after clinging briefly at the hole, entered the box, then in a quarter minute came out hurriedly. Presumably she was attacked each time. The two sittings had been under way for 9 and 5 minutes at the time of these occurrences, and were extended to 31 and 26 minutes, making them the longest sittings of the respective nestings.

On 20 July the male once flew onto the roof of the garage to which the 4608 nest box was fixed, and there moved about oddly, always just about half a dozen steps at a time, with his head somewhat raised, shoulder, rump and breast plumage fluffed out, and tail dragging. Soon I noticed the strange wren also on the roof, foraging normally, to all appearances. The male continued his display for about two minutes, then both birds disappeared as I jotted notes.

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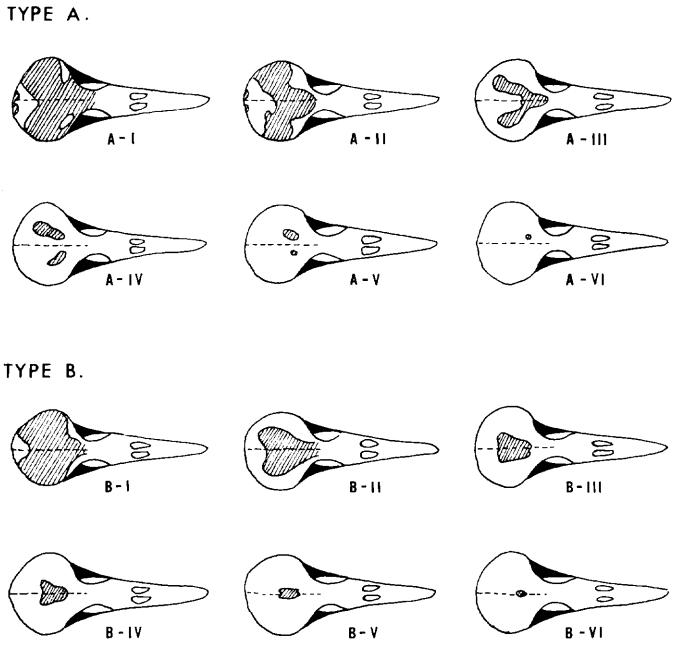
## PATTERN AND TIMING OF SKULL PNEUMATIZATION IN THE RUBY-CROWNED KINGLET

By ROBERT C. LEBERMAN

During fall bird-banding operations at Powdermill Nature Reserve (Carnegie Museum's field station in the mountains of southwestern Pennsylvania, three miles south of Rector, Westmoreland County), the skulls of most species are routinely checked for degree of pneumatization ("ossification") as an aid in age determination. The pattern and timing of pneumatization in several species has received additional attention.

In the fall seasons of 1967 through 1969, I examined (usually under magnification, and with the aid of artificial light) the skulls of over 1,000 living Ruby-crowned Kinglets (*Regulus calendula*). From these I made a series of 80 field sketches illustrating the patterns and stages of pneumatization observed. A review of these sketches indicates two common and basically different, if highly variable, patterns apparent in this species. In the first, designated as Type A, pneumatization takes place to the sides of the midline of the skull, leaving a pair of diminishing "windows" separated by

Figure 1. Type A: typical pattern of skull pneumatization in the Ruby-crowned Kinglet, terminating to the side of the midline. Type B: typical pattern of pneumatization terminating on midline. Shaded areas represent unpneumatized bone.




the pneumatized midline. A typical progression of this pattern is illustrated (Figure 1) by a six-stage composite of the field sketches. Although this pattern may be quite bilaterally symmetrical, especially in the earlier stages of development, this is not necessarily consistent and an asymmetrical pattern is often observed as pneumatization progresses (Figure 1, A-IV-VI). In the second pattern, Type B, pneumatization is terminated on the midline of the skull. The exact antero-posterior position of the final single "window" varies considerably, and pneumatization may terminate either at a point near the center of the skull posterior to the orbits, or it may nearly adjoin the base of the upper mandible well between the orbits; an intermediate position is shown in Figure 1, B-VI. It should be noted that Types A and B usually cannot be safely distinguished until pneumatization has reached stage III.

Because of the time and pressures involved in operating a large banding station such as that at Powdermill, full statistical records on the occurrence of the two skull types could not be kept. The relative frequency of each pattern, however, was noted to vary considerably between the fall migrations of 1968 and 1969. In 1968 most of the skulls far enough along in development to be

safely classified were observed to be Type A; only a few were classified as Type B. In 1969 the percentage of each type seemed about equal during the first half of the season, while after the first of November Type B predominated. The reason for this variability is not clear; perhaps the birds studied represented several discrete kinglet populations, each with slightly different genetic makeup, and migrating through western Pennsylvania at different times. There is no apparent correlation between skull type and sex or body size (using wing length as an index).

Immature kinglets with skulls appearing *almost* fully pneumatized (stage VI of either type) appeared at Powdermill as early as 3 October 1969, and by 7 October 1968. When the skulls of the first young birds have reached stage VI, a point in time is reached after which it is unsafe to assume that a bird with a fully pneumatized skull is adult. The findings of this study, then, indicate that the separation of adult kinglets from birds of the year on the basis of a completely pneumatized skull is unsafe after the end of September. Many first-year birds, however, are still found with unpneumatized skulls after this date, and by the first week of November when the majority of Ruby-crowns have already migrated through western Pennsylvania, birds representing stages III and IV of either type are still frequent. At least one bird, perhaps from a late nesting, representing stage I was recorded as late as 18 October 1968.

Eastern Ruby-crowned Kinglets may hatch young over a wide period. Nestlings or fledglings have been recorded as early as 14 June in Nova Scotia (Tufts, 1961) and as late as 14 August in Labrador (Clement, *in* Todd, 1963). The peak of hatching in the northeast in general is probably in early to mid-July. From these dates we may guess that skull pneumatization can be completed within a period as short as 110-120 days, although a somewhat longer period seems to be more usual.

A small sample of data from the Golden-crowned Kinglet (*Regulus satrapa*) indicates that the timing of pneumatization is more prolonged in that species, and that young and adult birds can safely be separated on the basis of skull appearance (which apparently may be of either type) over a somewhat longer period in the fall than can the Ruby-crowned Kinglet: perhaps into late November.

Among the passerines commonly banded at Powdermill, no species other than the Ruby-crowned Kinglet is known to complete pneumatization so rapidly. Even among the small wood warblers (Parulidae), near completion of pneumatization has not been observed within the period during which they occur at the Reserve. Mellencamp (1969), working in southeastern Pennsylvania, has indicated that immature White-throated Sparrows (*Zonotrichia albicollis*) are safely separable from adults through at least early November, but the cutoff period for most species remains poorly known.

I wish to express sincere appreciation to Dr. Mary Heimerdinger

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## A NEW METHOD OF CAPTURING NOCTURNAL ALCIDS

By C. JOHN RALPH and FRED C. SIBLEY

### INTRODUCTION

During the work of the Point Reyes Bird Observatory on the Farallon Islands, 26 miles west of San Francisco, estimates of the number of Cassin's Auklets (*Ptychoramphus aleuticus*) which breed on the islands were desired. Direct counts were impossible since this is a nocturnal species that flies to the islands by tens of thousands only after dark. Burrow counts did not prove practical because of the difficulty of determining which were occupied. The "Lincoln Index" method of mark-recapture (see Hayne, 1949 for discussion) was the obvious solution, provided that a method of randomly capturing large numbers of auklets could be developed.

Cassin's Auklets nest over most of the island surface, adapting to all varieties of terrain. They fly to the island shortly after dark, traveling slowly and evidently at the altitude of their burrow, most birds arriving within a half-hour period. In the morning the auklets leave the island from about two hours before dawn until daybreak. In this latter flight, they travel very rapidly, head directly for the sea and most fly between five and twenty-five feet above the ground.

During 1967 the Observatory attempted to use mist nets as earlier investigators had done (Kridler and Newton, 1961). This proved satisfactory during the incoming flight, but not during the morning flights when the birds were traveling at speeds probably