

sang an aberrant song. Vireos which held territories distant to the aberrant individual ignored playback of the aberrant song, as if they did not recognize it as the song of a conspecific. However, the four immediate neighbors of the bird reacted to its song no differently than they reacted to normal song. Apparently the neighbors of this individual learned to respond to the unusual song because it was associated with the appropriate visual stimuli. The learning hypothesis could be tested by using models during playback experiments. If it is true, birds in allopatric populations should habituate to golden-wing song if it is presented simultaneously with a golden-wing model, but should not habituate if presented with a blue-wing model.

If it is adaptive for Blue-winged Warblers to discriminate between species (to reduce the frequency of hybridization, interspecific aggression or both), then the learning mechanism described here is probably more efficient than selection for a genetically determined response. Because selection for a genetically determined response involves a change in gene frequencies which varies with each situation, it requires more time and involves waste in maladapted offspring, whereas learning involves a rapid response to different environmental conditions and offers individuals immediate advantages (Shields, Philopatry, Inbreeding, and the Evolution of Sex, State Univ. of New York Press, Albany, New York, 1982).

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The songs of *Microcerculus* wrens in Costa Rica.—The starting point of my recently published study of the taxonomy of *Microcerculus* in Middle America (Stiles 1983, *Wilson Bull.* 95:169–183) was the existence of two strikingly different “song types” in Costa Rica, as was first recognized by Slud (1958, *Condor* 60:243–251). Morphological and distributional data led me to conclude that the song types in reality represented different species, the northern *M. philomela* (Nightingale Wren) and the southern *M. (marginatus?) luscini* (Whistler Wren). In the course of this study, I also recorded both song types, but unfortunately the sonograms reached me just too late to be included in the paper. Accordingly I present here descriptions and sonograms of representative songs of the two species of *Microcerculus* wrens in Costa Rica and briefly compared them with songs of other populations of these species, other *Microcerculus*, and other genera of wrens. Songs were recorded on a Uher 4000-L tape recorder with an M-517 Uher microphone and a Griffith fiberglass parabolic reflector.

The song of *M. philomela* (Fig. 1) consists of a long series of pure clear whistles, mostly without harmonics, that are given at a rate of ca. 2 per sec. The whistles are 0.3–0.4 sec in duration, and even-pitched or upslurred at frequencies between 3 and 6 kHz. Successive notes are typically on different pitches, such that the song “rises and falls in an arresting manner” (Slud 1958). The overall effect is sometimes strikingly tuneful, and was undoubtedly

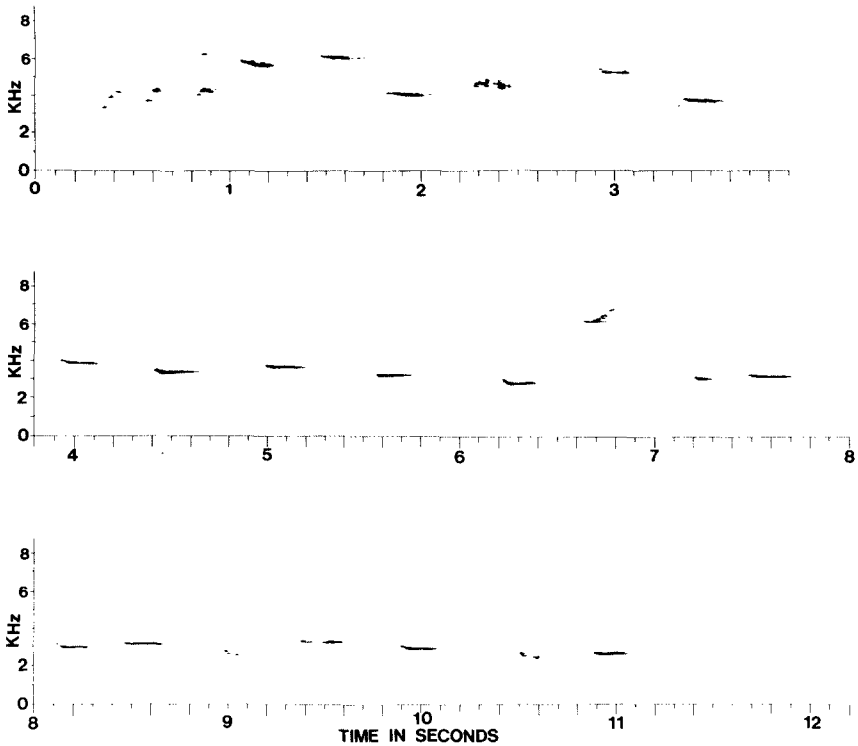


FIG. 1. A complete song of *Microcerculus philomela* recorded at Finca La Selva, Sarapiquí, Prov. Heredia, Costa Rica, on 26 Feb. 1981. Note the opening motif of shorter, softer, more rapid notes, and the tendency of the main part of the song to break into "phrases" of 6–8 notes.

responsible for the vernacular name of "nightingale" wren (although it certainly does not resemble the song of the true nightingales [*Luscinia* spp.]). The duration of the song is quite variable, ranging from less than 10 to over 20 sec. The main part of the song is introduced by a series of shorter, softer, more rapid notes. This opening motif is quite variable, and may consist of up to 10 notes (pers. obs.). I have heard the same bird give longer or shorter opening motifs on successive songs.

The song of *M. luscinia* shows some similarity in the form of the individual notes, but its structure is almost totally different (Fig. 2). The song opens with a series of ca. 10–15 short notes that decelerate, lengthen, increase in loudness, and rise in pitch from ca. 4.5 to over 5 kHz. The number of notes in this opening motif varies from ca. 8–14 in the three songs recorded (the first notes are so soft and fast that they are difficult to count and may easily be lost from the recording). The opening motif is followed by two loud, upslurred notes (7–8 kHz) that resemble in structure some of the notes in the song of *M. philomela*.

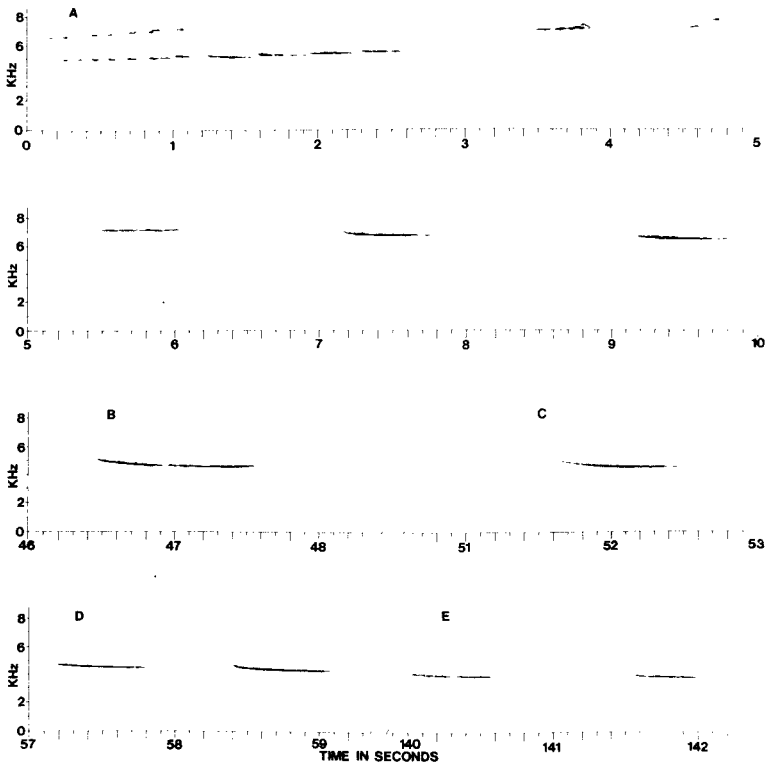


FIG. 2. Selected portions of a song of *Microcerculus lusciniæ*, recorded at Finca "Los Cusingos," El Quizarrá, Prov. San José, on 17 June 1982. See text for a description of the complete song (which would have required some 20 m of sonograms to display!). A. Opening motif through the first three single whistles; B. next-to-last single whistle; C. last single whistle; D. first double whistle; E. last double whistle.

From here on, however, the song is totally different. First there follows a series of pure, long-drawn-out, high-pitched whistles, which gradually become longer, more slurred, lower-pitched, and widely spaced through the series. The first whistles in the series are ca. 0.8–0.9 sec in duration, at a frequency of ca. 6.8 kHz little slurring, and separated by an interval of ca. 1 sec; the last ones slur from 5 to ca. 4.5 kHz, last 1.4–1.5 sec, and are separated by intervals of ca. 3.8 sec. In the three songs recorded, the number of single whistles is 13 or 14. Then, following a gap of ca. 4 sec, there begins a series of double whistles. The commonest notes are each ca. 1 sec in length and separated by 0.4–0.5 sec; the interval between doubles increases gradually from ca. 3.8 sec at the start, to ca. 5 sec at the end of the sequence. The first note of each double is distinctly downslurred, the second only slightly so; the frequency

of successive doubles gradually declines from 5–4.5, to slightly less than 4 kHz through the series. In all, some 15–18 doubles occurred in the three recorded songs although I have heard songs with as few as five (possibly interrupted) and as many as 20 or more, with the intervals between doubles increasing to 6–8 sec in the longest songs. The three full songs recorded averaged ca. 2.5 min in length, most of which (1.5 min or more) was occupied by the final sequence of double whistles (Fig. 2).

The opening motifs of both *M. philomela* and *M. luscinia* consist of softer and more rapid notes. In both species I have encountered considerable variability in the number and rapidity of these notes both between individuals and different songs of the same individual. It is my strong subjective impression that sometimes the opening motifs of the two species can be quite similar. Unfortunately, I lack a wide enough selection of recordings (or sonograms) to verify this impression. Aside from this variation in the opening motif, and in total song length, I have encountered no striking variation between the songs sung by a given individual: each individual seems to have but a single song.

I have also detected considerable geographic variation in the songs of both forms. In *M. philomela*, the La Selva song (shown in Fig. 1) is to me the most strikingly melodious, showing a tendency to break into “lines” of ca. 6–8 notes. In other populations, the song is often less strikingly melodious, with a less defined cadence; however, in all the delivery rate of ca. two notes per sec is preserved and the length of the individual notes is similar. Total length of the song seems to vary at least as much within as between most populations, although all songs heard at one locality, Volcán Orosí, in northern Costa Rica, were quite short (ca. 7–10 sec). A song of *philomela* recorded in Chiapas, Mexico (Hardy 1978, “The Wrens,” ARA Records, no. 2) is structurally identical to those of Costa Rican birds, including the opening motif, but is longer than most.

In *M. luscinia*, variation is most evident in the last part of the song, specifically whether it is composed of single or double notes. Most populations on the Pacific slope of Costa Rica end the song with a long series of double notes; on the Atlantic slope, these final notes are single: there is no transition in the middle of the song, but the whistles and the intervals between them lengthen gradually throughout the song. One song I listened to at Bribri, near the Panama border, lasted nearly 4 min; the interval between successive whistles was at least 12 sec at the end. A song of *M. m. marginatus* from NE Peru (Hardy 1978) seems very similar in temporal structure to the single-note version of the song of *luscinia*. However, the song as presented on the record is considerably shorter than a typical one of *luscinia*, and lacks the opening motif. I suspect that the recorded song is incomplete: given the length of the song and the usually long intervals between songs, it is all too easy to break into the middle of a song, and frustratingly difficult to record the opening motif! If a complete song of *marginatus* is indeed longer and with a fast, soft opening motif, this would provide strong support for considering *luscinia* as a subspecies of *marginatus*.

This geographical variation in no way blurs the distinctness of the two song types: there is always an order-of-magnitude difference in delivery rate, and the individual notes in the song of *luscinia* are always 2–4 times longer than those in the song of *philomela*. The birds themselves seem unequivocal in recognizing the difference, as well. My whistled renditions of the La Selva song type consistently produce strong reactions (countersinging and close approach) in other *philomela* populations (e.g., Carrillo, Volcán Orosí, Bijagua), but never in *luscinia* populations (Quizarrá, Osa Peninsula, vic. Parrita). On the other hand, a very poor-quality recording of a *luscinia* song from Bribri evoked a strong reaction from birds of Golfito and the General Valley, on the southern Pacific slope, but was ignored by La Selva birds. I should emphasize that my sample sizes for these “experiments” are small, and that a much larger number of recordings and experiments would be required to evaluate

the importance of geographic variation within song types, as well as my hypothesis that similarity in the opening motifs might facilitate interspecific territoriality (Stiles 1983).

Consisting as they do of pure-toned, unmodulated, long (0.3 sec or more) whistles, the songs of the two Costa Rican species of *Microcerculus* seem ideally suited for transmission in an obstruction-filled habitat like tropical forest understory (Morton 1975, *Am. Nat.* 109:17–33). Other understory wrens (e.g., *Henicorhina*, *Cyphorhinus*) sing songs of comparable tone quality, as do the other two recognized species of *Microcerculus*, *bambla* and *ustulatus* (cf. Hardy 1978). The songs of the latter two species have a very different temporal structure, however, with the whistles becoming progressively shorter and more rapid (in *ustulatus*, but not in *bambla*, the song finishes as an up- or down-slurred glissando). Of the wide selection of wren songs presented by Hardy (1978), that of *Cyphorhinus aradus* is most comparable in tone quality to those of *Microcerculus*, but is very different structurally: a low, burbling phrase is interspersed with the clear whistles, which themselves are given in a seemingly random order quite unlike the patterned utterances of *Microcerculus* spp. Thus, although song tends to confirm that the species of *Microcerculus* form a natural unit, it is scarcely helpful in establishing the relationship of this unit to the other genera of wrens.

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Cowbird nest selection.—The Brown-headed Cowbird (*Molothrus ater*) is well known for its brood parasitic habit (Friedmann et al., *Smith Contrib. Zool.* 235, 1977). The large number of recorded hosts testifies to the variety of situations encountered by egg-laying females. Since cowbird nesting activities are not centered on their own nests, the manner of host selection is an important factor in determining reproductive success of individual females. How, then, do cowbirds select host nests?

If all potential host nests are at equal risk (same probability) of being parasitized, and since cowbird parasitism is a “rare” event, the distribution of 0, 1, 2, 3, . . . cowbird eggs per nest will approximate successive terms of a Poisson series. Preston (*Ecology* 29:115–116, 1948) tested for such a distribution and found no good statistical fit; however, within the sample of parasitized nests, the distribution of cowbird eggs after the first egg did fit the Poisson distribution that was generated. He concluded that the first cowbird egg in a nest was placed nonrandomly and subsequent, additional eggs were randomly distributed among the already parasitized nests. Mayfield (*Condor* 67:257–263, 1965) looked at similar data and felt that host nests with one cowbird egg were under represented in the sample. Since some hosts may immediately abandon their nests after the first cowbird egg appears, these abandoned nests become difficult to locate. By adding 10–15% to the number of nests with one cowbird egg, he produced a close fit to Poisson distributions. Mayfield (1965) concluded that cowbirds distribute eggs randomly among available host nests. Elliott (*Auk* 94:590–