

SPECIES RANK OF *PHIBALURA (FLAVIROSTRIS) BOLIVIANA* BASED ON PLUMAGE, SOFT PART COLOR, VOCALIZATIONS, AND SEASONAL MOVEMENTS

A. BENNETT HENNESSEY

ABSTRACT.—The Swallow-tailed Cotinga (*Phibalura flavirostris*) has traditionally been considered to consist of two subspecies, *P. f. flavirostris* of southeastern Brazil's foothill forest and, isolated by ~2,500 km, a population of *P. f. boliviana* in central-western Bolivia. The plumage of the two taxa is distinctly different; *boliviana* males have a longer tail, and body plumage is significantly less sexually dimorphic. The iris of *boliviana* is mustard yellow, distinct from the blood red iris of *flavirostris*. *P. f. boliviana* has dull to bright orange-yellow feet whereas *flavirostris* has pink feet. Only one vocalization type is recorded for *P. f. flavirostris*, whereas at least five calls and a song are known for *P. f. boliviana*, which vocalizes significantly more often. The Brazilian *P. f. flavirostris* has strong seasonal movements, whereas *P. f. boliviana* has no seasonal movements. Given the diagnosable differences between the two taxa, it is highly probable they are separate lineages. *P. boliviana* qualifies as critically endangered for its declining small population due to continual habitat loss. Received 7 December 2010. Accepted 4 April 2011.

The Swallow-tailed Cotinga (*Phibalura flavirostris*) has traditionally been considered to be comprised of two allopatric subspecies. *P. f. flavirostris* of southeastern Brazil foothill forest, (400–1,200 m asl) and *P. f. boliviana*, which is restricted to an isolated Andean intermontane savanna and semi-humid forest matrix (1,400–2,000 m asl) surrounded by moist montane forest in the Department of La Paz, Bolivia. The two populations are separated by ~2,500 km of tropical lowland forest, Pantanal, and Beni Savanna habitat. Chapman (1930) described *boliviana* as a new subspecies based on two specimens (American Museum of Natural History) collected by R. S. Williams in 1902 from Aten, La Paz Department, Bolivia. Krabbe (1984) noted a mounted *boliviana* in the Zoological Museum, University of Copenhagen, collected prior to 1847, in La Paz Department, Bolivia, but without further details. These three specimens provided the only information available for *boliviana* for 98 years until its rediscovery in 2000 (Hennessey 2002), 60 km north of the original collection site (14° 39' S, 68° 36' W, 2,000 m asl). I present new data from field observations, photographs, and sound recordings that provide evidence of unique plumage, vocal, breeding, and ecological characteristics that suggest *P. f. boliviana* should be elevated to species rank under the biological species concept.

METHODS

Plumage comparisons are based on 3 *boliviana* specimens (American Museum of Natural History [AMNH]; Zoological Museum, University of Copenhagen), photographs of 17 individuals (Bromfield et al. 2004; J. C. Atienza, pers. comm.; Mileniusz Spanowicz, pers. comm.) and field observations of 46 *boliviana* individuals in the Apolo Region (14° 36' S, 68° 30' W) of Bolivia. Behavioral and ecological comparisons are based on a year-round breeding survey (2008) and a continued monitoring program by William Ferrufino, and tape recordings of 13 individuals made during field work on 4, 5, and 18 October 2002, and 4–12 December 2003 in Apolo, La Paz. The *flavirostris* comparisons are based on eight specimens (AMNH; Philadelphia Academy of Natural Science; Goeldi Musuem), 18 hrs of field observations of 14 individuals, and sound recordings of eight individuals from 26 October to 2 November 2004 in Intervales National Park, State of São Paulo, Brazil (24° 12' S to 24° 32' S, 48° 03' W to 48° 32' W).

RESULTS

Plumage.—The plumage of *boliviana* is sexually dimorphic. The male has a dark gray crown with a large, semi-concealed fiery-red central crown patch (central crown feathers tipped black). A well-defined black facial mask bordered by white below and on the neck extends to the ear coverts; it has an orange-yellow malar stripe, chin, and lower throat with some dusky barring laterally; and the sides of neck and breast black and variable white to yellowish-white (upper

Asociacion Armonia, Lomas de Arena 400, Casilla 3566, Santa Cruz de la Sierra, Bolivia; e-mail: abhennessey@armonia-bo.org

breast) or pale yellow (lower breast). The lower underparts are variable yellow, pale yellow (including vent) with slight black streaking on belly becoming denser on flanks; the feathers of the back and rump are brownish-olive with black subterminal bar and contrasting broad yellow tips. The tail is strongly forked, outer feathers rather pointed, outer rectrices black with dusky-brown base, remaining rectrices black with mostly olive-yellow outer and dusky-brown inner webs at base. The wing has blue-black coverts, primaries, and secondaries with the outer webs edged greenish to yellow-olive. The female plumage has more variable streaking, possibly related to age. This similar, but slightly duller overall to the male plumage, dull brown-gray shadow of the male's black mask with black appearing on ear coverts, underparts more extensively barred black (variable), tail notably shorter, outer rectrices dusky-brown with blackish-brown tip, remaining rectrices with mostly olive-yellow outer webs, blackish tips and dusky-brown inner webs; marginal wing coverts at wing bend blackish, remaining lesser and median coverts appear variable from black to dark olive-green tipped black, greater secondary coverts and tertials gray-brown broadly edged greenish-olive on outer webs, and black greater primary coverts.

The most quantifiable characteristic distinguishing the two taxa is the tail length of the males. The only male *boliviana* specimen has a tail length of 131 mm (Chapman 1930; Peter Capainolo, pers. comm.), which is 24.8 mm longer than the mean 106.2 mm (range = 99 to 125.8 mm) tail length of male *flavirostris* specimens ($n = 23$) (AMNH: Peter Capainolo, unpubl. data; Alex Jahn, pers. comm., Goeldi Museum). There was no overlap in tail length with the longest *flavirostris* tail 5.2 mm shorter than the only adult male tail of *boliviana*. Field observations and photographic comparisons ($n = 7$) confirm that male *boliviana* consistently have a long tail similar in length to that of the male specimen (pers. obs.; J. C. Atienza, pers. comm.; Geoff Bromfield, pers. comm.; Mileniusz Spanowicz, pers. comm.)

The extent of barring on female *Phibalura* is variable among individuals, but *flavirostris* is more extensively barred than *boliviana*. The chin and underbelly barring of *flavirostris* is variable in intensity but no individuals show a complete lack of barring (AMNH; $n = 21$), in contrast with *boliviana* where most females show no barring on

the chin or underbelly ($n = 32$; pers. obs.; J. C. Atienza, pers. comm.; Geoff Bromfield, pers. comm.; Mileniusz Spanowicz, pers. comm.). Female *flavirostris* have dull green upperwing coverts in contrast with the black male upperwing coverts. This feature does not appear to be constant in *boliviana* where, in some breeding pairs, the female has black upperwing coverts. Other than the shorter tail, some female individuals of *boliviana* have plumage features similar to the male, whereas the sexually dimorphic body plumage of *flavirostris* is clearly demarcated in all specimens ($n = 12$).

The marked differences in female plumage between the two taxa are important in considering why *boliviana* was initially considered only a subspecies. Chapman (1930) in identifying the subspecies status of *boliviana* (based on a single female specimen) did not indicate the *boliviana* female was substantially different from the female *flavirostris*. Chapman (1930) noted there were 'marked differences' but concluded this called into question the correctness of the identification of gender. Chapman speculated that it was possible the female *boliviana* used to base his subspecies conclusion 'may be a young male'. Snow (1982) agreed the 1902 AMNH female *boliviana* specimen was probably incorrectly assigned to gender. Krabbe (1984) examined all three *boliviana* specimens and compared them with *flavirostris* specimens, and also concluded, based on its distinctively different markings, the single female *boliviana* specimen was incorrectly assigned to a gender. These authorities believed it better resembled a male *flavirostris*, as they were not aware of the different female *boliviana* plumage.

Soft Part Colors.—The iris color of *boliviana* and *flavirostris* is distinctly different with no observed variation in color (*boliviana* $n = 17$, *flavirostris* $n = 10$, pers. obs.; J. C. Atienza, pers. comm.; Geoff Bromfield, pers. comm.; Mileniusz Spanowicz, pers. comm.). The iris of *boliviana* is mustard yellow, whereas the *flavirostris* iris is blood red. The iris in both taxa is semi-concealed suggesting the color may be involved in signaling.

Foot coloration also differs markedly between the two taxa. Feet of *boliviana* are dull to bright orange-yellow, whereas *flavirostris* feet are dull to bright pink. No overlap has been recorded. Soft part colors were not known for *boliviana* or noted in Chapman's (1930) classification.

Vocalizations.—No vocalizations of *flavirostris* were recorded before this study. I obtained 34

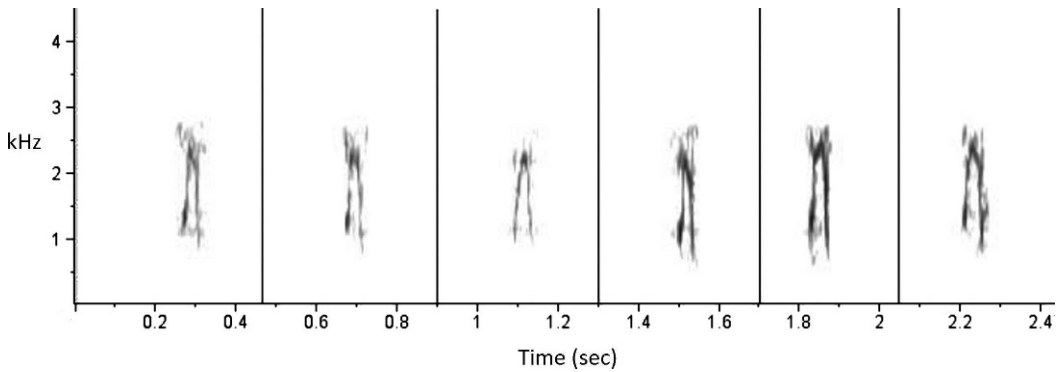


FIG. 1. Selected call notes of *Phibalura flavirostris flavirostris* demonstrating range of variability, Intervales State Park, São Paulo, Brazil.

sound recordings (representing at least 8 individuals) of *flavirostris* in Brazil during a similar stage of nesting conditions to compare to recordings of 13 *boliviana* individuals (#'s 120831, 120833, and 120834, Macaulay Library of Natural Sounds, Cornell University, Ithaca, NY, USA). The *flavirostris* vocalizations consisted of a single call note type with only a slight change of form but not frequency (Fig. 1). This call was most often recorded when one individual of a perched pair would call once before flight. No other sound was heard or recorded. The *flavirostris* population is considered to vocalize infrequently (Snow et al. 2004). I heard individuals vocalize on average once every 15 min.

Vocalizations of *boliviana* are highly variable and frequently emitted. One individual gave on average 80 type C call notes per minute over a 4-min sound recording (Fig. 2). Call C is the most common call note, used as a contact call in large flocks perched and in flight. There is also high variation in calling patterns with call types A, B, and C (Fig. 3) repeated without pattern but with slight variation in frequency for long periods. Calls D and E were recorded only once by

different individuals (Fig. 3). Several calls can be frequently heard at the same time while *boliviana* forages gregariously; where other call types have been heard but not recorded. Song A shows the only repeated patterned calls recorded for *boliviana* suggesting a song type (Fig. 4). This pattern was repeated without pause for >2 min. A female, while nesting, emitted Call C frequently while alone with a single egg. Single individuals of *flavirostris* while brooding eggs have not been heard to vocalize.

Seasonal Movements.—*P. f. flavirostris* has strong seasonal movements from 400 to 1,200 m elevation in Brazil (Sick 1993). Individuals arrive in open foothill areas to breed from October to January. Individuals are entirely absent from these breeding areas for 7 months of the year with unclear movements although some have been observed to move to lowland forest (Snow 1982, Sick 1993). In contrast, *P. f. boliviana* are present throughout the year (1,400–2,000 m asl) where studied and are known to breed from August to March with a peak around January (William Ferrufino, unpubl. data). No seasonal movements are apparent for *boliviana*.

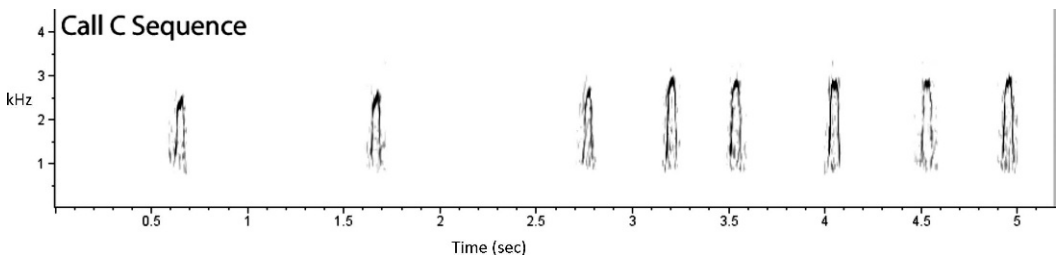


FIG. 2. Segment of call C sequence of *Phibalura flavirostris boliviana*, Pata, Madidi National Park, La Paz, Bolivia.

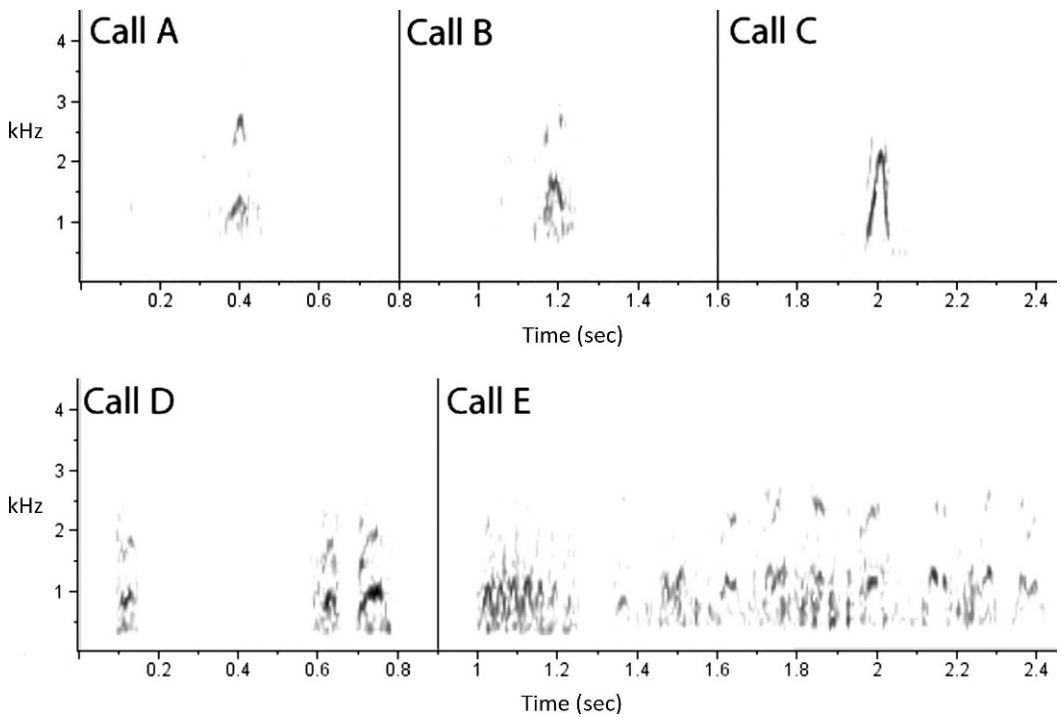


FIG. 3. Calls A, B, C, D, and E of *Phibalura flavirostris boliviana*, Apolo Region, La Paz, Bolivia.

DISCUSSION

Data collection in Bolivia has been intensive in the Madidi Region (Remsen and Traylor 1989, Hennessey and Gomez 2003, Hennessey et al. 2003), and we now know that *boliviana* is a reproductively isolated population. Given the extreme range disjunction between the two allopatric taxa, it is likely to retain its genetic and phenotypic integrity. From the consistent, diagnosable differences in morphometric plumage, soft part, vocalization, and reproductive seasonal movement differences between the two taxa, it is highly probable these are separate

lineages, each on its own evolutionary trajectory. A male *boliviana* was observed in an exaggerated flight display over two females in December 2003, similar to the flight display observed of Chestnut-crested Cotinga (*Ampelion rufaxilla*) (Hennessey 2004) where the tail was extended outward. The increased tail length of *boliviana* as compared to *flavirostris*, a sexually selected secondary character in its exaggerated form, would appear to demonstrate evolved reproductive behavior changes, possibly involving flight display and mate choice. The much more complex and increased vocal repertoire of *boliviana* also suggests evolved behavioral differences. The

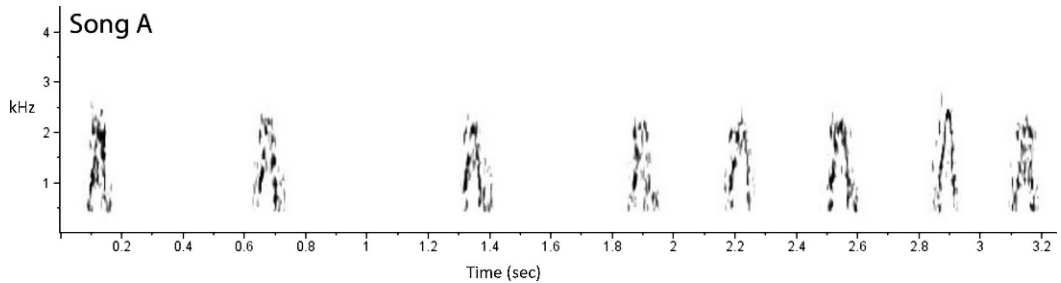


FIG. 4. Song A of *Phibalura flavirostris boliviana*, Apolo Region, La Paz, Bolivia.

evolution of less sexually dimorphic traits in *boliviana* suggests a complex change in reproductive behavior and that the two taxa are likely behaviorally reproductively isolated. I propose the local Quechua name, which means forked-tail, as the English name Palkachupa Cotinga for *Phibalura boliviana*, an endemic species for Bolivia.

CONSERVATION IMPLICATIONS

The Swallow-tailed Cotinga is considered near threatened (IUCN 2010) and a high research priority (Parker et al. 1996). Its threatened status was based only on known information for *flavirostris*. I estimate, based on field observations, that 400 to 500 *boliviana* individuals are within a broken ring of fragmented habitat surrounding the town of Apolo (William Ferrufino, unpubl. data). Given the habitat destruction in the Apolo area in the last 100 years, *boliviana* qualifies as critically endangered (1b2c) under IUCN criteria for its declining small population due to continual habitat loss. Endangered status is supported by its small range and small population. Much of this range continues to be deforested and burned for cattle pasture and agricultural areas within Madidi National Park's area of Integrated Management. The largest population is outside of Madidi National Park, around the original collection site of Aten.

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