

SECONDARY SEX CHARACTERISTICS IN ROADRUNNERS

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The literature contains no reports on sexual dimorphism in Roadrunners (*Geococcyx californianus*). Whitson (1971) determined sex from copulatory behavior, and Ohmart (1973) determined sex of dye marked birds at the conclusion of his study by dissection. Each researcher worked closely with a number of birds but did not report sexual dimorphism.

This report is from a study of the population ecology of Roadrunners during 1972 and 1973 at the Rob and Bessie Welder Wildlife Foundation Refuge near Sinton, Texas. Wild Roadrunners at the Refuge could be grouped into two distinct categories and an intermediate condition. These categories were based on the color of a portion of the post orbital apterium (POA), a featherless area of skin on the side of the head behind the eye. The general form of the POA is illustrated in Figure 1. Shufeldt (1885) gave

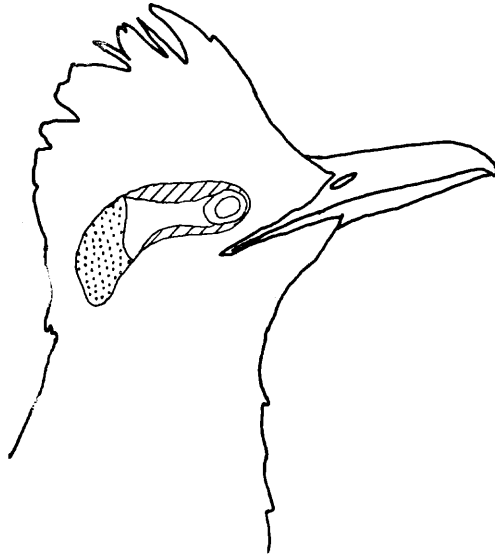


FIGURE 1. General form of the post orbital apterium (POA). Cross-hatched area is dark blue. Stippled area is orange. Remainder is variable between medium blue and white.

a fairly accurate description of the POA. His written description of the POA corresponds to the condition that we have associated with a female (described below), but the color plate in the Texas A & M University Library copy of the journal appears to be a male based on our experiences. Shufeldt presumed his specimen to be a male, but apparently did not dissect it.

The POA can be divided into several areas. The overall length from the posterior edge of the eye to the edge of the mid-dorsal line of feathers of the capital tract is approximately 30 mm (all measurements are approximate due to stretching of the skin). The posterior 14 mm is orange. The upper and lower edges of the anterior part are dark blue and extend 2 to 3 mm toward the center from the upper and lower feathers. The remainder of the anterior portion of the POA varies from bird to bird, ranging from light blue (medium blue in extreme cases), which we associate with females, to white, which we associate with males, with occasional intermediate conditions. The intermediate conditions take the form of intrusions of small patches of blue into the white field, particularly in the small folds in the skin. The width of this blue-white area is about 8 mm.

Both the blue and the white are likely caused by the same physical process, tyndall scattering. Fox and Vevers (1953), Lucas and Stettenheim (1972), and Rawles (1960) describe this scattering process. The orange area of the POA is apparently due to pigments deposited in a superficial layer of the skin. It can be physically peeled off and disappears after preservation in formalin. These colors are not preserved in study skins.

Throughout the study on the Welder Roadrunner population, judgments of POA color were made for 381 observations (representing about 38% of all observations). Of these, 215 (56%) were recorded as POA-W (post orbital apterium - white), and the rest as POA-B (POA - blue). During 1972, 50% of such judgments were POA-W, 32% were POA-B and 18% were undecided (because of intermediacy in color). Whether or not a determination could be made depended on lighting conditions and the distance between bird and observer. POA-W was recognizable at a greater distance than POA-B.

During the study, 29 adult Roadrunners were individually marked, and 26 of these were subsequently observed for a total of 132 observations in which POA color was recorded. The POA color was constant for all except one of the marked adult Roadrunners. This color constancy applied from one year to the next as well as throughout the breeding seasons. The one exception to color constancy was a Roadrunner tagged in February 1973, judged as POA-B when marked and for two subsequent observations. In May 1973, it was judged to be POA-W and this condition remained for all additional observations.

The association of POA color with sex was suggested by the fact that of 38 observations of Roadrunner pairs in which POA color of both birds was definitely determined, 37 pairs consisted of one each POA-W and POA-B. Of the other pair, both were POA-W.

Direct evidence of POA color association with sex was available for six cases, namely by examination of gonads. Two POA-W were males, and four POA-B were females. Indirect evidence associating POA color with sex was available for 17 additional cases. This evidence was based primarily on behavioral characteristics. Association of POA-W with male was suggested in

10 cases, and POA-B with female in 7 cases, with no inconsistencies. This direct and indirect evidence is presented in Table 1. The association of POA color with sex is highly significant (adjusted $G = 23.62$, 1 df, $P < .005$; Sokal and Rohlf, 1969).

TABLE 1.
Association of POA color with sex in Roadrunners

POA Color	Number of Males	Number of Females
POA-W ¹	12	0
POA-B ²	0	11

¹Gonads observed in 2 cases by laparotomy, 6 observations of typical male courtship behavior, 2 observations of boundary interaction, 1 observation of assumed territorial "cooing," and 1 observation of POA-W bird in territory where female was known to be dead.

²Gonads observed by dissection of 2 casualties, 2 cases by laparotomy, 5 observations of typical female courtship behavior, and 2 observations of enlarged cloacas in birds that had presumably recently laid eggs.

The transition of juvenile males from POA-B to POA-W possibly accounts for the intermediate condition assuming that all young Roadrunners have POA-B with adult females retaining this condition. The data from this study are insufficient to settle this point, although several young birds, as judged by lack of full color of the yellow eye ring, were POA-B.

Hence we believe that the POA-W condition is associated with males and the POA-B condition is associated with females in adults. The determination and interpretation should be done with caution as this evidence was based on only one population of Roadrunners. An additional reason for caution is that the observed pair in which both members were POA-W had a nest with a clutch of 6 eggs, fairly strong evidence that this method of sexing Roadrunners is not infallible.

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