31	6	60
elliptical	1960	32	19	60	14	73
entrance)		64	29	45	20	68.9
Totals		141	80		50	
Averages				57		62.5

TABLE 3. Cause of goldeneye duck nest losses in nesting boxes on the Blackduck Study Area, 1958-1960.

Cause	Old wood	Metal	New wood	Total nests	Percentage of total loss
Destroyed egg clutches					
raccoon	2			2	7
red squirrel	1			1	3
starling		1		1	3
unknown	1		1	2	7
Deserted nests					
dump nests	3	3		6	20
nest box destroyed	1		2	3	10
due to starling	1		1	2	7
human disturbance		1	2	3	10
unknown	2	5	3	10	33
Totals	11	10	9	30	100

TABLE 4. Return of banded adult goldeneye hens to the same nesting area, Blackduck Study Area, 1959-1960.

Year	Number of hens available[1]	Number of hens recaptured		Percent of hens returning to	
		Same lake	Same nest box	Same lake	Same nest box
1959	4	4	2	100	50
1960	18	9	7	50	38
1961	20	14	12	70	60
Totals	42	27	21		
Averages				64.3	50.0

[1] Number of hens captured in nest boxes the previous year (includes both newly banded and recaptures).

ever, it is known that less hunters now report bands than previously. When the direct recovery rate is adjusted for non-reported bands, as suggested by Martinson (1966), the proportion of birds bagged by hunters averaged 36.0 per cent during the early period and 35.4 per cent in the later period. Local goldeneyes have experienced the highest annual first-year mortality rate of the 7 major duck species (mallard, blue-winged teal, wood duck, redhead, canvasback, and ring-necked duck) breeding in Minnesota. However, after the first year, goldeneyes have the lowest mortality rate of these same 7 species (Lee *et al.*, 1964, p. 86). Of 55 normal wild adult females banded during the study, none have been reported as shot.

Distribution of 66 direct band recoveries from birds banded as flightless young in 1958-1959 was as follows: 59 per cent were shot within a 50-mile radius of the banding location; 19 per cent elsewhere in Minnesota; 12 per cent in other states, mostly near the Great Lakes and along the Mississippi River; and 10 per cent in Manitoba and Ontario.

The greater hunting take of immatures than of adults may be because adults leave the area before moulting and frequent larger lake areas. Adults have not been known to moult on the study area, and it is likely they fly north into Manitoba and Ontario to moult. Young goldeneyes, after gaining flight, are seen only occasionally on the study area. They too may move north, returning to the natal lakes in early October. The natal lakes are relatively small and have substantial hunting on them. Adults by contrast, probably remain further north longer, avoid the smaller breeding lakes in migration, and consequently, fewer are shot.

Under present conditions, it appears that any increase in hunting harvest of goldeneyes in Minnesota would reduce our resident population. Because of their strong homing tendencies little "pioneering" or "short stopping" of transient breeding goldeneye in fringe breeding areas can be expected and the hunting take must depend largely upon birds occupying the present breeding range.

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