MORE HYBRID HUMMINGBIRDS FROM THE UNITED STATES

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HYBRID hummingbirds collected within the A.O.U. Check-List (1957) area were discussed and summarized by Banks and Johnson (1961). Those authors questioned the occurrence of the cross *Archilochus alexandri* × *Calypte costae* (Black-chinned × Costa's hummingbirds) reported by Gray (1958). However, Short found a specimen in the U. S. National Museum collection labelled by Phillips as representing this cross and, in correspondence concerning this specimen, Phillips mentioned a second individual he thought represented this cross and also a specimen of *Eugenes fulgens* × *Cynanthus latirostris* (Rivoli's × Broad-billed hummingbirds) in the American Museum of Natural History. Short's study of these specimens convinced him that all three were indeed hybrids, and led to collaboration in preparing this report. The hybrids are described below in the manner of Banks and Johnson. We also offer comments concerning hybridization and the classification of A.O.U. Check-List hummingbirds.

Calypte costae × *Archilochus alexandri*

Banks and Johnson (1961) discussed purported hybrids representing this cross and concluded that specimens noted as hybrids of these two species were either not such hybrids, were non-existent, or had been lost. They correctly pointed out (1961: 10) that the unique type of *Trochilus violajugulum* Jeffries represents a cross between *Archilochus alexandri* and *Calypte anna*, not *Calypte costae*. In the U. S. National Museum, however, is a male specimen marked *Archilochus alexandri* × *Calypte costae*, ARP, 1941, and another Costa's × Black-chin hybrid, an adult female, is in the Dickey Collection, University of California at Los Angeles. The specimens bear the following data: male hybrid—"USNM no. 140340, Biological Explorations, U. S. Dept. Agri. Death Valley Expedition, ♂, Owen[s] Lake, California; May 20, 1891, F. Stephens" (and on the obverse) "Alt. 3700, Olancha, orig. no. 59"; female hybrid—"UCLA no. 25340, Campo, San Diego Co., California, May 15, 1917, col. by H. H. Kimball, orig. no. 430, ♀." The male hybrid was probably identified as such by Frank Stephens, the collector, or A. K. Fisher, who refers to it as a hybrid in his account of the Death Valley Expedition (1893: 56, 58). However, it had not been marked or set aside as a hybrid when Phillips rediscovered it in 1941. The female was first identified as a hybrid by Phillips. Short also examined a male and a female *Archilochus alexandri* (USNM no. 140263, 10 June 1891, and no. 140261, 16 May 1891, respec-

tively) collected by Stephens at Olancha at about the same time the hybrid was taken, and a male *A. alexandri* (USNM no. 140262, 30 May 1891) and female *C. costae* (USNM no. 140276, 31 May 1891) taken at about the same time just north of Olancha along Ash Creek ("alt. 3700" feet). None of these showed any indication of hybridization.

DESCRIPTION OF MALE HYBRID

Capital tract.—The hybrid's crown is green with dusky-tipped feathers, like that of *A. alexandri*, except for about eight feathers of the pileum and loral region, these being green tipped with iridescent violet and blue-violet. Both species and the hybrid have white postocular spots.

Spinal tract.—Similar (green to bronze-green) in both species and the hybrid.

Ventral tract.—The violet or blue-violet gorget of the Black-chinned Hummingbird is restricted to the posterior throat region, while the intermalar area forward to the bill is black. The rear edge of the gorget is approximately even, with no rearward extensions laterally. The violet gorget of Costa's Hummingbird covers the intermalar area and throat, and the lateral throat feathers are elongated, extending the gorget posteriorly as far as the breast. The hybrid has a more extensive purple gorget than *A. alexandri*, including partially expanded lateral throat feathers, which extend posteriorly only about half as far as they do in *C. costae*. The intermalar region of the hybrid is black anteriorly, but iridescent purple to violet-blue posteriorly—not all purple as in *C. costae* or all black as in *A. alexandri*. Banks and Johnson (1961: 6) noted the presence in *A. alexandri* of a narrow iridescent green band between the violet tips and grayish brown bases of the gorget feathers. They also reported this band in gorget feathers of *Selasphorus platycercus* (Broad-tailed Hummingbird). We observed this green iridescent band not only in those species, but in *C. costae* (where it is very narrow but unmistakable in good light) and in the hybrid. The rest of the underparts are colored similarly in the two species and the hybrid.

Alar tract.—The wings are similarly colored in the parental species and the hybrid. The outer primaries of *C. costae* are narrow rather than broad as in *A. alexandri*, while the inner primaries (especially primaries 5–8) of the former are broad, unnotched, and, slightly angled compared with the narrow, notched, sharply angled inner primaries of *A. alexandri* (see Banks and Johnson, 1961, fig. 1, p. 5). The outermost primary of the hybrid is not so narrow as it is in most Costa's Hummingbird males, nor is it quite so broad as it is in the Black-chinned Hummingbird. The hybrid's inner primaries lack the notch found in *A. alexandri*. They are intermediate in width (especially of the outer vane), however, and in having tips more acutely pointed than in *C. costae* but more rounded than in *A. alexandri*.

Caudal tract.—For purposes of the following discussion the rectrices of each side are numbered 1–5, beginning with the innermost. The major difference between these two species in tail color involves the second pair of rectrices (2). These are purple-black, occasionally with small green margins in *A. alexandri* (not dark iridescent green like rectrix 1 as stated by Banks and Johnson, 1961: 6; see also Ridgway, 1911: 633); in *C. costae* they are bright green with narrow dusky edges. The second rectrix (2) of the hybrid is intermediate in color; it is dusky-tipped and black along the shaft (especially on the inner vane), but with extensive bright green lateral to the dark area.

The shape of the rectrices of the two species is figured by Banks and Johnson (1961: 7). Briefly the outer rectrices (2 to 5) of *A. alexandri* are broad and have pointed tips and those of *C. costae* are narrow (especially the outermost rectrices) and round at

TABLE 1

MEASUREMENTS (IN MM) OF MALE *ARCHILOCHUS ALEXANDRI*, *CALYPTE COSTAE*, AND THE HYBRID[1]

	A. alexandri	*Hybrid*	C. costae
Wing length (chord)	40.7–43.2	43.9	43.0–45.4
Tail length	24.6–27.1	25.7	21.0–24.4
Exposed culmen	16.1–18.6	17.6	15.7–17.7
Length of central rectrix	21.1–24.3	23.6	18.1–20.6

[1] Measurements of *A. alexandri* and *C. costae*, from Banks and Johnson (1961: 8–9).

their tips. The hybrid has rectrix 1 rounded as in both species, rectrix 2 barely more pointed than rounded, and rectrices 3, 4, and 5 broader and more pointed than in *C. costae* but narrower and definitely less lanceolate at the tips than *A. alexandri*. The outer rectrix (5) is markedly intermediate, being broader and slightly more pointed than in Costa's Hummingbird but narrower toward the base and less pointed at the tip than in the Black-chinned Hummingbird. The shafts of the outer rectrices are not curved as they typically are in *C. costae*.

Mensural characters.—Measurements of males of the two species are presented by Banks and Johnson (1961: 8–9). Table 1 gives these measurements of *C. costae* and *A. alexandri* and corresponding measurements of the hybrid. The hybrid is well within the range of variation of *A. alexandri* and unlike *C. costae* in tail length and length of the central rectrices; it is more like *A. alexandri* (though barely within the range of *C. costae*) in bill length; and it is like *C. costae* but not *A. alexandri* in wing length.

The mixture of intermediate characters with some characters of each parental form, as usually found in an F^1 hybrid, clearly indicates the hybrid nature of the specimen.

DESCRIPTION OF FEMALE HYBRID

Female hummingbirds are notoriously very difficult to identify, and those of the very similar Black-chinned and Costa's hummingbirds are no exception. Females of *C. costae* tend to be grayer (less white) below and less frequently have spotted throats than *A. alexandri*. However, many females of the two are indistinguishable in color of the underparts and, since a few Costa's Hummingbirds have spotted throats and many Black-chinned Hummingbirds lack spotting, this character is far from infallible. Their similarity in coloration is further shown by Ridgway's virtually interchangeable descriptions of females of the two species (1911: 623, 633–634). However, a few differences exist in extent of black in the tail, in tail and wing shape, and in measurements (see Table 2), which permit identification of females and without which determination of hybrid origin of a female would, of course, be impossible.

Capital and spinal tracts.—Similar in the two species and the hybrid.

Ventral tract.—Generally similar in the two species (see comment above). The hybrid has very fine throat spots, matching those found in several U. S. National Museum specimens of each species. The rest of the hybrid's underparts are whitish gray to grayish white, nearly identical to specimens of both species, except that few individuals of either species have the under tail coverts as nearly pure white as those of the hybrid.

Alar tract.—Female Black-chinned Hummingbirds, like the males, have broad outer primaries and narrow, acutely pointed inner primaries, although the subterminal

TABLE 2

MEASUREMENTS (IN MM) OF FEMALE *ARCHILOCHUS ALEXANDRI*, *CALYPTE COSTAE*, AND THE HYBRID

		Archilochus alexandri	*Hybrid*	Calypte costae
Wing (chord)	M	46.89	43.0	44.22
	SE	0.28		0.22
	Range	45.3–50.9		42.4–46.1
Bill (exposed culmen)	M	20.33	16.8	17.83
	SE	0.18		0.11
	Range	18.5–21.5		16.8–18.7
Tail	M	27.44	26.4	24.42
	SE	0.22		0.20
	Range	25.8–29.7		23.0–26.2
Rectrix 4	M	27.55	26.5	24.20
	SE	0.20		0.16
	Range	26.0–29.5		22.8–25.5
Rectrix 5	M	25.91	24.5	21.55
	SE	0.18		0.19
	Range	24.9–27.5		19.8–22.6
Rectrix 3 minus rectrix 5	M	2.29	2.3	3.62
	SE	0.16		0.15
	Range	0.2–3.3		2.7–4.8
Length of black edge, outer 5th rectrix	M	10.64	8.5	5.67
	SE	0.36		0.16
	Range	7.5–13.5		4.6–8.8
Extent of black from tip of rectrix 2	M	8.56	5.8	4.83
	SE	0.27		0.33
	Range	5.8–11.2		0.0–7.0
Maximum width of 5th rectrix	M	5.07	4.6	3.86
	SE	0.07		0.10
	Range	4.6–5.7		3.2–4.6
Maximum width of outermost primary	M	4.90	4.6	3.48
	SE	0.05		0.06
	Range	4.3–5.4		3.0–4.1

notches of their inner primaries (3–7) are less discernible than those of the males. Females of Costa's Hummingbird exhibit narrow outer primaries and broader, more round-tipped inner primaries. The hybrid has primaries more like those of *A. alexandri*. Its outermost primaries are broad (measurements of maximum width across the outer part of the outermost primary in the hybrid and samples of both species are given in Table 2; this measurement was taken with the barbs "smoothed" but care was taken not to alter the width of the feathers). The inner primaries (3 to 6 especially) are acutely tipped as in *A. alexandri* and the feathers are narrow (especially the outer vanes) as in that species. A slight approach to *C. costae* is evident in the absence of the subterminal notches of the inner primaries, with slight rounding of the vane at the angle beside which the notch would occur.

Caudal tract.—The chief color difference between the two species is that involving the extent of black in their tails. *Archilochus alexandri* has a more extensive subtermi-

nal black area than does *Calypte costae*, as clearly shown by measurements of the black areas on rectrices 2 and 5 (Table 2). Despite this difference there is a slight overlap (in both measurements) and the hybrid falls within the overlap area in both measurements. The hybrid thus has more black in its tail than most females of *C. costae* but has less black than most *A. alexandri*.

The shape of the hybrid's tail is similar to that of *A. alexandri*. Females of the two species do not differ strikingly in tail shape, although there are minor differences which can be used to distinguish them. Essentially, *C. costae* has a notched tail, with the third pair of rectrices the longest, the first rectrices short, and the outermost (fifth) rectrices very short (much shorter than the first pair, and averaging nearly 4 mm less than the third rectrices). *A. alexandri*, on the other hand, has rectrices 2 or 3 the longest, and rectrices 5 relatively longer than in *C. costae* (nearly as long as the first rectrices, and averaging only about 1.5 mm less than the longest rectrices). These differences are shown by certain measurements presented in Table 2. The tails of female Black-chinned Hummingbirds average 3 mm longer than those of *C. costae*, with only slight overlap. Rectrix 4 is proportionately as long in both species but with no overlap of measurements in the samples compared. The hybrid has a longer tail than all specimens of *C. costae* examined and the inner four pairs of rectrices measure within the low range of *A. alexandri*. Although the fifth rectrices of the hybrid are only as short compared with rectrix 3 as the average for *A. alexandri*, they are slightly shorter in actual length than those of the *A. alexandri* females measured, apparently reflecting a tendency toward *C. costae*. The latter also has narrower outer rectrices than *A. alexandri*, with barely any overlap (Table 2). The hybrid is intermediate in the width of its outer rectrices, falling in the narrow area of overlap of the two species.

Mensural characters.—Measurements of the hybrid and females of both parental species are presented in Table 2. In wing length, the hybrid falls below the average of *C. costae* and over 2 mm below the minimum of *A. alexandri* females. The hybrid's bill is also like that of *C. costae*. Indeed, the hybrid has a bill as short as the shortest billed *C. costae* female examined. The tail of the hybrid, as noted above, is within the range of variation of *A. alexandri* in length, although the outer rectrices are intermediate in length between those of the two species.

In summary, the female hybrid is like *A. alexandri* in the shape of its outer primaries and in tail length. It resembles *C. costae* in wing length and bill length. It is intermediate in the length of its outer rectrices, and exhibits slight intermediacy in the shape of its inner primaries. It falls within relatively narrow areas of overlap, and hence might be considered intermediate, in the amount of black in its tail and the width of its outer rectrices. Although there are fewer and less distinctive characters to deal with than in males, the female hybrid exhibits both a mixture of characteristics of both species and intermediate characteristics, just as does the male hybrid.

COMMENTS

The distribution and habitat of the two species (in California and Nevada) were discussed by Banks and Johnson (1961, see especially pp. 8, 10, 12 for *A. alexandri* and pp. 14–15 for *C. costae*). The ranges of these two hummingbirds overlap broadly. Although their habitat preferences differ, the difference is not as great as Banks and Johnson (1961: 10) have suggested. The broad range and virtually complete altitudinal

overlap, because of the ability of the Black-chinned Hummingbird to utilize moist situations along desert washes, result in frequent sympatry of the two in central and southern Arizona (Monson and Phillips, 1964) and probably many places in the foothills of southern California as well.

The male hybrid came from a locality in the eastern foothills of the Sierra Nevada Mountains, at the northern extreme of the range of *costae*. The relative abundance of the two species around Owens Lake is indicated by Fisher (1893: 56–57) who called *A. alexandri* "common" at Olancha and Ash Creek and *C. costae* "more or less common" in Owens Valley, especially "along the eastern slope of the Sierra Nevada, where it was associated with the Black-chinned Hummer." Concerning the hybrid, he wrote: "At Olancha he [Stephens] secured a very interesting specimen which in its specific characters was intermediate between this species and Costa's hummer, and was probably a hybrid."

The female hybrid came from a foothill area of southern California just north of the Mexican border. Campo Creek passes through Campo, which is between 2,000 and 3,000 feet in elevation, about 40 miles southeast of San Diego. This locality is near the southern extreme of the breeding range of *A. alexandri*, which only rarely nests farther south in Baja California (Grinnell, 1928: 132). In addition to this hybrid, Kimball in May, 1917, also collected at Campo one male *A. alexandri* (in the San Diego Natural History Museum collection, R. C. Banks, *in litt.*) and two males and two females of *C. costae* (one female in the same collection, the others in the Dickey Collection, UCLA, O. M. Buchanan, *in litt.*). The dates of collection of these birds are within the breeding season but the specimens' labels bear no comments concerning the condition of the gonads. The hybrid is listed as *Calypte costae* on the collector's label, and *Calypte costae*? on the Dickey Collection label.

Eugenes fulgens × *Cynanthus latirostris*

A male specimen clearly representing this cross was noted by Phillips in the L. C. Sanford collection, and is now number 754741 in the American Museum of Natural History. It is labelled as having been taken in the Huachuca Mountains of Arizona on 2 September 1920 by W. W. Brown. The hybrid was labelled as such when Phillips saw it and was probably identified by Sanford.

The two species involved differ strikingly in size and in color.[1] The hybrid is intermediate in size (see Table 3) and in color of the crown, gorget, bill, tail, breast, and abdomen.

[1] This is particularly true in comparing *Eugenes fulgens* with *Cynanthus latirostris magicus*, the race of the latter, highly variable species evidently involved in the present cross.

TABLE 3

MEASUREMENTS (IN MM) OF MALE *EUGENES FULGENS*, *CYNANTHUS LATIROSTRIS*, AND THE HYBRID

	Eugenes f. fulgens	*Hybrid*	Cynanthus l. magicus
Wing			
N	21		15
M ± SE	72.43 ± .25	63.7	50.77 ± .32
Range	70.6–74.3		49.0–53.8
Tail length			
N	19		15
M ± SE	43.91 ± .45	40.1	32.54 ± .30
Range	41.3–48.0		30.5–35.2
Bill (exposed culmen)			
N	21		14
M ± SE	26.31 ± .23	26.4	20.60 ± .28
Range	24.4–29.1		18.9–21.9
Central rectrix			
N	22		15
M ± SE	37.58 ± .25	31.2	24.83 ± .27
Range	36.0–39.8		23.0–26.9

DESCRIPTION

Bill.—The bill of *Eugenes fulgens* is dull black and that of *Cynanthus latirostris* is (in life) red with a dusky tip. In museum skins *E. fulgens* has a blackish bill and *C. latirostris* a pale yellowish to horn-colored bill, darkening gradually to blackish toward the tip. Generally, the dusky or blackish area of the bill of *C. latirostris* is less extensive on the lower mandible, and more extensive on the upper mandible. The hybrid has the upper mandible entirely black as in *E. fulgens*, while its lower mandible is yellowish for its basal two-thirds with a dusky tip; it is hence intermediate between the two species in bill color.

E. fulgens is characterized by having an extension of feathers forward over the base of the bill, covering the operculum over the nostrils. The feathers extend along the culmen 2 to 3 mm beyond the anterior end of the operculum. In *C. latirostris* the anterior half of the operculum is bare, with only the proximal half covered by feathers. The hybrid is more like *E. fulgens* in this feature, but nonetheless exhibits intermediacy between the two species in that the feathers covering the operculum barely reach its anterior end, not extending farther forward along the culmen.

Capital tract.—The frontal and coronal regions of male *E. fulgens* are iridescent violet or purple; the forehead is blackish, often with green feather edges. *C. l. magicus* males have the entire top of the head metallic bronze-green, with occasional pale blue-green highlights; the feather bases are buffy-brown and the tips often buffy-edged, giving a slightly brownish effect. The hind-neck is dull (brownish) green in *E. fulgens*, and is bright green, like the head and back, in *C. l. magicus*. The hybrid exhibits coronal and frontal regions with moderate iridescence; the color is pale blue to blue-violet, less violet than in *E. fulgens*. The iridescence is reduced compared with that of *E. fulgens* because of its paler color and occurrence on fewer feathers.

The sides of the coronal region, the forehead, anterior frontal region, and hind-neck of the hybrid are basically green, except for some black on the forehead. A small postocular white spot is present in *E. fulgens* and the hybrid, and is present but very small (sometimes lacking?) and grayish in *C. latirostris*. Thus, the hybrid resembles *latirostris* on the hind-neck, and *fulgens* in its postocular spot; it is intermediate in color of forehead, frontal, and coronal regions.

Spinal tract.—The back of *C. latirostris* is bright green, with a slight bronzy cast, and that of *E. fulgens* is also green with some bronze but with sooty black coloring appearing on all but the tips of the upper back feathers. The hybrid has a green back which is more bronzy than most individuals of either species. Its upper back feathers have narrower green tips than *C. latirostris*, but broader green tips than *E. fulgens*; the dark feather bases show through at the surface of the feather-coat, giving an effect intermediate between the solid green upper back of *C. latirostris* and the black-green color of *E. fulgens*.

Ventral tract.—The gorget includes the area from the lower throat to the bill and from malar region to malar region in both species. Its posterior margin is even in *C. latirostris* but slightly concave in *E. fulgens*. The iridescent gorget is bright emerald green in *E. fulgens*; it ranges in *C. l. magicus* from blue-violet anteriorly to blue and then paler green-blue at its rear margin. The hybrid has a green-blue (nearly aquamarine) gorget, with slight violet highlights, and its rear margin is very slightly indented medially. It is hence intermediate in color and in having its posterior margin slightly uneven.

The feathers of the upper breast of *Eugenes* have velvety black bases (Ridgway, 1911: 565) and narrow bronze or bronze-green tips. Viewed from the front, the black sets off the brilliant gorget. From the rear, the entire breast, sides, and flanks appear metallic bronze-green. *C. l. magicus*, viewed from all angles, has the entire breast and belly metallic green or bronze-green. The underparts of the hybrid are metallic green anteriorly to bronze-green posteriorly. Considerable black shows through from the feather bases in its breast region, however, showing a slight tendency toward *E. fulgens*. The feathers of the hybrid's under tail coverts are gray with white margins, as in *E. fulgens*, not broadly white with gray centers as in *C. l. magicus*. Like both species, the hybrid has white tufts beside the vent and laterally below the rump (Ridgway, 1911: 370, 565).

Caudal tract.—The rather deeply forked, blue-black, dusky-tipped tail of *C. latirostris* contrasts with the slightly forked, metallic green tail of *E. fulgens*, which shows a very narrow dusky tip in fresh plumaged birds. The hybrid's tail is moderately forked. Its color is also intermediate; it is basically blue-black, but the outer edges of all rectrices are greenish-bronze, as are nearly the entire central rectrices. The dusky tips of the feathers are narrow as in *E. fulgens*.

Alar tract.—The wings are similarly colored in the two species, except for a slight metallic sheen detectable in some specimens of *C. latirostris* and found in the hybrid as well.

Mensural characters.—*Eugenes fulgens* is decidedly larger than *Cynanthus latirostris magicus* (Table 3). The hybrid tends toward *E. fulgens* in size (Table 3), but is intermediate in most measurements. It is almost exactly intermediate in the length of the central rectrix; intermediate, but close to *E. fulgens*, in tail length; and it has a bill even longer than the average for *E. fulgens*.

In sum, the hybrid is intermediate in most external features. It generally tends more toward *Eugenes fulgens* than *Cynanthus latirostris* but is not exactly like either in most respects.

COMMENTS

The ranges of the Broad-billed and Rivoli's hummingbirds overlap broadly through much of Mexico (Friedmann *et al.*, 1950), where both are widespread in the highlands (the Broad-bill occurs down to sea level and, except locally during post-breeding dispersal, is restricted to lower elevations than is *E. fulgens*). In southeastern Arizona both are uncommon to locally common breeding birds in mountain areas, including the Huachuca Mountains where the hybrid was secured. There both species occur (*C. latirostris* rarely) in moist situations—*E. fulgens* in pine forests and upper canyons, and *C. latirostris* usually lower down in riparian strips "near the canyon mouths" (Brandt, 1951: 657; see also Monson and Phillips, 1964). No data indicate exactly where the hybrid was taken, but since the putative date of collection was 2 September, the bird could have moved some distance from where it had spent the breeding season.

The occurrence of a hybrid between such distinct and apparently distantly related hummingbirds (as indicated by their relative positions in various classifications; see, e.g., A.O.U. Check-List; Friedmann *et al.*, 1950; Peters, 1945) appears remarkable. Nonetheless, such a hybrid is indicative of a basic similarity in the genotypes of the two species and sufficient cause for an appraisal of their relationships. While this appraisal ought to await broad study of trochilid generic relationships, a few remarks might be made at this time concerning morphological similarity of these two hummingbirds, especially since we have emphasized their differences to establish the hybrid nature of the specimen in question.

Both *Cynanthus* and *Eugenes* exhibit postocular white marks (Ridgway, 1911). Although these are narrow and grayish in *C. latirostris*, they are broader in the related *C. sordidus*. (Incidentally, an intrageneric hybrid from Oaxaca in southern Mexico has been reported, between *Cynanthus latirostris* and *C. sordidus*; Friedmann *et al.*, 1950: 167.) White femoral patches and patches below the rump are found in both of these species as well as in *Eugenes fulgens* (and, of course, in many other hummingbirds). The shape and color of the wings and structure of the primaries are similar in both genera. The hybrid shows gorget color intermediate between *C. latirostris* and *E. fulgens* and this color is nearly matched by the gorgets of *C. l. lawrencei* and *E. f. spectabilis*, in both of which the gorget is green-blue. Additionally, the posterior gorget margin of *E. f. spectabilis* is nearly even, unlike *E. f. fulgens* and like that of the hybrid. Although *C. latirostris* males have blue-black tails compared with green tails of *E. fulgens*, females of *C. latirostris*, males of *C. sordidus*, and both sexes of *E. f. spectabilis* exhibit tails that are variously green *and* blue-black. These are colored more or less like the tail of the hybrid. Indeed females of *C. latirostris* and *E. f. fulgens* are as strikingly similar in plumage (with mixed

green and blue-black tails tipped with whitish, dusky underparts, greenish sides, and green upperparts) as the males are strikingly different. While this discussion is not to be construed as a suggestion that the two genera should be merged, it does suggest that they are not as distantly related as implied in present classifications (e.g., Peters, 1945; A.O.U. Check-List, 1957).

DISCUSSION

The location and determination of 3 additional United States specimens of hybrid hummingbirds increases the number now known to at least 14 (see Banks and Johnson, 1961: 26). The three hybrids represent two new parental combinations, raising the number known to nine. The determination of a *female* hybrid shows that these do exist. Female hybrids are, of course, to be expected as frequently as males. This suggests that other female hybrids remain to be found in existing museum collections. Of these, some may represent crosses as yet unknown. Banks and Johnson (1961: 22) comment on Gray's (1958) listing of eight hybrid combinations among North American hummingbirds, two of which they state are without basis. We have shown above, however, that one of the two combinations they disallowed actually *does* occur and is represented by at least two specimens. We have further reported an additional hybrid combination. In view of this, and of the possibility that additional combinations may be found as female hybrids come to light, the actual frequency and variety of hybrid United States hummingbirds is evidently greater, *not* less, than the impression given by Gray's list.

Considering the emphasis properly placed by Banks and Johnson (1961: 23–24) on courtship dives of hummingbirds as possible isolating mechanisms, comments on such dives seem appropriate. *Archilochus alexandri* is noted by Banks and Johnson as having a nearly vertical dive and ascent, compared with a broad, U-shaped arc described by displaying males of *Calypte costae*. Short has observed male Costa's Hummingbirds in Arizona repeatedly making very narrow, deep "power" dives from 100 feet or so nearly to the ground, followed by a sharp upswing back to the original height. Rather than the hissing, whistling sound described by Cogswell (1957: 199), a "booming" noise accompanied the dive. This booming has also been described for *C. costae* by Fisher (1893: 58). Banks (1963: 56) described the dive of a male *C. costae* as follows: "The male dove [*sic*] nearly straight down from a height of approximately 40 feet and rose again nearly vertically, forming a broad, deep U." Thus, the dives of *C. costae* may on occasion be very like the dives of *A. alexandri*. The noise produced during these vertical dives is at least occasionally a booming sound, while a whining, whistling sound is perhaps the commonest one (Banks and Johnson, 1961: 23, after Cogswell, 1957; Banks, 1963:

22). The sound ascribed to *A. alexandri* (Banks and Johnson, 1961: 23, after Linsdale) is a whistling, plus a rattling sound. We have not seen adequate descriptions of the displays of male Broad-billed and Rivoli's hummingbirds and cannot therefore compare them.

The existence of hybrids must be considered in relation to the taxonomy of hummingbirds. Hybridization occurs when reproductive isolating mechanisms are non-existent, incomplete, or inefficient. It is obvious that formation of hybrids, even if they should prove sterile, requires a basic similarity in the genomes of the species involved. This is particularly true when, as in these hummingbirds, the hybrids are adult birds which have lived for a year or more. These adults have successfully coped with the rigors of nestling, juvenile, and immature stages, and (usually) have undergone two extensive migrations. Banks and Johnson (1961: 26) suggest that selection for stronger isolation between closely related, congeneric species which have evolved more recently, and less severe selection against hybridization between very distinct species in different genera, could result in more frequent intergeneric than intrageneric hybridization in hummingbirds. However, if modern phylogenetic ideas are correct, then intrageneric hybridization between more closely related birds should be more common than intergeneric hybridization between more distantly related species. We feel that the genera of hummingbirds are greatly oversplit and that this accounts for the more numerous "intergeneric," compared with intrageneric, hybrid hummingbirds. As an example, through an evaluation of sympatry based upon published descriptions of ranges and habitats of the 15 hummingbird species (representing nine "genera") breeding more or less regularly in the A.O.U. Check-List area, Short has calculated the maximum number of hybrid combinations which could occur. The total possible number of interspecific combinations is about 43. If one accepts the present classification, only two of these possible combinations are intrageneric and *41* are intergeneric! It is obvious that the "genera" are so oversplit that congeneric species, where there are such, are usually allopatric and hybridization is hence impossible.[1]

Banks and Johnson state (1961: 26) that the present generic arrangement of North American hummingbirds "may be unsatisfactory." Like many others (Taylor, 1909: 292, 293; Ridgway, 1911: 406; Griscom, 1932: 198, 199, 200, 208; Peters, 1945:*v*; Williamson, 1957: 121–122; and Sibley, 1957: 176), we feel that the trochilid generic arrangement *is*

[1] These hummingbirds apparently do not mate away from their normal breeding grounds. A report of "*Stellula*" *calliope* hybridizing with "*Atthis*" *heloisa* (Moore, 1937: 100) is in error; the specimen was later redetermined by Moore and has been examined by Phillips. We have never seen courtship behavior by migrant or wintering hummingbirds.

highly unsatisfactory. We shall discuss elsewhere the generic characters utilized in hummingbird classification.

ACKNOWLEDGMENTS

We would especially like to express our thanks to Richard C. Banks for critically reviewing an early draft of the manuscript. Although disagreeing with some of our taxonomic views, Dr. Banks offered valuable suggestions which resulted in the clarification of certain sections of the manuscript. We are indebted to the following institutions and individuals for making available specimens and information vital to our study: American Museum of Natural History (Charles O'Brien); Dickey Collection, University of California at Los Angeles (Thomas R. Howell and O. Marcus Buchanan); and San Diego Natural History Museum (Richard C. Banks). We also thank Dr. Alexander Wetmore for his helpful suggestions during our examination of the *Eugenes fulgens* × *Cynanthus latirostris* hybrid.

SUMMARY

United States hummingbird hybrids additional to those summarized by Banks and Johnson (1961) are described. These include a male *Eugenes fulgens* × *Cynanthus latirostris* collected in Arizona in 1920, a male *Archilochus alexandri* × *Calypte costae* taken in California in 1891, and a female representing the latter cross secured in California in 1917. The latter is the first female hummingbird identified as a hybrid from North America. Both crosses are additional to those listed by Banks and Johnson. Comments are offered concerning hybridization, courtship dives, and the classification of hummingbirds.

LITERATURE CITED

AMERICAN ORNITHOLOGISTS' UNION. 1957. Check-List of North American birds. Fifth edit.

BANKS, R. C. 1963. Birds of the Belvedere expedition to the Gulf of California. Trans. San Diego Soc. Nat. Hist., **13**: 49–60.

BANKS, R. C., AND N. K. JOHNSON. 1961. A review of North American hybrid hummingbirds. Condor, **63**: 3–28.

BRANDT, H. 1951. Arizona and its bird life. Cleveland, Ohio, Bird Res. Foundation.

COGSWELL, H. L. 1957. [Hummingbird accounts.] *In* R. H. Pough, Audubon Western Bird Guide, Garden City, New York, Doubleday and Co.

FISHER, A. K. 1893. Report on birds. (*in* The Death Valley Expedition). North Amer. Fauna no. 7, pp. 7–158.

FRIEDMANN, H., L. GRISCOM, AND R. T. MOORE. 1950. Distributional check-list of the birds of Mexico. Pacific Coast Avif., no. 29, pt. 1.

GRAY, A. P. 1958. Bird hybrids. Bucks, England, Commonwealth Agric. Bureaux.

GRINNELL, J. 1928. A distributional summation of the ornithology of Lower California. Univ. California Publs. Zoöl., **32**: 1–300.

GRISCOM, L. 1932. The distribution of bird-life in Guatemala. Bull. Amer. Mus. Nat. Hist., **64**: 1–439.

MONSON, G., AND A. R. PHILLIPS. 1964. A check-list of the birds of Arizona. Tucson, Univ. of Ariz. Press.

MOORE, R. T. 1937. Four new birds from northwestern Mexico. Proc. Biol. Soc. Wash., **50:** 95–102.

PETERS, J. L. 1945. Check-list of birds of the world. Vol. 5. Cambridge, Massachusetts, Harvard Univ. Press.

RIDGWAY, R. 1911. The birds of North and Middle America. U. S. Natl. Mus., Bull. 50, Part 5.

SIBLEY, C. G. 1957. The evolutionary and taxonomic significance of sexual dimorphism in birds. Condor, **59:** 166–191.

TAYLOR, W. P. 1909. An instance of hybridization in hummingbirds, with remarks on the weight of generic characters in the Trochilidae. Auk, **26:** 291–293.

WILLIAMSON, F. S. L. 1957. Hybrids of the Anna and Allen hummingbirds. Condor, **59:** 118–123.

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