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## RE-EVALUATION OF THE "HYBRID" HUMMINGBIRD *CYNANTHUS SORDIDUS* × *C. LATIROSTRIS* FROM MEXICO

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Friedmann et al. (1950) reported a "hybrid" between the Dusky Hummingbird (*Cynanthus sordidus*) and the nominate race of Broad-billed Hummingbird (*C. latirostris*). Gray (1958) did not list this hybrid combination in her extensive survey, but Short and Phillips (1966) and Mayr and Short (1970) mentioned its existence. Here I present evidence that the purported hybrid, as well as 14 similar specimens, are simply plumage variants of *C. sordidus*.

While studying the avifauna of the Mexican state of Oaxaca, I examined the hybrid specimen in question, No. 37930 in the Moore Laboratory of Zoology (MLZ) Occidental College, Los Angeles). It was an adult male collected by C. C. Lamb on 9 July 1943 at 1,829 m elevation at "Tamazulapam" (=Tamazulapan del Progreso), a town located in the interior highlands of extreme northwestern Oaxaca, not far from the Puebla border. My field companions took two similar specimens in Oaxaca, and my search of museums disclosed an additional 12 from various Mexican states, as follows: MICHOACÁN: Tafetán, 1,410 m elevation, 31 July 1939 (MLZ 24159); DISTRITO FEDERAL: no locality, 14 March 1943 (MLZ 36007); MORELOS: 3 mi S Cuernavaca, 1,433 m elevation, 3 November 1946 (MLZ 44491); 12 mi E Cuernavaca, 1 March 1970 (F. G. Stiles 249); PUEBLA: no locality, July 1928 (MLZ 641); 4 mi N Izúcar de Matamoros, 1,326 m elevation, 28 July 1957 (Western Foundation of Vertebrate Zoology [WVZ] No. 4407) and 29 July 1957 (WVZ 4408); OAXACA: Rancho Las Animas, 2 mi W Nejapa, 915 m elevation, 8 July 1957 (WVZ 4402), 11 July 1957 (WVZ 4403), and 25 September 1952 (MLZ 54436); 9 mi E El Tule (=Santa María del Tule), 9 May 1961 (Louisiana State University Museum of Zoology [LSUMZ] No. 24339); 18 mi SE Matatlán [=Santiago Matatlán], 976 m elevation, 30 May 1964 (LSUMZ 33086); 10 mi SE Oaxaca, 1,585 m elevation, 28 November 1964 (WVZ 21269); 15 mi SE Oaxaca, 1,585 m elevation, 30 November 1964 (WVZ 21268).

The purported hybrid has never been described. I compared it and the other "hybrids" for size and plumage color to typical examples of *C. sordidus* and all races of *C. latirostris* (*magicus*, *propinquus*, *latirostris*, *toroi* and *doubledayi*). A. R. Phillips (in litt.) and I both agree with Salvin and Godman (1888-1904), Ridgway (1911) and others that *C. l. nitida* (Salvin and Godman), accepted as a distinct race by Friedmann et al. (1950), is a synonym of *C. l. doubledayi* (Bourcier), the described differences being attributable to age, wear, or individual variation. All of the "hybrids" were adult males as determined from the labeled sex, plumage characters, and absence of the strong bill corrugations of immatures (Ortiz-Crespo 1972). Of the many females and 14 immature males that I examined, none possessed intermediate characters. Hence, here I deal with only adult males.

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The major color differences between *C. sordidus* and *C. latirostris* are as follows (*C. latirostris* in parentheses): (1) throat dull sooty-gray, each feather with a concealed darker gray subterminal area (strongly glittering bluish-green to purplish-blue); (2) midbreast sooty-gray (metallic, i.e., shiny but not strongly glittering, yellow-green, green, blue-green or blue); (3) abdomen dull pale gray (metallic yellowish-green to blue-green); (4) long undertail coverts pale buffy-gray (white, mostly white or, in *doubledayi*, glossy bluish-black); (5) dorsal surface of central rectrices olive-green, basal one-third orange-green (glossy bluish-black, tipped gray); and (6) forehead and crown metallic yellowish-green (similar, except strongly glittering green to bluish-green in *doubledayi*).

The "hybrids" were identical to *C. sordidus* in all respects except throat color, which, presumably, was the character noted by Friedmann et al. (1950). The throat of "hybrids" had a variable number (from 1 to many) of feathers with a single, metallic, green-to-blue subterminal disc that was only partially concealed. I judged the color of these spots by eye, employing an evenly graded spectral scale from green to blue, as follows: 1, green; 2, bluish-green; 3, blue-green; 4, greenish-blue; and 5, blue. Of the 15 "hybrids" that I examined, 1 had green spots, 5 bluish-green, 6 blue-green, 1 greenish-blue and 2 blue. The average value was 2.9, or approximately blue-green. If the spotted-throat birds were true hybrids, I would have expected more similarities in plumage color between them and *C. latirostris*, especially in view of the great differences between the species.

Simon (1921) long ago noted that certain "very old" adult males of *sordidus* have colored spots on the "chest." This character might be the result of older age but I cannot think of any way to test this possibility short of raising birds in captivity. The "hybrid" spots are similar in shape and position to the concealed dark gray subterminal areas of typical *sordidus*, differing only in extent, color, and iridescence, which suggests that the two are merely variations on a single theme.

The races *C. l. latirostris*, *magicus*, and *doubledayi* were smaller than *C. sordidus* in wing, tail and culmen lengths, outer rectrix width, and weight (Table 1). The depth of the tail fork was greater in *magicus* and *doubledayi* than in *sordidus* but about the same in nominate *latirostris*. In size, *propinquus* is similar to nominate *latirostris* (Moore 1939), while *toroi* is intermediate between *latirostris* and *doubledayi* (Berlioz 1937).

All available measurements for the reported "hybrid" (MLZ 37930) were similar to the means for *sordidus*; compared to *C. latirostris*, they were outside the range of variation in outer rectrix width and near the upper extremes in tail and culmen lengths. The means for the other "hybrids" were virtually identical to those for typical *sordidus*, except in tail fork depth, and were appreciably larger than those for *C. latirostris*. Compared to *doubledayi*, the "hybrids" exceeded the range of variation in weight, wing length, and culmen length, and matched the largest extremes for tail length and outer rectrix width. Only in the depth of the tail fork were the "hybrids" clearly intermediate between the two species. If the spotted-throat birds were hybrids, I would have expected more of their measurements to be intermediate (or perhaps larger than *sordidus* if hybrid vigor were involved).

The known ranges of the two presumed parents also argue against, if not preclude, hybridization. *C. sordidus* occurs in Jalisco, Michoacán, Guerrero, Oaxaca, Hidalgo, Distrito Federal, Morelos, and Puebla, while *C. latirostris*

TABLE 1. <sup>1</sup>Measurements ( $\bar{x} \pm 1$  SD; range; sample size in parentheses) of adult male *Cyananthus sordidus*, supposed "hybrids" *C. sordidus*  $\times$  *C. latirostris*, and three subspecies of *C. latirostris*.

	Wing length	Tail length	Culmen length	Outer rectrix width	Tail fork depth	Weight
Typical <i>C. sordidus</i>	55.9 $\pm$ 2.0 52.9–58.6 (20)	34.4 $\pm$ 2.3 31.5–37.6 (18)	21.5 $\pm$ 1.4 19.5–24.3 (21)	7.8 $\pm$ 0.4 6.7 $\pm$ 9.1 (20)	6.6 $\pm$ 2.0 4.2–8.8 (16)	4.3 $\pm$ 0.0 4.3–4.3 (2)
Reported "hybrid" (MLZ 37930)	molt	35.0	22.7	8.0	molt	none
Other "hybrids"	55.8 $\pm$ 1.4 53.1–57.8 (12)	34.8 $\pm$ 1.2 32.9–36.4 (11)	21.8 $\pm$ 1.9 20.3–23.9 (13)	7.8 $\pm$ 0.3 6.7–8.7 (11)	7.0 $\pm$ 1.1 6.0–9.4 (11)	4.4 $\pm$ 0.1 3.8–4.7 (5)
<i>C. l. latirostris</i>	53.4 $\pm$ 1.2 51.8–55.0 (16)	32.1 $\pm$ 1.0 30.5–33.4 (14)	21.2 $\pm$ 1.2 19.0–23.0 (17)	6.9 $\pm$ 0.1 6.4–7.7 (15)	6.5 $\pm$ 1.5 4.4–8.5 (13)	3.4 $\pm$ 0.4 2.6–4.2 (7)
<i>C. l. magicus</i>	51.8 $\pm$ 3.0 49.7–54.8 (9)	31.9 $\pm$ 3.7 28.9–35.1 (11)	20.4 $\pm$ 1.0 18.2–22.1 (12)	6.9 $\pm$ 0.2 6.0–7.4 (11)	8.2 $\pm$ 3.3 5.3–10.7 (9)	none
<i>C. l. doubledayi</i>	48.6 $\pm$ 3.0 45.3–51.2 (8)	30.4 $\pm$ 4.4 26.8–32.9 (6)	18.1 $\pm$ 0.9 16.4–18.9 (8)	6.3 $\pm$ 0.1 6.0–6.7 (5)	9.0 $\pm$ 2.4 7.3–11.0 (6)	2.4 $\pm$ 0.3 2.0–2.8 (2)

<sup>1</sup> In mm. Wing length = chord; culmen length = posterior edge of nostril to tip; outer rectrix width at a point 7 mm from tip; tail fork depth on one side with shafts of outermost and adjacent central rectrix parallel; weight = g.

is widespread from southwestern United States south to Chiapas and northern Veracruz (Friedmann et al. 1950). Both species occur in all states in which *sordidus* has been recorded, except perhaps in Puebla (see below). On zoogeographical grounds, I would expect both species to occur also in the states of Guanajuato, México, and Tlaxcala, where *sordidus* is apparently unrecorded.

Before discussing further the evidence inherent in ranges, two apparent errors by Friedmann et al. (1950) must be corrected. Those authors listed Oaxaca in the range of *C. l. latirostris* on the basis of two female specimens in the Moore Laboratory of Zoology that were taken in February "near Tequisistlán," a town located in the Pacific lowlands just west of the Isthmus of Tehuantepec. I have been able to find only one such specimen, an immature female (MLZ 45107) collected by C. C. Lamb on 18 February 1947 at 915 m elevation at Rancho Las Animas, about 56 km west of Tequisistlán. This specimen, in my opinion, cannot be assigned to race; even its specific identity is questionable because the tail color closely resembles that of *C. sordidus*. I know of no other Oaxaca records for nominate *latirostris*.

According to Friedmann et al. (1950), the range of *doubledayi* includes "Puebla and northern Oaxaca." I have found no evidence that this subspecies occurs in either place. In Oaxaca, it is restricted to the arid tropical scrub and open tropical deciduous forest of the Pacific coastal lowlands below 275 m elevation and has not been recorded in the arid temperate scrub in the interior highlands of central or northern Oaxaca. I also doubt that it occurs in Puebla, as all references to that state apparently stem from a locality variously written as "Chinautla" or "Chiantla," Puebla, "Chinantla," Guerrero, and "Chimantla," country of México. The only similar locality I can find is "Chinantla," which is between 1,000 and 1,500 m elevation in the interior highlands of southern Puebla, well outside the known elevational, geographical, and vegetational ranges of *doubledayi*. I therefore believe that allocation of any record to Chinantla, Puebla is erroneous. My search of the major U.S. museums failed to reveal a Puebla specimen for any race of *C. latirostris*. I would expect *C. l. latirostris* to occur in the northern part of that state, as it has been recorded in Morelos, Hidalgo, and northern Veracruz, according to Friedmann et al. (1950).

Thus, with the deletion of *C. l. latirostris* from the entire state of Oaxaca and of *doubledayi* from the northern part,

the reported "hybrid," MLZ 37930 from Tamazulapan del Progreso in northern Oaxaca, was collected where only one of the supposed parents, *C. sordidus*, occurs. The same may be said for all seven of the other Oaxaca "hybrids." The three taken at Rancho Las Animas, where nine typical *sordidus* have also been collected (LSUMZ, MLZ, WFWZ), are the closest to the known range of *C. latirostris* (the subspecies *doubledayi* having been recorded about 56 km east at Tequisistlán [pers. observ.]). The three "hybrids" from the Oaxaca Valley, which is situated in the interior halfway between Tequisistlán and Tamazulapan del Progreso, are well outside the geographic ranges of the subspecies *doubledayi* and *latirostris* as well as the habitat and elevational ranges of the former. The large number of "hybrids" (15) and their wide range of occurrence in southern Mexico also dispute hybridization, which even in Trochilidae must still be considered a rare phenomenon (see Lynch and Ames 1970).

Vagrancy on the part of one parent has led to hybridization in hummingbirds (Banks and Johnson 1961, Baldrige et al. 1983). Although I cannot completely exclude this possibility in the present case, the probability that as many as 15 hybrids have resulted from vagrancy of *C. latirostris* seems remote. Also, if we were dealing with hybrids, I would have expected some to have been found inside the range of *C. latirostris* and outside the range of *sordidus*.

In view of the large number of "hybrids," their wide geographic range, the absence of one of the presumed parents in part of this range, and the lack of intermediate size and color characters other than throat-spotting, I conclude that the supposed hybrids are normal individual or age variants of adult male *C. sordidus* and that the hybrid combination *C. sordidus*  $\times$  *C. latirostris* does not exist.

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## APPARENT DOUBLE BLASTODERMS IN ADÉLIE PENGUIN EGGS

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As part of a study of yolk formation in the Adélie Penguin (*Pygoscelis adeliae*), we removed 148 freshly-laid eggs from 94 marked pairs nesting at the Cape Crozier rookery, Ross Island, Antarctica, in November 1981. While analyzing yolk structure, we discovered that 17 (11%) of these eggs had yolks supporting two apparent blastoderms (fertilized ova). Multiple blastoderms and blastodics (unfertilized oocytes) have been noted in domestic chicken (*Gallus gallus* var. *domesticus*), quail, and turkey (*Meleagris gallopavo*) eggs at low frequencies (Abbott, pers. comm.; Romanoff and Romanoff 1949). Olsen (1962) found this multiple condition most frequently in unfertilized eggs laid by turkeys vaccinated with fowl pox virus. The occurrence of dizygotic embryos developing on a single yolk has been reported as rare (Dareste 1874, Riddle 1924, Newman 1940, Levi 1957). Out of over 15,000 yolks examined from more than 80 non-domestic species, these Adélie Penguin eggs are the first eggs we have seen to clearly exhibit this anomaly.

Of the 17 eggs considered here, 8 were from four two-egg clutches and 9 were single eggs from complete clutches. Twelve eggs were laid by 9 females all nesting within an area of approximately one ha. Our study plot inscribed an area of over 100 ha with penguin nests occurring on all available snow-free patches of open ground. Since egg collection within the plot was well distributed, we were surprised at the clustered occurrence of these unusual eggs. All females from which eggs had been taken (total = 148) had been given an oral dose of non-toxic lipophilic dye (Sudan black B) before laying as part of another experiment. This dye was transferred to the layer of yolk deposited on the dose date and was used to define the timing of yolk formation. For the eggs containing double blastoderms, the dye served to tint the yolk blue and enhanced the visibility of the blastoderms, which appeared as 2-5

mm undyed discs on the surface of the yolk. The presence of a second blastoderm may have gone unnoticed without the dye since the blastoderm is hard to see on the pale yellow yolk surface of penguin eggs. Blastoderms are easily visible on egg yolks of most species where the female is feeding while the yolk is formed; female Adélie Penguins are fasting at this time.

Yolk is deposited in a regular and predictable manner with lipoprotein material laid down in layers, enlarging the growing yolk over a period of days. The number of days of yolk deposition is species-specific. No yolk is deposited at the position of the blastodisc, either because yolk material cannot pass between the follicle's granulosa cells or because the oolemma outside the blastodisc is unable to incorporate the yolk (Perry et al. 1978). The result is visible as the neck of the latebra—a tubelike extension of the pale yellow yolk seen in a yolk cross-section—which connects the central latebra, or primordial yolk, with the nucleus of Pander under the blastodisc (Romanoff and Romanoff 1949). Cross-sections of yolk from penguin eggs with double blastoderms show two distinct latebral necks (Fig. 1), although one neck often is less noticeable. This duplication of yolk structure indicates that both apparent blastodiscs were present many days before ovulation, usually days before the females arrived at the rookery. Thus, the possibility is eliminated that these anomalies resulted from any postovulatory events, such as polyspermy or structural disturbances owing to rough handling or shaking—treatments known to induce monozygotic "double-monsters" in single blastodermal eggs handled later in development (Ulshafer and Clavert 1979). Similarly, a high incidence of monozygotic twins can result from inducing hypothermia in egg-laying chickens (Sturkie 1946) or from exposing waterfowl eggs to low temperatures before incubation (Batt et al. 1975). These two conditions are effective only after fertilization, however, and thus are unlikely causes of the present problem. Because all our eggs were subjected to the same procedures of transport, storage, and fixation, artifacts of preparation are effectively precluded. The angle formed between the two latebrae averaged 85° (10°-170°) but did not prove to be a clue as to their origin.

Preparation of yolk for analysis of its formation requires freezing, fixation in a 4% formalin, and slicing (Grau 1976). These procedures do not preserve the vitelline membrane and the adherent blastodermal tissue for histology. As a result, hematoxylin-eosin staining of sections of the apparent blastoderms failed to reveal conclusive evidence that both locales supported cellular material. We were