

latest date I found an adult Verdin still molting was 9 October. Amadeo Rea (pers. comm.) collected an adult female (AMR # 870) at Gila Bend, Maricopa County, Arizona, on 9 October, that was beginning her postnuptial molt.

The postnuptial molt of the adult Verdin is complete. This molt begins with the loss of the first (innermost) primary (table 4). Secondary replacement does not begin until several primaries have molted. Secondary 8 is molted first, followed shortly by loss of 9 and 7. About the same time that secondary 7 is being replaced, secondary 1 (innermost) is lost. Subsequently, the remaining secondaries are replaced in the following order: 2, 3, 4, 5, and 6. Molt of the rectrices typically begins after the secondaries and the primaries have begun their replacement. The sequence of replacement is from the innermost (first) to the outermost (sixth) feather.

Replacement of the upper greater primary coverts progresses with the corresponding remiges. However, the upper greater secondary coverts appear to be replaced, in sequence proceeding distally to proximal, prior to the loss of their respective remiges.

During the breeding season the yellow on the head of adult Verdins, especially males, becomes more intense. This does not appear to result from a pre-nuptial molt as I never found sheathed feathers during this time. Sennett (1879) implied that the perfection and increase in the yellow on the Verdin's head probably occur with subsequent annual molts. He may be correct in making this assumption since many older Verdins, especially the males, possess much more yellow on their heads than do first-year Verdins. Additional investigation is required to clarify this point. The deep orange spot on the Verdin's forehead is present in both sexes and in first-year birds.

Recent data obtained on the postjuvinal molt of the genus *Parus*, along with the data presented herein on the Verdin, further strengthen the current idea that the Verdin is not a parid. Keith Dixon (pers. comm.), in his studies (unpubl.) on the Mountain Chickadee (*Parus gambeli*) and the Black-capped Chickadee (*P. atricapillus*), found that not more than the four proximal secondaries are replaced, and in most individuals no remiges are dropped. Juvenal rectrices are invariably retained. In an earlier study on the Plain Titmouse (*P. inornatus*), Dixon (1962) found that rarely the outermost primaries and their coverts may be renewed.

## STILL MORE RESPONSES OF THE POOR-WILL TO LOW TEMPERATURES

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Physiological responses of the Poor-will (*Phalaenoptilus nuttallii*) to low environmental temperatures have been studied by numerous workers since Jaeger's (1948) discovery of a torpid individual in southern California (Jaeger 1949; Brauner 1952; Marshall 1955; Bartholomew et al. 1957; Howell and Bartholomew 1959; Bartholomew et al. 1962; Lasiewski and Lasiewski 1967; Lasiewski et al. 1967; Austin and Bradley 1969). Recent studies have shown that the European Nightjar (*Caprimulgus europaeus*) possesses capabilities similar to those described for the Poor-

## SUMMARY

The molts of the Verdin were studied in 1965 and 1966. Most of the 43 immature and 18 adult Verdins examined were collected in the desert areas near Mesa and Tempe, Maricopa County, Arizona. The Verdin's postjuvinal molt is incomplete: no specimen examined showed the first (innermost), second and third primaries in molt. The appearance of the yellow head feathers initiates the postjuvinal molt, and occurs before the appearance of the chestnut-colored lesser wing coverts. However, these wing coverts complete their molt before the head molt is terminated. The postnuptial molt is complete. The sequence of loss and replacement of the remiges and rectrices in both immature and adult Verdins are similar. The postnuptial molt is initiated by loss of the first primary.

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will (Peiponen and Bosley 1964; Peiponen 1965a and b, 1966).

Despite the great interest in the responses of Poor-wills and other caprimulgids to low temperatures, pattern of weight loss over many days has not been investigated. Neither has spontaneous arousal from torpor at body and ambient temperatures below 15°C been demonstrated. These topics are considered in this report.

## METHODS

A Poor-will captured on 26 September 1967 near Pocatello, Bannock County, Idaho, weighed 59.1 g. This appears to be the heaviest wild individual recorded (cf. Marshall 1955). This bird soon became tame and thoroughly habituated to its cardboard box container. It could readily be force fed quantities sufficient to cause large depositions of fat. Upon exposure to low ambient temperatures this Poor-

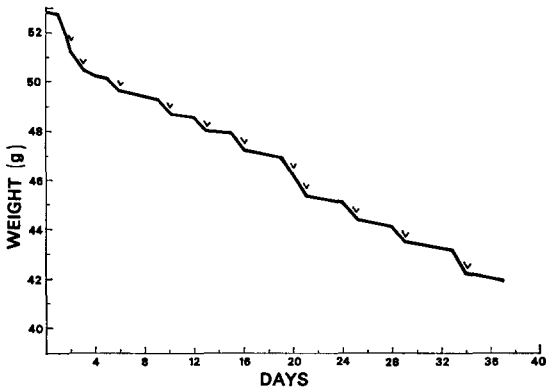


FIGURE 1. Pattern of weight loss in a captive Poor-will over 37 days at an ambient temperature of 4–5°C and body temperatures of 5.2–8.9°C. Weight loss averaged 0.26 g/day. Checks indicate periods of arousal.

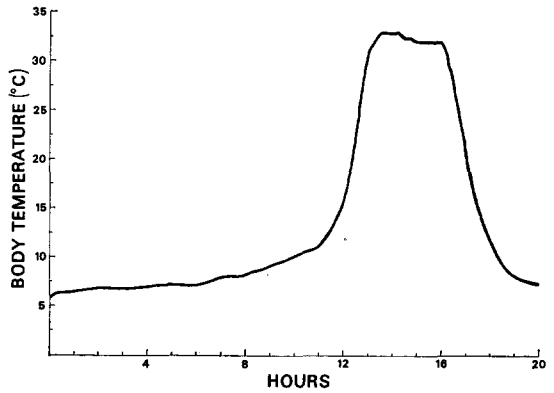


FIGURE 2. Spontaneous arousal from torpor in the Poor-will, as indicated by rise in body temperature. Ambient temperature was about 1°C.

will became torpid at weights of 52.8 and 51.3 g. These values are comparable to that of the wild bird studied by Jaeger (1948, 1949). Other authors have been unable to induce torpidity in heavy caprimulgids (Marshall 1955; Peiponen 1965). Four additional Poor-wills were captured in May 1968. These were forced into torpor by a combination of food deprivation and exposure to low ambient temperatures.

Torpid Poor-wills were weighed on a Mettler balance, accurate to 0.01 g. Body ( $T_B$ ) and ambient ( $T_A$ ) temperatures were recorded with either a Schultheis quick-registering thermometer or a Yellow Springs Tele-thermometer connected to a small animal probe inserted into the cloaca and firmly attached to the bases of the rectrices with surgical clips. Quick, careful handling during weighing and temperature recording with the thermometer did not appear to disturb birds in deep hypothermia, although it probably hastened arousal when they were spontaneously emerging from torpor. Clean absorbent papers were kept on the floor of the box so that all droppings could easily be seen and noted; the corners of the box were numbered so that movement from one to another could be recognized.

## RESULTS

**Pattern of weight loss.** Figure 1 shows the pattern of weight loss and arousal in one Poor-will over 37 days at a  $T_A$  of 4–5°C. All arousals were accompanied by 2–4 droppings composed almost entirely of what was assumed to be uric acid (cf. Folk 1969) and a clear mucous-like fluid. Marshall (1955) found that Poor-wills kept in an outdoor cage never remained torpid for more than four days. Overall weight losses per day were similar at  $T_A$  of 4–5°C and 9–10°C. These were about 0.26 g/day and 0.19 g/day, respectively, about twice the value estimated by Bartholomew et al. (1957). However, weight loss during periods between arousals was about 0.1 g/day, which agrees with their estimation.

**Spontaneous arousal and re-entry into torpor at low ambient temperatures.** To demonstrate spontaneous arousal from deep hypothermia at low  $T_A$ , I left the Poor-will undisturbed for nine days before recording a cycle of arousal and re-entry into torpor by use of the tele-thermometer (fig. 2). Arousal, as indicated by  $T_B$ , was very slow for several hours; it then in-

creased rapidly (10.1–33.0°C in 3.25 hr, or 7.1°C/hr). This ability to arouse from torpor at  $T_B$  and  $T_A$  well below 15°C contradicts the assertion of Hudson and Bartholomew (1964:546) that “the Poor-will, *P. nuttallii*, warms up only passively from the application of external heat when torpid at ambient and body temperatures below 15°C.” After about 3 hr the Poor-will re-entered torpor at a rate of about 4.8°C/hr.

Austin and Bradley (1969) provide a recent summary of rates of cooling and warming in torpid Poor-wills under a variety of experimental procedures.

**Exposure to sub-freezing ambient temperatures.** A lean Poor-will that had been torpid for about 18 hr ( $T_B$ , 5.5°C) was moved from  $T_A$  of 5°C to  $T_A$  of –12°C.  $T_B$  had dropped to 0.1°C 30 min later. I then removed the bird. It was limp, its wings were extended, and its head was thrown back, unlike the characteristic posture of torpid Poor-wills (see Jaeger 1949: fig. 13). The Poor-will was placed at room temperature (ca. 26°C) and  $T_B$  recorded periodically.  $T_B$  was 28.9°C 3 hr later. It was apparently fully recovered 21 hr later and flew well at  $T_B$  of 33.6°C. This bird subsequently was released in good condition.

Although this thin Poor-will apparently was unable to increase metabolism sufficiently to prevent its freezing at –12°C, the position of the wings and head suggest that it had sensed the very low  $T_A$ .

**Hypothermia in Poor-wills captured in spring.** Poor-wills return to southeastern Idaho in early May. On 11 May 1968 I found two fresh Poor-will rectrices and a bird was seen at the same site on 12 May. This bird (identification based on missing rectrices) was captured, as were three others. All four were exposed to  $T_A$  of about 6°C; all became hypothermic within one to four days, demonstrating that this capacity is not limited to one time of year and that it is present following long-distance migration (see also Austin and Bradley 1969; Peiponen 1966).

## DISCUSSION

Hibernating Poor-wills have been found only in the extreme southwestern portion of the United States, where cold periods are of short duration and flying insects are irregularly available throughout the winter (see Jaeger 1949: fig. 11). Winter conditions can be extreme in southeastern Idaho, and Poor-wills undoubtedly do not overwinter there. Peiponen (1966)

reached a similar conclusion regarding European Nightjars in northern Europe. Survival value of torpor is probably greatest in spring, when returning migrants may be faced with cold and perhaps wet weather for several days, as occurred at Pocatello in May 1968. In the autumn the Poor-wills depart from southeastern Idaho when the weather is mild and flying insects are plentiful.

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#### USE OF DIPPER NEST BY MOUNTAIN BLUEBIRD

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Dippers (*Cinclus mexicanus*) often nest on the supporting beams of bridges. I visited one such nest near Togwotee Pass, Wyoming (Teton National Forest Road 30018 over Black Rock Creek), in each of three summers. The underside of this bridge also contained a colony of Cliff Swallows. On 23 July

#### VARIATION IN AVIAN PLASMA PROTEINS

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In a recent paper, Sibley and Hendrickson (*Condor* 72:43, 1970) showed that avian plasma proteins (as delimited by starch gel electrophoresis) are of little value in uncovering the relationships of the higher categories of birds. They found a basic similar pattern in all the birds examined, but great variation in minor protein bands. I have examined the plasma proteins of many passerine species using disc acrylamide electrophoresis and would like to place

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1967 the nest was occupied by a pair of Dippers with two chicks, all of which I banded. Possibly as a result of this disturbance, there were no Dippers there in 1968. The nest was being utilized by Mountain Bluebirds (*Sialia currucoides*) who had 4 eggs (7 July) and 4 chicks (27 July). By 10 July 1969 occupancy had reverted to Dippers, but apparently to different individuals, as neither adult bore a band. At least two chicks were in the nest.

The Mountain Bluebird nests in river-bank cavities of Bank Swallows (Bent, U.S. Natl. Mus., Bull. 196:278, 1949), but I find no record of use of a Dipper nest by the bluebird.

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on record much the same conclusions as reached by Sibley and Hendrickson.

Avian blood was collected in a culture tube containing a tablet of potassium oxalate dissolved in a 1.0 per cent saline solution. The tubes were immediately placed on ice and the red blood cells precipitated by centrifugation. The resulting supernatant was submitted to electrophoresis. The technique used was similar to that described by Davis (*Ann. New York Acad. Sci.* 121:404, 1964), and Ornstein (*Ann. New York Acad. Sci.* 121:321, 1964). A tris-glycine buffer at pH. 8.5 with Brom-phenol blue added as a marker was used. Ten tubes, each conducting 5 ma, were run simultaneously in a cold room and the current was terminated after the Brom-phenol blue front had migrated 32 mm. The gels were stained for general protein with an amido black solution, and destained in 8 per cent acetic acid.