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AERIAL DISPLAY SOUNDS OF THE BLACK-CHINNED HUMMINGBIRD[1]

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Key words: Hummingbirds; courtship; displays; vo-
calizations; Trochilidae.

Remarkably little is known of the sounds produced by
hummingbirds. Earlier work is descriptive, and there
are few published sonograms (see Mirsky 1976, Wells
et al. 1978, Baptista and Matsui 1979, Wells and Bap-
tista 1979). Considerable debate concerns whether
sounds produced during aerial displays are vocal, me-
chanical or both (Rodgers 1940, Wells et al. 1978,
Baptista and Matsui 1979). The sources of dive sounds
cannot be determined by ear, and visual inspection of
sonograms can be inconclusive. In some cases, the
structure and temporal pattern of the sounds could fit
either category of sound production.

Aerial displays of many hummingbirds consist of
repeated pendulum-like arcs or vertical oval flights per-
formed by both sexes in some species and used in both
territorial and courtship displays (Pitelka 1942, Banks
and Johnson 1961, Stiles 1982). Sounds are generally
produced at the base of the arc, directly above the other
bird (See descriptions in Bent 1940).

Here we present a sonographic analysis of the sounds
produced during aerial displays by the Black-chinned
Hummingbird (Archilochus alexandri). We compare
sonograms of aerial display sounds to sonograms of
mechanical and vocal sounds produced by Black-
chinned Hummingbirds in other contexts. In addition,
we compare Black-chinned Hummingbird display
sounds to published accounts of the aerial display sounds
of the Anna's Hummingbird (Calypte anna) and Cos-
ta's Hummingbird (Calypte costae), which are closely
related to the Black-chinned Hummingbird (Mayr and
Short 1970). Based on these analyses, we suggest the
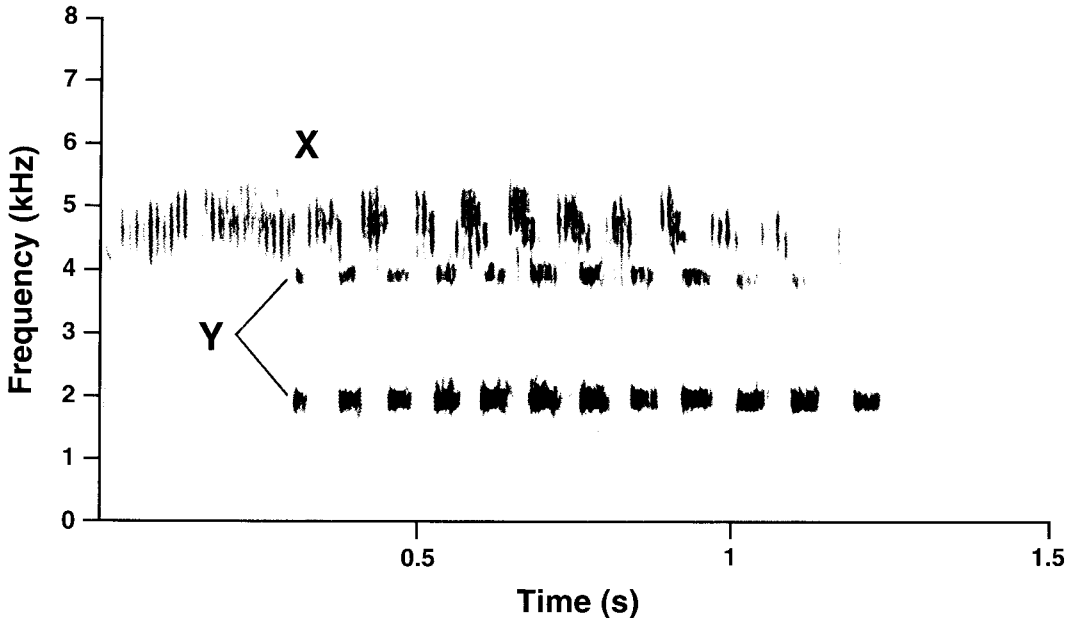vocal source of the dive sounds of the Black-chinned
Hummingbird.

FIGURE 1.   Aerial display sounds of a male Black-chinned Hummingbird showing X and Y elements.

METHODS

Displays were observed at approximately 17:00 CST in Ramsey Canyon, Arizona, on 21 May 1993. The displays occurred in sparsely vegetated pine-oak-juniper habitat at about 2,000 m. The microphone was held approximately 3 m from the female target of the display. The male was between 1–5 m from the female when producing the display sounds. Recordings were made with a Sony Walkman Professional cassette recorder (WM-D6C) and Audio-technica line cardioid microphone (AT877). Sonograms were produced on a Kay Sona-graph 7800 (150 Hz band width).

RESULTS

The aerial display dives of the Black-chinned Hummingbird are U-shaped pendulum flights (Bent 1940). The arms of the U are not vertical, but lie at about a 45° angle from the horizon. The apex of each upward flight is approximately 20–30 m from the ground. In the aerial displays observed in this study, the base of the U was about 1 m above a bush in which a female Black-chinned Hummingbird was perched approximately 1.5 m from the ground. While flying directly above the female, the male produced a series of sounds in rapid succession. There was no apparent change in flight speed during any part of the display except when the male reached the top of the arc and turned around to fly down again. The male did not appear to point its bill down towards the female while flying upward along the arms of the arc as does the displaying Anna's Hummingbird (review in Wells et al. 1978).

Two display bouts were separated by a 4 min interval during which the male was not in sight. The first display

bout consisted of six dives, the second of nine. The female remained silent throughout the observations.

DISCUSSION

The trill (X) component of the aerial display is structurally similar to wing noises of male Black-chinned Hummingbirds produced in agonistic interactions (Figs. 1, 2). Both are composed of a rapid trill. Some notable differences also occur. The temporal pattern of the X trill is unlike wing noise produced in all other recorded contexts including hovering, turning, and direct flights. The duration is shorter and X elements do not continue throughout the course of the dive or through the full base of the arc, but only in conjunction with the Y components which are produced immediately above the target of the display. Presumably, if the X component were a byproduct of the flight movements, the sound would increase in amplitude as the bird flew towards the mircophone, and fade as he flew away. Instead, there is a relatively abrupt appearance and disappearance of the sound as the bird is directly over the female. While we do not dismiss the possibility that hummingbirds are capable of controlling the timing of wing noises used in communication, the temporal characteristics of the component in conjunction with the Y elements are more supportive of the hypothesis that the sound is not a function of the flight movements as it is in Broad-tailed Hummingbirds (*Selasphorus platycercus*) (Miller and Inouye 1983). In addition, the frequency range of X elements does not overlap that of wing noises. The frequency of the X elements is between 4–5 kHz and wing noises are produced at 2–3 kHz (Figs. 1, 2).

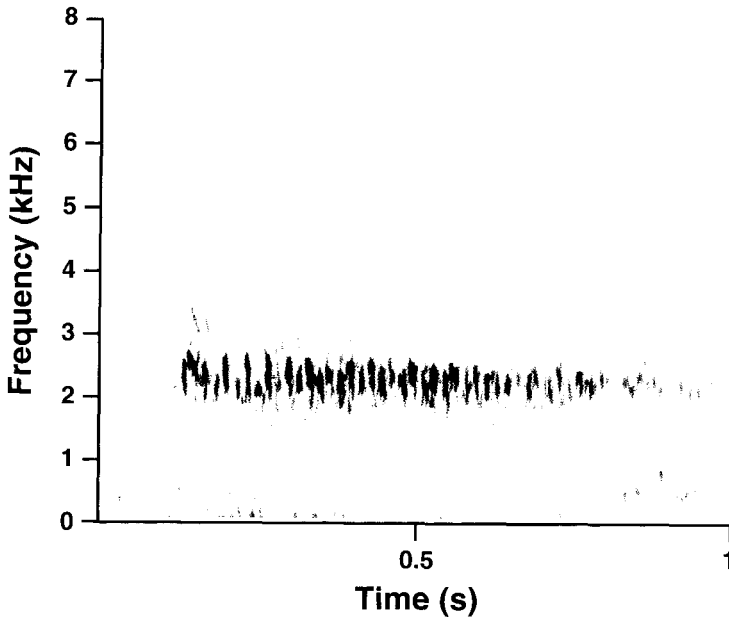The Y elements are short, pure tone "bell-like"

FIGURE 2. Wing buzz of a male Black-chinned Hummingbird during an agonistic interaction.

sounds. These elements are structurally unlike either mechanical or vocal sounds recorded in other contexts. The Y element is dissimilar to vocal sounds produced in agonistic interactions, but agonistic vocalizations are variable,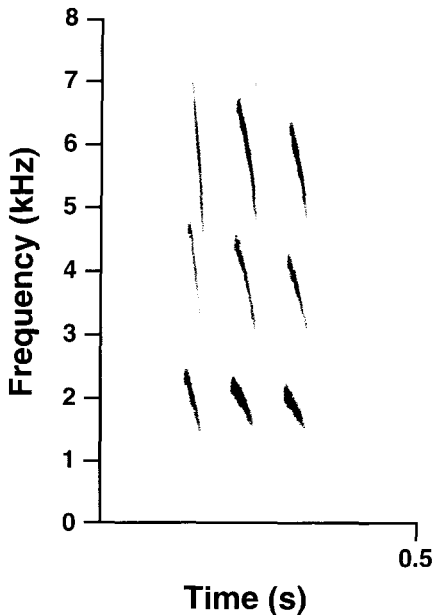 and it is not surprising that aerial display sounds would be very different from agonistic ones. Additional characteristics suggest vocal origins. Like the X elements, the frequency range of Y elements is within that of vocally produced notes. The inter-note interval between Y elements and between X elements is also similar to that found between notes in vocally produced sequences (Fig. 3). No similar temporal patterns have been found in wing noises. Instead, wing sounds are long segments of continuous "buzzing." We also believe the hypothesis that the X element is mechanical and Y element vocal can be rejected because of the improbability of two different sound production mechanisms showing such precise alternation within these time intervals (Fig. 1).

Probably the most convincing evidence for vocal origins of the Black-chinned Hummingbird display sounds is revealed by comparisons of these display sounds with the aerial display sounds of the Anna's Hummingbird. The X note of the Black-chinned Hummingbird is structurally similar to the vocally produced "a" elements of the Anna's Hummingbird. The "a" elements are produced by Anna's Hummingbirds during aerial courtship displays and during singing while perched (Baptista and Matsui 1979, Fig. 1). Elements similar to X and Y are also shown in some sonograms of the Anna's Hummingbird by Mirsky (1976). Similarly, the Costa's Hummingbird produces a vocal note during its aerial courtship display which is also produced during perched singing (Wells et al. 1978). As these sounds were produced while the birds were perched, wing noise can be ruled out as a source. *Calypte* and *Archilochus* are closely related and have been known to hybridize (Mayr and Short 1970). Evolutionary conservatism would support the notion that similarity of note structure suggests a similarity in means of production.

FIGURE 3. Vocally produced note sequence of a male Black-chinned Hummingbird during an agonistic interaction.

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THE NONBREEDING DISTRIBUTION OF THE BLACK SWIFT: A CLUE FROM COLOMBIA AND UNSOLVED PROBLEMS[1]

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The distributions of many species of swifts of the genus Cypseloides remain poorly known, due to the difficulties of field identification and collecting specimens of these obscurely marked, usually high-flying birds. New specimen reports and breeding records (e.g., Marín and Stiles 1992, 1993) often involve large range extensions or overturn previous ideas regarding breeding areas and seasonal movements (see Marín and Stiles 1992 vs. Monroe 1968 on C. cryptus for one such example). In this report we describe the first records of the northern Black Swift (C. niger borealis) for Colombia, indeed, for South America, and we review and reinterpret existing information for this and other races of the species. If this analysis seems to further confuse an already cloudy situation, it also serves to emphasize our all too fragmentary knowledge regarding this species.

The breeding range of C. n. borealis includes the mountainous areas of western North and Central

America from extreme southeastern Alaska to Veracruz, México (Friedmann et al. 1950, AOU 1957). The winter range of this race was long considered to lie in southern Mexico (e.g., AOU 1931), but a thorough examination of existing specimen records led Bent (1940) to conclude that no authentic winter records existed, all birds from southern Mexico having been taken during breeding or migration periods. Positive information on this point has remained elusive; yet the AOU (1983, p. 317) still stated "winters in México (presumably)." However, they overlooked a significant specimen record for the spring migration period (19 April) from southwestern Costa Rica (Kiff 1975). Stiles and Skutch (1989) reported regularly seeing flocks of up to 30 Black Swifts over the Valle Central of Costa Rica during April to early May and September to early October in various years (inclusive dates 9 April–11 May, 13 September–10 October). Although specimens were not obtained, it is possible that these birds were migrating borealis. These reports suggest that this race might winter much further south than previously supposed. Reports of Black Swifts at sea off Chiapas during the spring migration period (16 May 1963, Buchanan and Fierstine 1964), and off Guatemala during fall migration (20 September 1933, Davidson 1934) are also