# COMPARATIVE NESTING BIOLOGY OF SOME HOLE-NESTING BIRDS IN THE CARIBOO PARKLANDS, BRITISH COLUMBIA

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The purpose of this paper is to present comparative data on the nesting of certain birds using tree holes in central British Columbia. The stability of the hole-nesting community there had been disrupted by the appearance and increase of the Starling (*Sturnus vulgaris*) which, introduced into the eastern United States in 1890, had spread across the continent to British Columbia by 1947 (Myres 1958). Our data were collected incidentally in the course of studies of other aspects of the biology of hole-nesting birds (Erskine 1960, McLaren 1963).

## STUDY AREA AND METHODS

Field work began on 3 May 1958 and 25 April 1959, and continued into August in both years. Searching for new nests was sporadic after mid-June; consequently, nests started later were probably under-represented in our samples. A number of known sites were checked in May 1964 when, however, no follow-up to determine nesting success was possible. Nesting data reported here were collected by AJE, except for 47 nests (21 in 1958, 26 in 1959), of Mountain Bluebird (*Sialia currucoides*) by WDM, and 3 nests of Common (Red-shafted) Flicker (*Colaptes auratus cafer*), 11 of Tree Swallow (*Iridoprocne bicolor*), and one of Mountain Bluebird, by A. J. Wiggs, who accompanied AJE in 1958.

Our studies were carried out in the Cariboo Parklands (Munro 1945), part of the interior plateau of central British Columbia between the Coast Range and the Cariboo Mountains. Areas receiving intensive coverage were centered near 105 Mile (AJE), Springhouse (WDM), and Riske Creek (both), but we also visited most lakes accessible by road between the main areas. We also made a few observations in comparable habitats south of Kamloops, near Knutsford and Bestwick.

These areas are in the interior Douglas fir zone (Tisdale and Maclean 1957), at elevations between 850 and 1050 m. Most of the intensive study areas were in parkland of groves and clumps of trembling aspen (*Populus tremuloides*) with grassland between. Others were in open, mixed-aged stands of Douglas fir (*Pseudotsuga menziesii*). Lodgepole pine (*Pinus contorta*), the other common tree in both communities, was seldom used by hole-nesting birds. We found some nests in ponderosa pine (*P. ponderosa*) south of Kamloops. Munro (1945) described the Cariboo Parklands habitats in detail, but his account underemphasized the importance of Douglas fir.

We searched for nests mainly by examining the trunks of all trees 20 cm diameter breast height or larger. In aspen parkland, we examined all groves back to 400 m from the nearest lake, but where closed stands prevailed we searched mainly within 135 m of the edge of lakes. Access to holes was by ladder, climbing irons, or by logs placed against the tree trunk. The contents of cavities were examined by reflecting the beam from a flashlight into the hole with a strip of mirror glass inserted at an

angle. When nestlings were to be banded, a hole was drilled into the cavity at the side or back (Erskine 1959), or a portion of the sill was cut out and later nailed back into place. We also inspected contents of nest boxes in the area, erected for ducks by Lawson G. Sugden, then of the British Columbia Game Branch. Details of all nests of which the contents were determined were entered on nest record cards and deposited in the British Columbia Nest Records Scheme (now housed in the Provincial Museum, Victoria).

In evaluating the data on clutch initiation, clutch size, and nesting success, we were guided by the criteria of Myres (1955) and Snow (1955 a,b). However, the small size of most samples necessitated including all the data available, excepting those believed to represent renests or incomplete clutches.

## RESULTS

Data are presented here for 4 species: Common Flicker, Tree Swallow, Mountain Bluebird, and Starling, which with the Bufflehead (*Bucephala albeola*) are the main species occupying flicker holes in this region. As the data were collected while we were inspecting sites that might be used by Buffleheads, nearly all the natural sites of Tree Swallows examined were of flicker origin, although this swallow also uses both larger and smaller holes (McLaren 1963). Data for Buffleheads (Erskine 1972) and Yellow-bellied Sapsuckers (*Sphyrapicus varius*) (Erskine and McLaren 1972) have been published elsewhere. The records for other hole-nesting species are too sparse to warrant extensive treatment.

First we considered the comparability of the data from nest boxes. Nearly all available nest boxes were used by some species, boxes with large entrances (12.5 cm) by Barrow's Goldeneyes (*Bucephala islandica*) or Tree Swallows, and those with small entrances (6.3 cm) by Starlings or Tree Swallows, with a few of other species in both sizes. No flickers used nest boxes in 1958 or 1959, and only 3 bluebird clutches (none followed up) were in boxes, so comparisons with natural sites were possible only for Tree Swallows and Starlings (Table 1). In view of the small samples, none of the differences in clutch size is convincing and the differences in laying dates are very slight. We thus felt justified in combining our data from nest boxes with those from natural sites in all subsequent comparisons.

For each of the 4 main species, we have summarized the data on clutch initiation dates (Fig. 1, Table 2), clutch size (Table 3), and nesting success (Table 4).

## DISCUSSION

*Data from nest boxes.*—Our admittedly meager data (Table 1) suggest no striking differences between data obtained from nest boxes and those from natural sites, for the 2 species examined. This by itself neither justifies nor argues against treating nest box data as representative for other species, in-

TABLE 1

COMPARISON OF MEDIAN LAYING DATE AND MEAN CLUTCH SIZE FOR NESTS IN NEST BOXES AND NATURAL SITES, CARIBOO PARKLANDS, BRITISH COLUMBIA

| Species | Year | Nests in | Median laying date | Mean clutch size |
|---|---|---|---|---|
| Tree Swallow | 1958 | Boxes | 22 May (9)* | 6.33 (9)* |
| | | Tree holes | 21 May (19) | 5.75 (16) |
| | 1959 | Boxes | 24 May (12) | 5.64 (11) |
| | | Tree holes | 26 May (36) | 5.88 (17) |
| Starling | 1958 | Boxes | 29 April (7) | 5.71 (7) |
| | | Tree holes | 2 May (7) | 6.00 (1) |
| | 1959 | Boxes | 8 May (6) | 5.40 (5) |
| | | Tree holes | 10 May (32) | 4.62 (24) |

* Sample size.

cluding Mountain Bluebirds. The situation found for Buffleheads (Erskine 1972:87–88) and Barrow's Goldeneye (M. F. Jackson, pers. comm.), where clutches in nest boxes averaged markedly smaller than those from natural sites, indicates that one should not accept nest box data as equivalent to those from natural sites without some attempt to compare them.

*Chronology.*—The species differed in their responses to the different climatic regimes in 1958 and 1959. Warming began much earlier in 1958, and in that year the earliest nesting species, the Starling, began much earlier than in 1959. The Mountain Bluebird, which like the Starling forages for terrestrial arthropods in grassy habitats, also started nesting much earlier in 1958 than in 1959. The other species showed much less difference between years. These species have very different foraging habits from Starlings and bluebirds, and the observed differences in nesting chronology may reflect availability of food rather than being directly in response to temperature.

Flickers in temperate latitudes seem never to attempt second broods, but the passerine species may do so. A complete nesting cycle requires at least 44 days (nest lining, 5; laying, 6; incubation, 14; fledging, 19) for Tree Swallows, about 39 days (3, 5, 14, 17) for Mountain Bluebirds, and about 41 days (3, 5, 13, 20) for Starlings (various sources, including our own data). There seems to be no conclusive evidence of second broods by Tree Swallows anywhere in Canada, though both time and flying insects seemed sufficient for them to do so. In contrast, Barn Swallows (*Hirundo rustica*), which arrive and start laying later than Tree Swallows, commonly

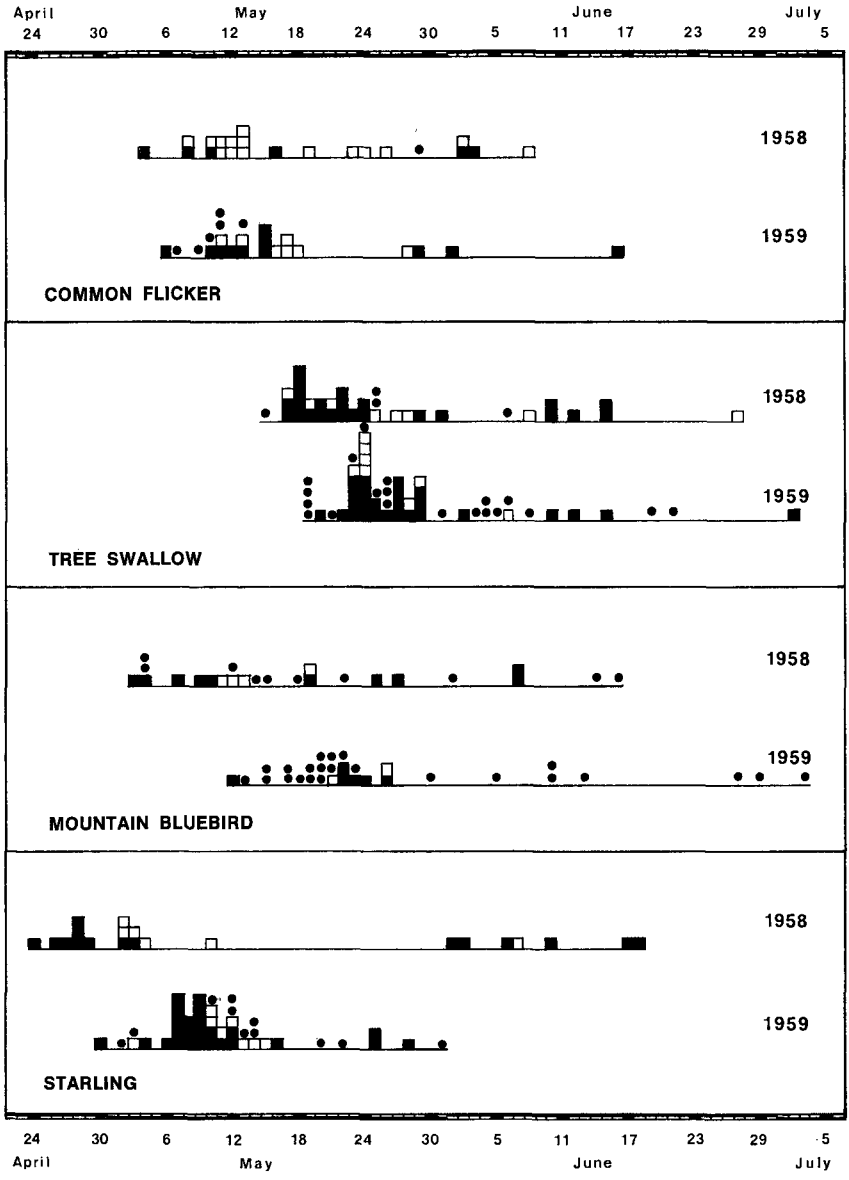


FIG. 1. Clutch initiation dates, Cariboo Parklands, British Columbia, 1958–59. Filled squares = dates known to ± 0–2 days; Open squares = dates known to ± 3–5 days; Filled circles = dates known to ± 6 or more days.

rear 2 broods through most of western Canada (unpublished data from Prairie and B.C. nest records). We did no marking of adults to check on the possibility of second broods, and the circumstantial evidence is good only for Starlings in 1958. A number of nest cavities were re-used after broods had fledged, with a period of 3 weeks separating the starts of the first and (assumed) second nestings (Fig. 1). We estimated that about 20% of Starlings attempted second broods in 1958; none had done so in 1955–57 when the population density was lower (M. T. Myres, pers. comm.), and we did not detect a single instance of second broods in 1959. Dunnet (1955) has shown that in western Europe the proportion of Starlings which attempted second broods varied among areas and among years, from about 70% to none. A few bluebird nests and 2 Tree Swallow nests were late enough that second broods seemed possible, since Mountain Bluebirds regularly raise 2 broods in Montana (Power 1966) and Alberta (J. L. Park, pers. comm.). Both these species suffered heavy nesting losses earlier in the season, and all of their late nests may have been renests rather than second attempts. Laying dates for first broods of bluebirds were similar to those found by Power (1966).

Starlings showed much less scatter in laying dates than did the other 3 species, all of which seem to have suffered to some extent in competition with the introduced species. The scatter was greatest in the bluebird, which is most directly in competition with the Starling, although the lack of precise laying dates for most bluebirds may have contributed to the scatter. Some flickers had to renest repeatedly; 3 nests, in which laying began on 17 May, 29 May, and 1 June, were all within 150 m of each other, and were believed to be of the same pair. Starlings destroyed the eggs in the first, and disturbed the flickers until they abandoned the second attempt. Starlings probably disturbed Tree Swallows less, since the latter started nesting when most Starlings were incubating (Fig. 1).

*Clutch size.*—The greater the spread in median dates of first laying between 1958 and 1959, the greater the spread in mean clutch sizes between years; all species showed a decrease in clutch size with later dates of nest initiation. The Starling data for 1964 and the second broods in 1959 also conform to this pattern. There seem to be few quantitative studies of any of these species in the northwest for comparisons, and eastern areas where such studies have been made differ so much in altitude, latitude, and climate that comparison with them seems futile. Tree Swallow data from Montana (Weydemeyer 1935) are roughly similar (mean 6.05 eggs), but Power (1966) reported a much higher mean clutch in Mountain Bluebirds (5.90 eggs for early first nests) in Montana, with no Starlings present.

TABLE 2

DATES OF CLUTCH INITIATION OF HOLE-NESTING BIRDS, CARIBOO PARKLANDS, BRITISH COLUMBIA

| Species | Sample size* | Clutch initiation date | |
|---|---|---|---|
| | | Median* | Interquartile range (no.)* |
| Common Flicker | 14 | 11 May 1958 | 10–13 May (9) |
| | 20 | 12 May 1959 | 11–15 May (11) |
| Tree Swallow | 28 | 21 May 1958 | 18–24 May (17) |
| | 47 | 25 May 1959 | 24–29 May (26) |
| Mountain Bluebird | 19 | 12 May 1958 | 9–19 May (11) |
| | 24 | 20 May 1959 | 18–22 May (12) |
| Starling | 14 | 29 April 1958 | 28 April–2 May (7) |
| | 38 | 10 May 1959 | 8–12 May (20) |
| | 24 | 8 May 1964 | 8– 9 May (13) |

* For first nestings only, not including re-nestings.

*Nesting success.*—Breeding success was highest in the Starling, and lowest in the bluebird, the species most directly in competition with the Starling. Flickers, unlike the other species, can make a new nest cavity when dispossessed by Starlings. Losses by flickers seem to have been relatively higher in the early stages, when Starlings were also establishing their nests (cf. Table 2). Overall, the success rates found for flickers are not far from the usual values for hole-nesters cited by Nice (1957).

A few swallow nests were lost in competition with Starlings or Buffleheads, and 1 or 2 to vandalism. Other nests were likely destroyed by squirrels, *Tamiasciurus hudsonicus* and/or *Glaucomys sabrinus*, which were common in all wooded areas. Since Starlings pre-empted most nest sites near open areas, Tree Swallows were more often found by lakes in woodland. In 1959 Tree Swallow nest losses were much higher than in 1958, and included many nests deserted with eggs intact. This probably reflected the cold, rainy weather of May and June 1959 (cf. Erskine 1972, Fig. 33, p. 190), when swallows may have had difficulty in securing food. The failure of Starlings to attempt second broods in 1959 may also have been a result of the adverse weather.

The nesting success data for bluebirds are not very complete, owing to lack of follow-up in many cases. Even by combining all records for each year, regardless of the stage at which the nests were found, not more than 3 nests out of 10 succeeded in 1958 and not more than 3 out of 6 in 1959,

TABLE 3

CLUTCH SIZES OF HOLE-NESTING BIRDS, CARIBOO PARKLANDS, BRITISH COLUMBIA

| Species | Year | Mean clutch (sample size) | No. of clutches with | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 eggs |
| Common Flicker | 1958 | 7.43 (7) | | | 1 | 1 | 2 | 2 | | | 1 |
| | 1959 | 7.40 (15) | | | | 4 | 3 | 6 | 2 | | |
| Tree Swallow | 1958 | 5.92 (25) | 1 | | 4 | 16 | 3 | 1 | | | |
| | 1959 | 5.79 (29) | | 3 | 10 | 8 | 7 | | 1 | | |
| Mountain Bluebird | 1958 | 5.29 (17) | 1 | 2 | 5 | 9 | | | | | |
| | 1959 | 4.87 (23) | 2 | 6 | 8 | 7 | | | | | |
| Starling | 1958 | 5.75 (8) * | | | 4 | 3 | | 1 | | | |
| | | 4.17 (6) † | | 5 | 1 | | | | | | |
| | 1959 | 4.63 (30) | 4 | 8 | 11 | 7 | | | | | |
| | 1964 | 5.18 (17) | 1 | 3 | 6 | 6 | 1 | | | | |

* First nestings; † Second nestings.

with corresponding egg success of 13 young fledged from 44+ eggs and 10+ from 24+ (Table 4), which are very low success rates for a hole-nesting species (cf. Nice 1957). This low nesting success was probably not sufficient to maintain local breeding numbers, which were thought to have decreased greatly during the 1950's (M. F. Jackson, pers. comm.). This is well correlated with the dramatic increase in Starling numbers at that time (cf. Myres 1958), but we have only circumstantial evidence that Starlings were in fact responsible for the bluebirds' decline. Starlings too had less success in 1959 than 1958, but even then their success should have maintained the population without second broods, since they had increased rapidly prior to 1958 with only one brood a year. The breeding success rate compared favorably with those from studies elsewhere, but there are no comparative data from western Canada or the U.S.

Finally, we must emphasize that this account covers only one stage in the interaction between Starlings and other hole-nesting birds using flicker cavities in the Cariboo region. Starlings were first noted there in 1948, and increased rapidly up to 1958 (Myres 1958), when they had nearly saturated preferred nest sites in rural areas. By then, Mountain Bluebirds had markedly decreased from former numbers, but other hole-nesting species' populations had changed little. Unfortunately, no useful population data for any species are available from the pre-Starling period, and we have no density figures even from 1958–59. By comparison with flicker

TABLE 4

BREEDING SUCCESS OF HOLE-NESTING BIRDS, CARIBOO PARKLANDS, BRITISH COLUMBIA

| Species | Year | Stage when found | No. of nests | No. (%) which fledged young | No. eggs – No. young fledged (%) |
|---|---|---|---|---|---|
| Common Flicker | 1958 | B or L* | 5 | 2(40) | 34+– 9+ (27) |
| | | Eggs | 6 | 5(83) | 37+–26 (70–) |
| | | Young | 10 | 8(80) | 66+–49 (74–) |
| | 1959 | B or L | 16 | 11(69) | 91 –47+ (52+) |
| | | Eggs | 5 | — no follow-up — | |
| | | Young | 1 | 1(100) | 4+– 4 (100–) |
| Tree Swallow | 1958 | B or L | 25 | 12(48) | 120 –43+ (36+) |
| | | Eggs | 3 | 3(100) | 16 –13+ (81+) |
| | | Young | 1 | 1(100) | 4+– 4 (100–) |
| | 1959 | B or L | 20 | 7(35) | 87+–21+ (24) |
| | | Eggs | 3 | 0(0) | 13+– 0 (0) |
| | | Young | 3 | — no follow-up — | |
| Mountain Bluebird | 1958 | B or L | 5** | 0(0) | 18 – 0 (0) |
| | | | 1† | 1(100) | 6 – 4 (67) |
| | | Eggs | 3 | 1(33) | 15 – 4 (27) |
| | | Young | 1 | 1(100) | 5+– 5 (100–) |
| | 1959 | B or L | 3 | 1(33) | 12 – 3+ (25+) |
| | | Eggs | 1** | 1(100) | 5 – 5 (100) |
| | | | 1† | 0(0) | 4 – 0 (0) |
| | | Young | 1 | 1(100) | 3+– 2 (67–) |
| Starling | 1958 | B or L | 3** | 3(100) | 16 –15 (94) |
| | | | 6† | 5(83) | 25 –14 (56) |
| | | Eggs | 6** | 5(83) | 30 –19+ (63+) |
| | | | 1† | 1(100) | 2 – 1 (50) |
| | | Young | 3 | 3(100) | 11+–11 (100) |
| | 1959 | B or L | 19 | 13(68) | 86+–39+ (45) |
| | | Eggs | 3 | 3(100) | 10+– 5+ (50) |
| | | Young | 3 | 3(100) | 8+– 8+ (100) |

* B or L — Building or Laying; ** First nestings; † Second nestings.

densities in eastern Canada, where contact with Starlings had extended over 30 years or more, we anticipated that flicker numbers would gradually decrease after 1958. The availability of flicker holes would also decrease, but more slowly. Most sites used by Starlings were in aspens, the common tree around the open areas, and the majority of nests in aspens would be unusable within 10 years (Erskine 1972, Table 9, p. 70), although new

ones would have replaced some of these. A new equilibrium among numbers of flickers, flicker holes, and birds and other animals using these holes might require 15 to 20 years for attainment. If flicker holes became scarcer, we would expect that competition for them would be intensified, and the resulting disturbance to nesting would affect most of the parameters here studied. We suggest that further studies of the hole-nesting birds in the region might profitably be undertaken now that 15 years have elapsed since our work there. In particular, quantitative estimates of the relative abundance of the species involved would be most desirable.

## SUMMARY

Comparative statistics on laying chronology, clutch size, and nesting success are presented for 4 species of hole-nesting birds in the Cariboo region of British Columbia in 1958–59, about 10 years after Starlings first appeared there. Data obtained from nest boxes were similar to those from natural sites (flicker holes) for Starlings and Tree Swallows. Circumstantial evidence suggests that competition for nest sites affected Mountain Bluebirds adversely, these birds having a wider scatter in laying dates and lower nesting success than the others. Common Flickers and Tree Swallows showed considerable scatter in laying dates, with most nest losses occurring during periods when Starlings were establishing nests, but their nesting success overall was near normal. Starlings had the most closely synchronized laying schedule and the greatest breeding success. As the most successful species, they must be viewed as influencing the breeding of all other species which use similar nest sites. All species nested later and less successfully in the wet, cold season of 1959 than in 1958.

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