

**Diagnoses of hybrid hummingbirds (Aves: Trochilidae). 14. New perspectives on Sefton's specimen (*Calypte costae* × *Selasphorus platycercus*) from the Rincon Mountains, southeastern Arizona**

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*Abstract.*—The unique hummingbird specimen collected by J. W. Sefton, Jr., in 1932 in the Rincon Mountains, southeastern Arizona, is confirmed to be a hybrid, *Calypte costae* × *Selasphorus platycercus*. The hybrid exhibits a blended mosaic of plumage characters of the parental species. Other parental hypotheses were ruled out on the basis of plumage color and on measurements of the outermost rectrix (R5).

On 21 June 1932, J. W. Sefton, Jr., collected an unusual hummingbird in the Rincon Mountains, Pima County, Arizona, that was cataloged as *Calypte costae* (Costa's hummingbird) in the collections of the San Diego Society of Natural History (Huey 1944). More than a decade later, Huey noted that the adult male specimen differed from typical *C. costae* and sent it to A. J. van Rossem (University of California, Los Angeles) and Alexander Wetmore (Smithsonian Institution) for identification. Van Rossem (Huey 1944:636) replied, "I cannot imagine it as anything other than a good hybrid between *Calypte costae* and *Selasphorus platycercus* [broad-tailed hummingbird], both of which species are presumably common in the Rincons and are the only two which could produce the combinations shown—'spotty' crown, color of throat intermediate, tail characters also intermediate including length." Wetmore (Huey 1944:636) concurred with van Rossem's identification and observed, "the form of the tail and gorget are like *Calypte*, except that in the latter the produced end has the feathers more rounded, somewhat as they are found in the *C. anna* [Anna's hummingbird]. The

larger size agrees with *Selasphorus*. The color of the crown and the gorget are intermediate between the two, and the reduction of the brilliant color of the crown is suggestive of the larger bird. The slight emargination of the tip of the outer primary is intermediate also, being suggestive of *Selasphorus*."

Huey (1944) presented several wing and tail measurements of Sefton's specimen and the putative parental species, as well as a brief summary of the ecological distributions of *Calypte costae* and *Selasphorus platycercus* in Arizona. However, his brief note failed to address alternative hypotheses, particularly the possibility that *Calypte anna* was one of the parental species, as suggested by Wetmore's observation of tail shape of the specimen. Banks & Johnson (1961) could not locate Sefton's specimen for their monographic review of North American hummingbird hybrids. Nonetheless, subsequent compilations accepted Huey's treatment without additional comment (Gray 1958, Panov 1989, Stiles 1999). A recent inquiry revealed that Sefton's specimen was still in the collections of the San Diego Museum of Natural History (P. Unitt, in litt.). Here I provide a more compre-

hensive assessment of the specimen employing the methods and assumptions outlined in Graves (1990) as modified by subsequent papers (Graves & Zusi 1990, Graves 1998, 1999a).

### Materials and Methods

Sexed as ♂ on the San Diego Society of Natural History label, Sefton's specimen (now San Diego Natural History Museum No. 15883) appears to be adult as judged by the absence of striations on the maxillary ramphotheca, the absence of distinctive buffy feather tips on the dorsal plumage, and the presence of a fully developed, brilliantly iridescent gorget. Description and discussion in this paper refer to definitive male plumage. Given the migratory behavior of hummingbirds in western North America, Sefton's specimen could have been hatched at some distant location (e.g., California or Sonora, Mexico). Thus, I compared the specimen with series of all trochiline species (National Museum of Natural History, Smithsonian Institution) which regularly breed in California, Arizona, northern Chihuahua, and Sonora: *Calypte anna*, *C. costae*, *Selasphorus platycercus*, *S. rufus* [rufous hummingbird], *S. sasin* [Allen's hummingbird], *Stellula calliope* [calliope hummingbird], *Archilochus alexandri* [black-chinned hummingbird], *Calothorax lucifer* [Lucifer hummingbird], *Heliomaster constantii* [plain-capped starthroat], *Eugenes fulgens* [magnificent hummingbird], *Lampornis clemenciae* [blue-throated hummingbird], *Amazilia beryllina* [berylina hummingbird], *A. violiceps* [violet-crowned hummingbird], *Hylocharis leucotis* [white-eared hummingbird], and *Cyananthus latirostris* [broad-billed hummingbird] (Friedmann et al. 1950, Howell & Webb 1995). I subjected the specimen to an analytical procedure termed the hybrid diagnosis (Graves 1990), which focuses on the identification of apomorphic character states in puta-

tive hybrids. Complete dominance and polygenic inheritance of plumage characters may prevent or obscure the expression of parental apomorphies in hybrids. When parental apomorphies are not identifiable, the parentage of a hybrid may be indicated, although less conclusively, by the presence or absence of a suite of plesiomorphic characters (Graves 1990; Graves & Zusi 1990; Graves 1998, 1999a)

Measurements were taken with digital calipers and rounded to the nearest 0.1 mm: wing chord; bill length (from anterior extension of feathers); rectrix length (from point of insertion of the central rectrices to the tip of each rectrix), and width of the outermost rectrix (8 mm from tip). Rectrices (R1–R5) and primaries (P1–P10) are numbered from the innermost to the outermost. A scatter plot of measurements of R5 was used to illustrate size differences among specimens. General color descriptions presented in Appendix I were made under natural light.

### Results and Discussion

I considered three hypotheses—Sefton's specimen represents (1) a color morph of *Calypte costae*, (2) an undescribed species, or (3) a hybrid. The first hypothesis can be rejected because the external measurements and proportions of the specimen are substantially different from those of all age classes of male *C. costae* (Table 1). Although the second hypothesis seems highly improbable, several putative trochiline species are known from one or two specimens (Graves & Olson 1987; Graves 1993, 1999b). In any event, hybridization must be ruled out before species status is conferred. Evidence presented below suggests that Sefton's specimen represents an intergeneric hybrid between *Calypte costae* and *Selasphorus platycercus*. For brevity, I refer to the specimen as a hybrid in the remainder of the paper.

Table 1.—Ranges and means ( $\pm$ one standard deviation) of measurements (mm) of adult male *Calypte costae*, *C. anna*, *Selasphorus platycercus*, and the hybrid (*Calypte costae*  $\times$  *Selasphorus platycercus*; SDNHM No. 15883).

Characters	<i>Calypte costae</i> (n = 22)	<i>Calypte anna</i> (n = 10)	<i>Selasphorus platycercus</i> (n = 15)	Hybrid
Wing chord	41.3–45.9 (43.9 $\pm$ 1.1)	48.2–50.3 (49.0 $\pm$ 0.8)	47.7–50.7 (49.4 $\pm$ 0.8)	48.4
Bill length	14.3–16.9 (15.6 $\pm$ 0.6)	15.2–17.7 (16.3 $\pm$ 0.9)	15.1–18.0 (16.3 $\pm$ 0.7)	15.4
Rectrix 1 length	17.7–20.6 (19.3 $\pm$ 0.8)	22.8–26.7 (24.7 $\pm$ 1.1)	30.5–32.2 (31.4 $\pm$ 0.6)	26.4
Rectrix 2 length	18.6–21.9 (20.5 $\pm$ 0.9)	23.3–25.5 (24.5 $\pm$ 0.7)	31.4–33.4 (32.3 $\pm$ 0.6)	27.8
Rectrix 3 length	20.8–24.7 (22.6 $\pm$ 0.9)	26.5–29.4 (28.1 $\pm$ 0.8)	32.1–34.1 (32.9 $\pm$ 0.5)	29.2
Rectrix 4 length	20.8–24.8 (22.8 $\pm$ 0.9)	31.1–33.4 (32.1 $\pm$ 0.9)	31.5–34.1 (32.6 $\pm$ 0.9)	29.1
Rectrix 5 length	20.1–23.6 (22.2 $\pm$ 1.0)	30.6–33.2 (31.9 $\pm$ 0.9)	29.8–33.2 (31.2 $\pm$ 1.1)	28.1
Rectrix 5 width	1.4–1.8 (1.7 $\pm$ 0.11)	3.0–3.6 (3.2 $\pm$ 0.2)	4.3–5.1 (4.7 $\pm$ 0.2)	2.6

Plumage characters of the hybrid that facilitated the identification of its parental species include: (1) brilliant frontlet and crown; (2) elongated lateral gorget feathers, (3) emarginated tip of R2; (4) emarginated tip of P10; and (5) absence of rufous pigmentation on the capital and spinal feather tracts (Figs. 1–2). Only two of the potential parental species, *Calypte costae* and *C. anna*, possess brilliant frontlets that contrast with the remainder of the capital feather tract (the crown but not the frontlet of *Eugenes fulgens* is brilliant), but neither species of *Calypte* has emarginated tips of R2 and P10. This indicates that one of the parental species was either *Calypte costae* or *C. anna* and that the emarginated tips of R2 and P10 were contributed by the other parental species. Three of the potential parental species (*Selasphorus platycercus*, *S. rufus*, *S. sasin*) exhibit an emarginated outermost primary (P10) and second rectrix (R2). This trio may be reduced to a single species by focusing on the absence of rufous or buff pigmentation in capital and spinal feather tracts of the hybrid.

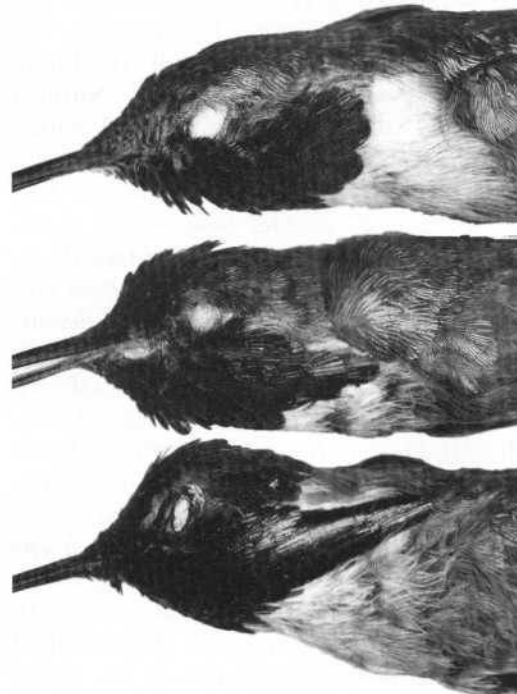


Fig. 1. Lateral views of adult males: *Selasphorus platycercus* (top), *Calypte costae* (bottom), and probable hybrid (middle), *Calypte costae*  $\times$  *Selasphorus platycercus* (SDNHM No. 15883). Distal portions of bills are cropped in the photograph.



Fig. 2. Emarginate tip of outermost primary (P10) of the probable hybrid, *Calypte costae* × *Selasphorus platycercus* (SDNHM No. 15883).

Because brown and reddish-brown pigments appear to exhibit consistent penetrance in hummingbird hybrids (Banks & Johnson 1961, Graves & Newfield 1996), *Selasphorus rufus* and *S. sasin* can be eliminated from further consideration. Thus, plumage characters suggest that the hybrid represents the offspring of *Calypte* sp. × *Selasphorus platycercus*.

I narrowed the pool of parental species to a single pair through an examination of size and external proportions (Table 1). External measurements of trochiline hybrids invariably fall within the mensural ranges exhibited by their parental species as a consequence of a polygenic mode of inheritance (Banks & Johnson 1961, Buckley 1982, Graves 1990, Graves & Zusi 1990, Graves 1996). Hybrid luxuriance or dwarfism in avian hybrids has not been documented. Measurements of Sefton's specimen fall within the cumulative range of measurements recorded for *Calypte costae* × *Selasphorus platycercus*, but not for *Calypte anna* × *Selasphorus platycercus* (Table 1). In particular, the outer rectrices (R4–R5) of the hybrid are too narrow and short to have been produced by the later cross (Fig. 3). In summary, analyses of plumage color and external measurements provide strong support for the hypothesis that Sefton's specimen represents a hybrid between *Calypte costae* and *Selasphorus platycercus*.

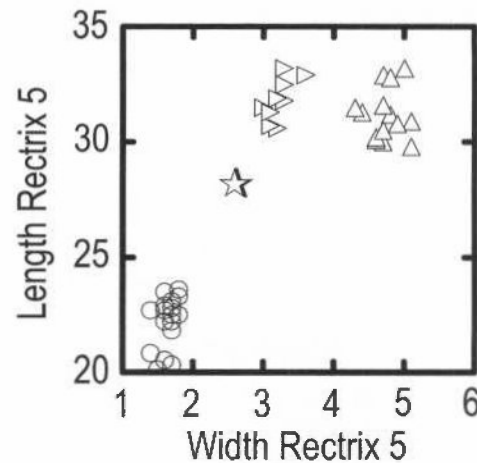


Fig. 3. Bivariate relationships of measurements (mm) of rectrix 5 of adult male *Calypte costae* (O), *Calypte anna* (▷), *Selasphorus platycercus* (△), and the probable hybrid (☆), *Calypte costae* × *Selasphorus platycercus* (SDNHM No. 15883).

Sefton collected the hybrid at Manning Camp, 7900 ft elevation (~2409 m), in the ponderosa pine (*Pinus ponderosa*) zone of the Rincon Mountains, a spur of the Santa Catalina Mountains, which flank the eastern boundary of the Sonoran desert in southeastern Arizona. Although the elevational distribution of *Calypte costae* is poorly known in Arizona, it typically nests in desert scrub (Baltosser 1989, Baltosser & Scott 1996). However, breeding birds occur as high as 1200 m in Sonora (Russell & Monson 1998), and nest building has been observed as high as 7500 ft (~2287 m) in the Sierra San Pedro Martir, Baja California Norte (Anthony 1893). *Selasphorus platycercus* breeds commonly in the conifer zone at higher elevations in the Rincon and Santa Catalina mountains (Phillips et al. 1964). Although the breeding ranges of *C. costae* and *S. platycercus* are largely allopatric, individuals probably occasionally encounter one another in the transition zone (1800–2100 m) between Sonoran desert scrub and ponderosa pine forest in several of the isolated mountain ranges in southeastern Arizona. In any case, Sefton's specimen is the only known

hybrid between these two ecologically divergent species.

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#### Appendix I

Comparative description of male *Calypte costae*, *Selasphorus platycercus*, and a probable hybrid, *Calypte costae* × *Selasphorus platycercus* (SDNHM 15883). Descriptions of structural colors are unusually subjective, as color seen by the observer varies according to the angle of inspection and direction of light. For this reason I use general color descriptions.

In *costae*, the forehead, loreal region, and crown (extending posteriorly ~10 mm behind the eye) above the superciliary are feathered with brilliant, iridescent violet-purple discs; plumage from the hindneck to the rump is dull olive-green. Feather

tips of dorsal contour feathers are frequently tipped with pale brown or grayish-brown. A short grayish supraocular stripe is present in many specimens.

The forecrown, crown, hindneck, back, and rump of *platycercus* are green to golden-green with turquoise highlights, depending on the angle of inspection. When viewed head-on under direct light, crown feathers, and to a lesser extent, back feathers, exhibit golden-green reflections. The loreal streak is pale grayish-white flecked with green or brownish feather barbules.

The dorsal plumage of the hybrid combines features of *costae* and *platycercus*. The forecrown, crown, and loreal area are rosy-violet, but the coronal iridescence is more subdued (less intense) and more distributionally restricted than in *costae*. Rosy-violet or violet feather tips contrast with green feather bases to impart a banded appearance to the central crown and a spotted appearance to the posterior margin of the coronal area (violet feather tips extend ~5 mm posteriorly from the eyes). A short grayish-white supraocular stripe extends posteriorly from the loreal region. The hindneck, back, and rump are medium green, brighter than in *costae*, but duller than *platycercus*.

The violet-purple gorget in *costae* covers the chin, throat, and subocular region, and extends laterally to form a tapered point along each side of the throat. Gorget feathers are tricolored; basal portions of feathers are pale gray, bordered distally with a very narrow transitional band of bluish-green, and broadly tipped with iridescent violet-purple discs. Feathers bases of the greatly elongated lateral gorget feathers (up to 15 mm long) are darker gray. The gorget is bordered posteriorly by a band of white plumage across the lower throat and upper breast that extends underneath the lateral tails of the gorget. The sides, flanks, and belly are grayish-green, palest along the midline. The undertail coverts are white or very pale gray with a pale diffuse bronzy-green spot centered over the proximal section of the rachis.

In *platycercus*, gorget feathers are pale gray or pale buffy-gray (particularly along the sides of the gorget), broadly tipped with an iridescent rose-red disc. A narrow transitional band of iridescent green occurs between the gray base and rose-red disc of most gorget feathers. Lateral gorget feathers are less elongated (~8–9 mm) than in *costae*. Plumage immediately posterior to the gorget is grayish-white. The lower breast, sides, flanks, and abdomen are grayish-green (slightly brighter than in *costae*) with scattered gray and buffy barb tips, particularly along the flanks. The undertail coverts are white or very pale gray with a pale diffuse bronzy-green or grayish-green spot centered over the proximal section of the rachis.

The gorget of the hybrid is intermediate between those of *costae* and *platycercus* in size, shape, and color. Gorget feathers are medium gray, broadly tipped with a brilliant rosy-violet disc; a narrow transitional band of iridescent green or bluish-green occurs between the gray feather base and rosy-violet disc. Violet reflections predominate along the disc margins. Lateral gorget feathers are more elongated (~10.7 mm) than in *platycercus*, but less so than in *costae*. The width of the longest lateral gorget feather is ~2.4 mm wide (compared to ~1.7 mm in *costae* and ~2.8 mm in *platycercus*). A narrow white postocular stripe extends down the side of the neck to the white band below the gorget as in *costae* and *platycercus*. The lower breast, sides, and flanks of the hybrid are very similar to those of *costae* and slightly duller, exhibiting fewer green reflections, than in *platycercus*. The undertail coverts of the hybrid are intermediate in color and length between those of *costae* and *platycercus*.

Viewed from the dorsal aspect, the rectrices of *costae* and *platycercus* are fairly dissimilar in color and shape. In *costae*, the innermost rectrix (R1) is dull bluish-green tipped with bronzy-green, R2 is bronzy-green, whereas the outer rectrices (R3–R5) are gray, grading to grayish black along the rachis and toward the distal tip. Rectrix width decreases from the broad central pair (R1) to the very narrow outermost pair (R5). All rectrices have rounded tips.

In *platycercus*, the innermost rectrix (R1) is iridescent bluish-green. The remaining rectrices (R2–R5) are dark purplish-brown, nearly black. The outer vane of R2 is narrowly margined with rufous, with lesser amounts of rufous or buff along the margins of the outer vanes of R1 and R3. The inner vanes of all rectrices are narrowly margined with rufous or buff. The tip of R1, and to a lesser extent of R2, is emarginated.

The shape and pigmentation of the hybrid's rectrices are intermediate between those of *costae* and *platycercus*. The innermost rectrix (R1) is bluish-green broadly tipped with bronzy-green, R2 is bronzy-green, narrowly tipped with purplish-brown. The three outer rectrices (R3–R5) are grayish-green, broadly tipped with dark purplish-brown. The outer vanes of R2 and R3, and inner vanes of R2–R4 are faintly margined with pale buff. The tip of the inner vane of R2 is distinctly emarginated, although less so than in *platycercus*.

Wing color in *costae* and *platycercus* is similar but the scapulars and wing coverts of *costae* are olive-green rather than green or golden-green. The two outer primaries in *platycercus* (P9 and P10) have emarginated inner vanes whereas the primaries of *costae* are unmodified. The outermost primary (P10) of the hybrid has a distinctly emarginated inner vane. The maxillary and mandibular ramphotheca of *costae*, *platycercus*, and the hybrid are black.