were successful. A fledged but not yet independent juvenile was observed gleaning grasshoppers and dragonflies. During a 7-min period, this bird stalked 4 insects, struck at 3, and captured 2.

Palmer (1962, Handbook of North American Birds, New Haven, Connecticut, Yale Univ. Press, pp. 464–472) and others mention Louisiana Herons taking dragonflies, but gleaning as a method of prey capture has not been previously recorded in this species. The utilization of a food resource in the vicinity of the nest is certainly an advantage to the birds, especially when they generally forage 2–5 km from the breeding site.

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Aspects of the Annual Cycle in Highland Populations of the Rufous-collared Sparrow, *Zonotrichia capensis*

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The form of the annual cycle of *Zonotrichia capensis* has been described from several localities in Latin America (Miller 1959, 1961; Miller and Miller 1968; Wolf 1969; Davis 1971; King 1972a, b, 1973a, b, 1976). While in northwestern Argentina, I collected information on certain of the breeding activities of this species at altitudes between 2,000 m and 3,000 m. The data supplement those of King (1973a, b) on populations at 550 m and 2,000 m in the same part of Tucumán Province, Argentina. Data were collected from various localities around and above the village of Tafí del Valle (hereafter referred to as Tafí) in the upper Angostura valley, which runs north-northwest into the Sierra del Aconquija, a pre-Andean range in the province of Tucumán, northwestern Argentina. Handford and Nottebohm (1976) show the location and give a description of the vegetation and climate of the general area.

Above 1,900 m, the Angostura valley is a wide, flat, semi-arid zone of scrub and grasses with some isolated trees, and extends 11 km to Tafí at 2,000 m, with its domestic gardens and orchards. Above Tafí, this wide valley climbs through rough pasture, which grades into rough bunchgrass (predominantly *Festuca heironymii*) from about 2,750 m to the pass of El Infiernillo at 3,040 m. Above 1,900 m, the valley receives virtually no rain from May through September. The heaviest rains are in December through February, giving a yearly total in the region of 300 mm (Meyer and Weyrauch 1966). The onset of the summer rains appears to be quite variable: in 1972, the first significant rain fell 13 November, which was 3–4 weeks late according to local information. In 1973, showers began in mid-October, and between 7 December 1973 and 21 January 1974, 110 mm of rain fell in Tafí and 132 mm fell near El Infiernillo. Twice in January 1973 there were heavy hailstorms in the valley above 2,850 m, which badly flattened the grasses. Between Tafí and about 2,600 m, the grasses began to green by November, but the area above 2,850 m preserved a dry, brown aspect late into December in both years of this study. Between 2,600 m and 2,750 m, the grasses produced flowering shoots by mid-December, and they seeded by mid-February, while above 2,850 m, flowers did not appear until mid-January. Although vegetative growth is thus retarded in the higher levels of the valley, there is dense, tall (~40 cm) cover available year round, for it is little grazed.

The artificial watering employed near Tafí and neighboring inhabited areas has a marked effect on the growth of the vegetation there. Thus on October 1972, apple trees were in bloom and willows around Tafí were in leaf, while willows 1–2 km from the village but at the same altitude were still in tight bud, as were natural alders just outside the village limits. These alders did not leaf until the first week of November.

In the first week of January 1972, vast numbers of a pierid butterfly began flying in most of the valley, and they persisted until about the end of January. During this period of abundance, they were commonly fed upon by many species of birds, including *Zonotrichia capensis*. These butterflies were rather scarce in 1969–70 (J. R. King in litt.) and also in 1973–74, single individuals being first observed 30 December 1974. Overall, then, this valley shows considerable variation both within and between years in the appearance of new vegetation and in the availability of insect food. In addition, the highest areas are subject to occasional severe storms.

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In 1972–73, I netted and trapped a total of 205 birds at 2,800 m and at 2,980 m. All of these birds were released. In 1973–74, 203 birds were captured at 5 sites: 2,000 m, 2,600 m, 2,800 m, and 3,020 m.

Prenesting activities and movements.—Probably most of the sparrows move into the upper valley from below around the end of August (King 1973a, Olrog pers. comm.), though it is not known where they winter. The timing of onset of the breakdown of winter groups, of pair formation, and of singing activity appears to be rather variable. Nottebohm and Nottebohm (in press) report strong singing activity above Tafí in September, and this is corroborated by King (1972b). In 1972, however, although I saw *Z. capensis* throughout the valley by 1 November, they were still largely in small groups, and there was very little singing then, except in the immediate vicinity of Tafí. Most songs were incomplete (lacking the terminal trill) or poorly formed (showing a pronounced wavering quality) at that time. By 19 November, however, most birds were clearly paired up to about 2,800 m, while above this, fully half of the birds were still moving around in small groups. By the end of the first week of December, virtually all the birds seemed paired, and singing was vigorous throughout the valley. The situation was similar in 1973–74; loose groups of sparrows were found to the top of the valley by 13 October, but sustained singing by obviously paired birds was not heard at 2,800 m until 20 November, even though significant rain had begun in mid-October. As late as 29 November there was little sustained song at 3,000 m. By this time, birds in the village of Acheral at 400 m had been singing well for at least 6 weeks.

In November 1973 a large (70–100) flock of Rufous-collared Sparrows moved up the valley. They were first observed at 2,750 m on 18 November, and they stayed in that locality for 4 days. This conforms with the observation of a flock, "evidently migrants," reported at 2,000 m on 20 November 1969 by King (1972b). They were last seen on 9 December at the pass of El Infiernillo. These transient birds were readily distinguishable from the local birds, many of which were obviously paired and giving the *sep* note (Miller and Miller 1968). To a large extent, the transients were silent, although occasionally a single bird would give a loud, complete song while making a fluttering descent from about 10 m in the air. These flight songs, which apparently constitute a display not previously reported in this species, were of similar basic structure to those heard elsewhere in northwestern Argentina.

The established Rufous-collared Sparrows distributed themselves fairly uniformly over the grazed and previously burnt areas, characterized by short grass and separated grass tussocks, but they were largely absent from dense, exposed, pure stands of *Festuca,* which were dominated by the finches *Phrygilus plebejus* and *P. alaudinus.*

The cloacal protuberance and brood patch.—In the first season, the length of the cloacal protuberance was measured (Fig. 1). Birds were not taken at both localities throughout the season, but all samples appear to fall into a single pattern. Virtually all birds were paired and singing was vigorous in all of the valley by the time of the first sample shown in Fig. 1. Limited data from the second season suggest that a protuberance of about 7.0 mm was achieved at both 2,800 m and 2,980 m about 10 days earlier, and 16 specimens taken near the village (2,000 m) between 11 and 17 December 1973 had a mean protuberance length of 7.16 mm. Because testis condition was not assessed, it is not possible to estimate with certainty the date by which most males had become sexually competent. Davis (1971) considered males with a protuberance of 7.0 mm or longer to be fully competent, but it would probably not be safe to use the same index here, as the Peruvian birds clearly achieved a higher maximum protuberance length. Similar caution is suggested by noting that the Colombian birds reported by Miller (1958) were sexually competent with a protuberance measuring 5–7 mm.

In the first season, the condition of the brood patch was noted. At 2,800 m, the first bird with an oedematous patch was captured on 20 December; by the first week of January, most females captured showed oedematous patches at both 2,800 and 2,980 m. The first bird with a flaccid, wrinkled, regressing patch was taken on 27 January 1973 at 2,980 m, and by the second week of February, most birds at both sites were in this condition. At the higher site, 7 apparent females (based on wing length and lack of cloacal protuberance) out of a total of 29 captured between 12 January and 7 February 1973 had fully feathered breasts. These certainly represent nonbreeding rather than early-breeding individuals, as their plumages were rather worn, showing no signs of the postnuptial molt during which the breast is refeathered.

In the second season, samples from the orchards near Tafí (2,000 m) showed that 5 of 6 females had oedematous brood patches on 17 December, while only 3 days later, 8 of the 9 females taken from above 2,800 m were showing only slight defeathering, while one was vascularized.

Nest, eggs, and young.—Twenty-three nests were found in or under the bases of grass tussocks. Three were between or under small rocks, and one was found about 20 cm up in a small *Berberis* bush. With the small number of nests found, and the fact that field work was not distributed evenly throughout the nesting season at all altitudes, one can only make rough estimates of the onset and duration of the

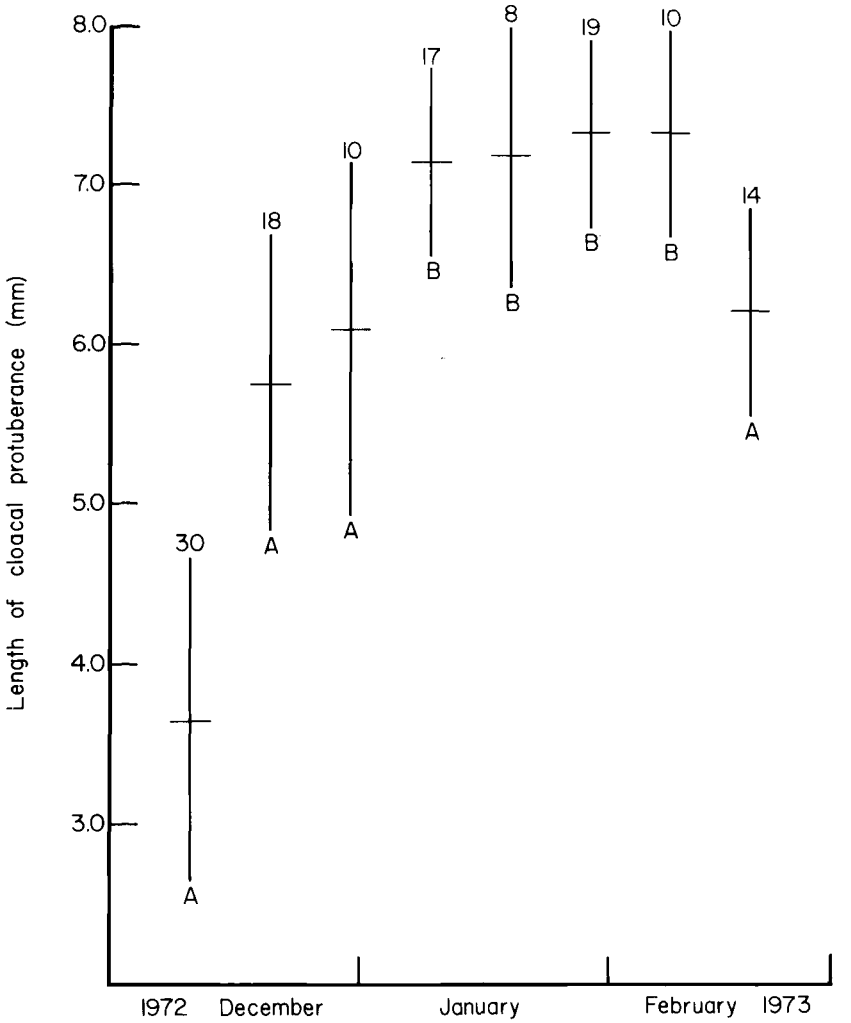

Fig. 1. Length of cloacal protuberance in samples of adult *Z. capensis*, December 1972–February 1973. Shown is the mean and one SD. Sample size is given above each bar, sample origin below: A = 2,800 m, B = 2,980 m.

complete fresh-egg clutch and nestling seasons. Nevertheless, there are indications that, at altitudes greater than 2,500 m or so, the seasons may be later and shorter than those reported by King for 2,000 m (1973b), at least in some years. On both 8 and 10 December 1973, three nests with probably complete clutches were found in the immediate vicinity of Tafí (2,000 m), comparing well with King's (1972b) estimate for earliest complete clutches of 6 December. I was afield at 2,800 m almost daily from mid-November in the first season, yet the first eggs were not found at that altitude until 21 December. As late as 17 December, many sparrows were still to be seen carrying nest material at 2,980 m. It is not possible to say to what extent this delay is a typical feature of highland populations; certainly, however, there are substantial differences in season among years. Thus at 2,980 m, juveniles with fully grown flight feathers but no appreciable tail were not caught until 6 February 1973, while between 8–12 January 1974, several poorly flying juveniles with emerging tails were captured and seen at the same locality. By late January of that year, juveniles were already forming loose groups at this altitude (Olrog pers. comm.).

From the data on four nests (1 from 2,800 m and 3 from 2,980 m), I estimate 11–12 days as the period of incubation, an estimate that agrees well with that reported for Colombian sparrows (Miller and Miller

1968). Fledging times (to leaving nest) from 6 nests (3 each from 2,800 m and 2,980 m) are as follows: one, 8–9 days; one, ≤9 days; one, 9–10 days; and three, 8–10 days. An average of a 9-day fledging time seems probable, and this is substantially shorter than that of both Colombian birds from ca. 2,000 m (11.1 days, Miller and Miller 1968) and birds from 550 m in Tucumán, Argentina (11 days, King 1973a). It is not known whether this reflects more rapid growth or simply earlier quitting of the nest.

Complete clutches indicate a mean clutch size of 2.66 (8/3) at 2,980 m, 2.33 (21/9) at 2,800 m, and 2.80 (14/5) at 2,000 m. King (1973a) reports a mean clutch size at 550 m of 2.69 (35/13); thus, there is no suggestion of a trend toward greater clutch size at higher altitudes in this region.

Five of the 16 nests from the first season were either trampled or preyed upon, while two nests were deserted. Eight nests appeared successful, with a maximum of 18 chicks leaving the nest. In the second season, five of the 11 nests were destroyed or preyed upon. This nest success, in terms of the fraction of nests producing at least one fledgling, is similar to the 4/10 reported by King (1973a).

The overall impression gained is that the timing and success of breeding activities in the high valley are strongly affected by the condition of the habitat (probably new summer vegetation, as suggested by King 1973b). Similar variability has been noted in high altitude populations of a north American congener, *Z. leucophrys oriantha* (Morton 1976), although here the determining variable appears to be the disappearance of snow pack and occurrence of spring blizzards.

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