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Barrow's Goldeneye nest-box utilization in the Cariboo parkland, British Columbia: Year 1

by J.-P.L. Savard[1]

Abstract

In the course of a study on the breeding ecology of Barrow's Goldeneye (*Bucephala islandica*), 137 nest boxes were erected near Riske Creek, BC. Breeding attempts were recorded in 95 (69%) of the boxes, and 9 (22%) of the remaining boxes were used at least once for roosting. Barrow's Goldeneye, European Starling (*Sturnus vulgaris*), and American Kestrel (*Falco sparverius*) accounted for 36, 28, and 24 respectively of the boxes used. Nest boxes located on ponds with high densities of goldeneye had more use than those on ponds with low densities. Only 13 (54%) of the 24 breeding attempts of American Kestrel were successful. Barrow's Goldeneye used 13 of 38 old (1957) boxes in 1981, a ratio comparable with that in the new boxes, but American Kestrel made no use of the old boxes, which had larger entrance holes. The high rate of occupancy of new nest boxes during the first year indicates a shortage of cavities of that size in the study area. The acceptance of nest boxes by Barrow's Goldeneye and American Kestrel suggests that population levels of those species might be increased by proper use of nest boxes.

Introduction

Barrow's Goldeneye are considered secondary hole-nesters because they use existing cavities instead of excavating their own (McLaren 1962). In British Columbia, their nests have been found in the old nests of Common Crow (*Corvus brachyrhynchos*) (Edwards 1953, Sugden 1963), and in the burrow of a Yellow-bellied Marmot (*Marmota flaviventrus*) (Munro 1935), but they most commonly nest in tree cavities (Munro 1939, Bellrose 1976). They use the old cavities of Pileated Woodpecker (*Dryocopus pileatus*) and Common Flicker (*Colaptes auratus*) that have been enlarged by weathering (M.F. Jackson *in* Bellrose 1976). In treeless Iceland, they nest in cavities under stream banks and in the holes in lava rocks (Bengtson 1970, Palmer 1976). Similarly, in Washington, they sometimes nest in holes in rock cliffs (Harris *et al.* 1954).

In the parkland habitat of British Columbia, tree cavities provide most nesting sites for Barrow's Goldeneye, but logging activities in that region have reduced the number of nest sites near several breeding ponds. Surveys have shown a ratio of 0.53 broods per pair, indicating a possible shortage of nest sites (CWS, unpubl. data).

As part of a project on the breeding ecology of Barrow's Goldeneye, we placed nest boxes in a 100-km^2 area near Riske Creek, BC, to find if there was a shortage of nesting cavities in the area, to monitor the response of cavity-nesting birds to an increase in nest sites, and to identify other factors that limit the population of cavity-nesters. In this paper, I summarize the utilization of nest boxes by Barrow's Goldeneye and other wildlife in the first year of the program.

[1]CWS, Delta, British Columbia V4K 3Y3.

Methods

We based the nest boxes on Lumsden *et al.* (1980) design for Common Goldeneye (*Bucephala clangula*), using 2-cm unpainted rough plywood with internal measurements of 23 × 30 cm × 61 cm high. The face was only 56 cm high because the roof sloped downward to the front. We placed the entrance hole 30 cm above the floor, and scarred the interior front panel of the box with saw marks to make it easier for the young to get out. The rear panel of the box extended 5 cm at the bottom and top for attaching it to trees. Part of one side panel was removable for looking inside.

We nailed nest boxes on aspen, pine or fir trees with the entrances between 4 and 5 m above the ground, and added 2 to 3 cm of spruce shavings as nest material. In early March 1981, we installed 139 boxes on 50 of the 117 lakes of the study area, siting them close to the water whenever possible, but because most lakes were surrounded by open grassland, the boxes ranged from 0 to 400 m from the water's edge.

When Barrow's Goldeneye arrived there, they had 137 new boxes for nesting (two had disappeared) and another 38 boxes installed in 1957 by the BC Fish and Wildlife Branch. The latter were shallower and had larger entrance holes than the new ones.

I checked the nest boxes once in early June when most female Barrow's Goldeneye were incubating, and once more in early August after the breeding season.

Results

Newly installed nest boxes

I recorded breeding attempts by various species in 69% of the nest boxes (Table 1), and noted that 22% of the remaining boxes had been used at least once for roosting. Barrow's Goldeneye, European Starling, and American Kestrel accounted for 93% of this breeding activity.

Table 1
Utilization of new nest boxes during 1981 breeding season

Type of use	Boxes	%boxes
Barrow's Goldeneye	36	26.3
European Starling	28	20.4
American Kestrel	24	17.5
Red Squirrel	6	4.4
Common Flicker	1	0.7
Total wildlife use	95	69.3
No use	42	30.7

Table 2
Production of Barrow's Goldeneye in new nest boxes near Riske Creek, BC, in 1981

Units	Successful hatching	Deserted	Partial success: Hatched	Partial success: Failed	Total
Nests	22	9	5		36
Eggs*	141	45	24	16	226
Eggs/nest	6.4	5.0	8.0		6.3

* Minimum number because some females were still laying at the time the nest boxes were visited.

Barrow's Goldeneye

Barrow's Goldeneye nested in 36 nest boxes and laid 225 eggs, 73.0% of which hatched (Table 2). Nest desertions accounted for 73.8% of the losses. Females were absent from seven of the nine deserted nests when I was checking them (Table 3), which means that only two desertions might be attributed to my presence.

Five female Barrow's Goldeneye nested successfully on top of European Starling nests. I could not determine whether the European Starling had completed nesting or had been displaced from their nests. They may have interfered with Barrow's Goldeneye in two other boxes, in one of which I found four eggs punctured in an incomplete starling's nest, and in another, a starling's nest built on top of an intact Barrow's Goldeneye egg.

Three clutches had broken eggs. The presence of dried yolk at the entrances of nests and on the floors indicated that the females broke them when entering or leaving the boxes. Those clutches had less than four eggs, only one hatched, the others being deserted, which meant that the females were probably breeding for the first time.

Table 3
Nest success of Barrow's Goldeneye in relation to presence or absence of female at time nest box was checked

Clutch result	Female present	Female absent
Successful hatch	16*	6
Partial hatch	1	4
Deserted	2	7
Total	19	17

* Number of nests.

Most occupied nest boxes could be identified by the down that often stuck to the entrance hole. Incubated eggs had large amounts of down around them. I found only small amounts of spruce shavings in occupied boxes, indicating that female Barrow's Goldeneye may have removed some of it. If so, the benefit of the shavings is doubtful.

Table 4
Nest-box use in relation to abundance of Barrow's Goldeneye on pond in previous year

Population	Ponds	Barrow's Goldeneye abundance: Total yearlings	Total pairs	Total broods	Nest boxes	Nest boxes used	% used
Ponds with >5 yearlings in 1980	17	361	147	33	59	24	41
Ponds with <2 yearlings in 1980	22	5	38	19	52	12	23
Ponds with no goldeneye in 1980	6	0	0	0	18	1	6

We had placed nest boxes on ponds used by Barrow's Goldeneye as well as on ponds not used by them in previous years to see how important the availability of nest sites is in pond selection, and if the presence of goldeneye on the lake would increase nest-box utilization. Ponds little used by Barrow's Goldeneye in 1980 were not used more in 1981, in spite of the presence of nest boxes. They used only 1 of 18 boxes on those lakes. Nest boxes located on ponds with high densities of goldeneye had more use than those on ponds with low densities (Table 4). Although 27 clutches hatched from nest boxes, the number of broods on the lakes did not increase (Table 5). There were fewer broods in 1981 (85) than in 1980 (96).

I also checked nest boxes at the end of the breeding season to detect late nesting and see if I could accurately assess clutch size from eggshell remains. The results were negative in both cases. Clutch size was always underestimated, and several nests had few eggshells and membranes although several eggs had hatched successfully earlier in the season. The female or some other creature either removed or ate the eggshells.

Table 5
Number of broods on ponds where a nest box was used and on ponds where no box was used*

	Broods: 1980	Broods: 1981
Nest box used	48	40
No nest box used	48	45
Total	96	85

* $\chi^2 = 0.16$, $P > 0.05$.

American Kestrel

American Kestrel attempted to breed in 24 nest boxes, but succeeded in only 54% of them. Successful clutches averaged 4.54 eggs and unsuccessful ones only 3.91 eggs Table 6). I could not relate nest desertion to any observed factor. The presence or absence of an adult in the nest when it was checked did not affect the desertion rate (Table 7). I found no eggs or eggshells in those deserted nest boxes, in contrast to the deserted Barrow's Goldeneye clutches, which were still intact 1 month later.

The presence of dry forbs and grasses in 10 nests suggests that American Kestrel may have displaced European Starling from those nest boxes. All other boxes were devoid of new nest material. The inside walls of nest boxes where young were raised were coated with white excrement, and the floors covered with prey remains and pellets.

European Starling

In 20 cases, the young starlings had fledged before my first visit to the nest boxes, but one nest box still had eggs and two nests contained the headless remains of chicks.

Table 6
Production of American Kestrel in nest boxes near Riske Creek, BC, in 1981

Units	Successful clutch	Deserted clutch	Total
Nests	13	11	24
Eggs	59	43	102
Eggs/nest	4.54 ± 0.14*	3.91 ± 0.25*	4.25

* T test: $T = 2.6$, $P < 0.05$.

Table 7
Nest desertion of American Kestrel in relation to adult present at time nest box was checked

Adult in nest	Nests	% nests deserted
Male	6	33
Female	12	50
None	6	50

Red Squirrel (Tamiasciurus hudsonicus)

I found Red Squirrel nests in six boxes. One box had a litter of four young, one had an adult, and four had empty nests.

Common Flicker

A female had laid an egg in a nest box, but had abandoned it.

Old nest boxes

Only half (19 of 38) of the old nest boxes were used compared with the 70.1% occupancy of the new boxes. Barrow's Goldeneye accounted for 68% of the breeding attempts. No American Kestrel and only one pair of European Starlings nested in the old boxes (Table 8).

Ten of the 13 clutches of Barrow's Goldeneye in the old boxes hatched successfully. I have not shown the

Table 8
Utilization of old nest boxes during 1981 breeding season

Type of use	Boxes	% boxes
Barrow's Goldeneye	13	34.2
Red Squirrel	4	10.5
European Starling	1	2.6
Tree Swallow	1	2.6
Total wildlife use	19	50.0
No use	19	50.0

total number of eggs laid in Table 8 because I did not know the clutch size in four of the successful boxes. One nest box had 17 eggs, but the absence of down indicated a possible dump nest (where several females lay their eggs). It was deserted.

Discussion

The high rate of occupancy of nest boxes during the first year indicates a shortage of cavities of that size in the study area. Both Barrow's Goldeneye and American Kestrel responded well to the increase in nest sites. Hamerstrom *et al.* (1973) found the number of suitable nesting cavities to be a limiting factor for a population of American Kestrel in central Wisconsin. In the present study, the high percentage of desertion by American Kestrel may indicate the presence of inexperienced birds among the 24 pairs that attempted to breed. Young birds are usually more susceptible to disturbance than older and experienced birds. Competition among pairs may have caused some desertions, since some occupied nest boxes were less than 200 m apart.

Barrow's Goldeneye used proportionally similar numbers of old and new nest boxes, although the old boxes had been available for several years. The new boxes may have provided better nesting sites because they had more depth and were higher above ground than the old boxes: two preferences of Common Goldeneye shown by Lumsden *et al.* (1980). Henson and Keran (1977) found a similar height preference among Wood Duck *(Aix sponsa)*, which Barrow's Goldeneye may share.

Other factors may have influenced the use of the nest boxes. Rajala and Ormio (1971) found that Common Goldeneye changed nest boxes from one year to the next when boxes abounded. Eriksson (1979) found a significant positive relationship between the use of the same nest box in 2 successive years and a successful breeding attempt. However, the design of the new boxes and their better location are the most likely reasons for their use by goldeneye. Among the old boxes that were not used by Barrow's Goldeneye in 1981, none showed signs of previous use by goldeneye.

The attractiveness of the new nest boxes may explain partially why their use did not increase the number of broods in the study area. Pairs may have just chosen them as better nest sites, but would have bred near that locality in any case. Other forms of population control may explain this stability in spite of having more nest sites. The results of the next few years should provide a better view of the role of nest-site availability in the limitation of Barrow's Goldeneye populations.

The greater use of nest boxes on ponds heavily frequented by Barrow's Goldeneye than those on ponds with low numbers of goldeneye indicates a shortage of suitable nesting cavities near good lakes. It also shows that the presence of nesting cavities may not influence the utilization of a given lake by Barrow's Goldeneye. Munro (1939) speculated that food rather than nesting cavities influenced their use of a lake and Donaghey (1976) arrived at a similar conclusion for Bufflehead.

No Bufflehead bred in any of the 175 nest boxes I checked. That is surprising in view of the abundance of Bufflehead in the area (72 broods) and the fact that they use nest boxes in other areas (Miller 1966, Erskine 1972; Murray Clark, Ducks Unlimited, pers. commun.). Plenty of small natural cavities exist in the area (McLaren 1962, Erskine 1972), and Bufflehead may prefer them because they reduce the chances of confrontations with Barrow's Goldeneye. Bufflehead deaths from such confrontations have been reported by Erskine (1959, 1960, 1972) and McLaren (1969).

From this first year's observations, there seems to be a shortage of large cavities in the aspen parkland of British Columbia. The acceptance of nest boxes by Barrow's Goldeneye and American Kestrel indicates that their populations may be increased by installing nest boxes throughout the aspen parkland. Further studies are needed to identify other factors besides nest-site availability that may limit those populations.

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