Systematics and Acoustic Behavior of United States Crickets of the Genus *Cyrtoxipha* (Orthoptera: Gryllidae)[1]

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ABSTRACT

Four species of *Cyrtoxipha* occur in the United States. *C. columbiana* Caudell occurs throughout the southeastern States, *C. gundlachi* Saussure is restricted to peninsular Florida, and *C. **nola*** and *C. **confusa,*** n. spp., are known only from the mangrove areas of the south Florida coast. The songs of these species are distinctive in the field, and differences in pulse rate and rhythm are apparent from analyses of field and laboratory tape recordings. Other characters not previously used, such as male genitalia and stridulatory file, are useful in distinguishing the species of *Cyrtoxipha.* The stridulatory files of *columbiana* and *gundlachi* show geographic variation.

The United States species of the genus *Cyrtoxipha* are tiny, agile, green crickets known only from the southeastern States. They are often numerous, but their quick movements, small size, and arboreal habits make them difficult to collect and they are hence rare in collections. Their abundance in nature is evidenced by the tinkling choruses of the males that are among the most characteristic sounds in southeastern hardwoods on summer evenings and cloudy afternoons. The males of *columbiana,* the most widespread species, synchronize their chirps; consequently, a woods or a doorside shrub may seem to maintain a steady, musical throb, reminiscent of the jing jing of sleigh bells in the distance.

The only reports of the behavior of *Cyrtoxipha* have been descriptions of the songs (e.g., Fulton 1932) and of the mating of *columbiana* (Alexander and Otte 1967). Feeding habits are unknown, but specimens can be maintained for as long as month on dry dog food (Purina® dog chow) and water.

METHODS

Methods were similar to those described for studies of oecanthine crickets and *Orocharis* (Walker 1962a, 1969). The following abbreviations are used in this paper: ANSP (Academy of Natural Sciences of Philadelphia), FSCA (Florida State Collection of Arthropods), JDS (J. D. Spooner), REL (R. E. Love), TJW (T. J. Walker), UFT (University of Florida Tape), USNM (U.S. National Museum). Holotypes and allotypes have been deposited in USNM and paratypes have been sent to ANSP and the University of Michigan Museum of Zoology.

NOMENCLATURE AND DESCRIPTIONS

The generic classification of the trigonidiine crickets of the world has never been revised, and the limits of the genus *Cyrtoxipha* have changed from author to author and from time to time. Kirby (1906) listed 43 species, but many of these are now placed in other genera. Since 1906, from localities as scattered as South America, Borneo, Japan, and Africa, at least 20 additional species have been described as *Cyrtoxipha.*

Although the limits of *Cyrtoxipha* are by no means clear, the U. S. species will certainly remain in the genus because they are quite similar, and 1 of them, *gundlachi,* is the type-species of *Cyrtoxipha.* Chopard (1956: 259) gave these identifying characters for *Cyrtoxipha* in his key to the New World genera of Trigonidiinae: tegmina of male with mirror, terminal joint of maxillary palp short and nonfoliaceous, head flattened above, and eyes horizontally lengthened. The U.S. species of *Cyrtoxipha* are light green (dried specimens rapidly turn yellow), while all other U.S. trigonidiine crickets are brown or red and black.

The nomenclature of the 4 U.S. species of *Cyrtoxipha* is complicated by uncertainty concerning the identity of Saussure's *gundlachi.* For the sake of nomenclatural stability I have (1) used the name *gundlachi* for the most commonly collected and widely distributed peninsular Florida species, and (2) designated no lectotype from among the 5 syntypes I have seen.

The 1st action has the desirable effect of making ca. 90% of the specimens that have been identified as *"gundlachi"* correctly identified. The 2nd action is desirable in light of the following circumstances: (1) Saussure described *gundlachi* from 7 specimens, 6 from Cuba and 1 from the southern United States; (2) examination of the 5 syntypes known to be extant (all from Cuba) reveals that Saussure had more than 1 species in his type-series; (3) only 2 of the 5 extant syntypes are indistinguishable from the present *gundlachi;* (4) if either of these 2 syntypes was designated lectotype, future workers might discover better means of identification and find that the lectotype did not belong to the species here called *gundlachi;* (5) so long as even 1 of Saussure's 7 syntypes is missing, no appeal to the International Commission will be required to preserve established usage.

Yet another nomenclatural complication exists. Two species similar to the present *gundlachi* are here described as new and named *nola* and *confusa.* Their restriction to mangrove in south Florida suggests that they may be common elsewhere in the Caribbean. The present disarray in taxonomy and nomenclature of Caribbean gryllids prevents my knowing if *nola* and *confusa* have already been given other specific epithets in *Cyrtoxipha* or some other genus.

Cyrtoxipha gundlachi Saussure
Gundlach's green sword-tailed cricket
(Fig. 1, 2, 6, 10, 11)

Cyrtoxipha gundlachi Saussure. 1874: 373. Type-locality: Cuba and S. U. S. Types: 3 ♂, 4 ♀. Syntypes exa-

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mined: 2 ♂, 3 ♀. Museum d'Histoire Naturelle, Genève, Switzerland. Other syntypes, including females from S U.S., lost or destroyed?

The reasons for calling the present species *gundlachi* have been discussed above. None of the 5 syntypes of the Museum d'Histoire Naturelle can be positively identified because none is from a locality in which *Cyrtoxipha* has been studied. I have examined the 5 specimens through the courtesy of Dr. Bernd Hauser and tried to identify them using the key in this paper with the following results: 1 ♀, unidentifiable (no ovipositor); 1 ♀, *gundlachi* or *nola* (ovipositor blade 1.45 mm); 1 ♀, *columbiana* (ovipositor blade 2.55 mm); 2 ♂, stridulatory vein (measured from above) as in *confusa* (0.82 and 0.78 mm), genitalia as in *nola*.

Cyrtoxipha columbiana Caudell
Larger green sword-tailed cricket
(Fig. 1, 3, 6, 10, 12)

Cyrtoxipha columbiana Caudell, 1907: 237. Type-locality: Falls Church, Va. Type: lectotype here designated from 2 ♂ syntypes, 14 Sept. 1907, USNM.

This is the only species of *Cyrtoxipha* occurring north of peninsular Florida.

Cyrtoxipha nola, n. sp.
Tinkling green sword-tailed cricket
(Fig. 1, 4, 7, 10, 13)

C. nola was mistaken for *Orocharis nigriforns* Walker (Walker 1969) when it was first heard. Both species produce bell-like tinkling sequences from mangrove in south Florida; *nola* (Latin) = a little bell.

Holotype.—♂, Marco Island, Collier Co., Fla., 28 Apr. 1963, on black mangrove, TJW, JDS; UFT 623-3. Similar to *gundlachi* except for phallus and stridulatory vein. Lateral phallic processes as in Fig. 13. Stridulatory file 1.06 mm with 126 teeth. Stridulatory vein from above 0.95 mm. Other measurements (mm): pronotum (length × caudal width) 1.0 × 1.8, length of tegmen, 5.1.

Paratypes.—16 ♂. FLORIDA. MONROE Co.: nr. Flamingo, 27 Apr. 1963, 1 ♂ (UFT 623-5), Flamingo 25 Dec. 1965, 1 ♂ (UFT 623-12). COLLIER Co.: Marco Island, 28 Apr. 1963, 4 ♂ (UFT 623-2,4,6,7). CHARLOTTE Co.: Punta Gorda Isles, 15 May 1965, 1 ♂ (UFT 623-16); 27 Aug. 1964, 4 ♂ (incl. UFT 623-13, 14). MANATEE Co.: Sunshine Skyway Bridge, 16 May 1965, 2 ♂; 30 Aug. 1964, 3 ♂ (All FSCA.)

Other Records.—FLORIDA. Tapes only: MONROE Co., Flamingo, 26 Apr. 1963, UFT 623-1; COLLIER Co., Marco Island, 5 July 1965, UFT 623-15; CHARLOTTE Co., Punta Gorda Isles, 28 Nov. 1963, UFT 623-8, 9, 10. Listening records: MONROE Co., nr. Flamingo, 26 Apr. 1963, TJW, DADE Co., nr. Flamingo, 26 Apr. 1963, TJW; Matheson Hammock, 3 July 1965, (specimen watched while singing) REL; CHARLOTTE Co., Punta Gorda Isles, 29 Dec. 1963, REL.

Cyrtoxipha confusa, n. sp.
Trilling green sword-tailed cricket
(Fig. 1, 5, 8, 9, 10, 14)

On separate trips to the Florida Keys in the summer of 1958, R. D. Alexander and I discovered this species of *Cyrtoxipha* by its trilling song. The name *confusa* refers to the fact that the trill of *confusa* is not a simple trill as produced by many trigonidiine crickets of the genus *Anaxipha* but rather is a series of paired pulses that are probably homologous to the chirps of *gundlachi*.

Holotype.—Male, Saddle Bunch Keys, Monroe Co., Fla., 24 June 1964, on buttonwood, TJW, REL, UFT 624-5. Similar to *gundlachi* except for phallus and stridulatory vein. Lateral phallic processes as in Fig. 14. Stridulatory file 0.86 mm with 90 teeth.

Allotype—♀, N. Key Largo, Monroe Co., Fla., 22 June 1964, on red mangrove, TJW, REL. Similar to *gundlachi* except for length of ovipositor.

Measurements of Holotype and Allotype (mm).—Pronotum (length × caudal width) ♂ 1.1×1.8, ♀ 1.0×1.6; length of tegmen ♂ 5.4, ♀ 5.7; length of hind femur ♂ 4.4, ♀ 4.5; length of stridulatory vein from above 0.83; length of ovipositor blade 1.95.

Paratypes.—28 ♂, 19 ♀, 1 gynandromorph. FLORIDA. MONROE Co.: Key West, 19 Jan. 1904, 3 ♂, 15–16 Mar. 1910, 6 ♂, 4 ♀, 3–7 July 1912, 1 ♂, 1 ♀, 1 ♂♀; Big Pine Key, 6 July 1912, 2 ♂, 1 ♀; Key Vaca, 14 Mar. 1910, 1 ♂, 2 ♀; Long Key, 13 Mar. 1910, 1 ♀; Key Largo, 11 July 1912, 1 ♂, 9 Aug. 1930, 1 ♂, 1 ♀ (ANSP); Stock Island, 23 June 1964, 1 ♀, 24 June 1964, 2 ♂ (incl. UFT 624-4), 21 Aug. 1958, 1 ♂; Big Pine Key, 16 July 1963, 1 ♂; Key Largo, 22 June 1964, 4 ♂ (incl. UFT 624-3, 6, 7), 1 ♀; 17 July 1963, 1 ♂, 2 ♀; Flamingo, 21 June 1964, 3 ♀, 24 Dec. 1965, 1 ♀ (FSCA). DADE Co.: Virginia Key, 11 Mar. 1915, 1 ♂; Biscayne Bay, 9 Feb. 1904, 1 ♂; Miami, 25 Feb. 1919 1 ♀ (ANSP); Matheson Hammock, 20 June 1964, 1 ♂; Gould's Canal, 3 July 1965, 1 ♂ (FSCA).

Other Records.—FLORIDA. Specimens identified for E. O. Wilson: MONROE Co., red mangrove islands nr. Calusa Keys, 28 Feb., 17 Apr., 30 Dec. 1967; 3 ♂, 2 ♀. Song records without specimens (REL): DADE Co., Gould's Canal, 3 July 1965, UFT 624-11; MONROE Co., Key Largo, 4 July 1965; COLLIER Co., Marco Island, 5 July 1965; MANATEE Co., Sunshine Skyway Bridge, 16 May 1965.

GEOGRAPHICAL DISTRIBUTION

Fig. 1 summarizes the distribution of *Cyrtoxipha* within the United States. All 4 species coexist in the coastal areas of southern Florida, but only *columbiana* is known north of Florida. The distribution of the 4 species outside the United States is not known, but it seems likely that at least 3 occur in Cuba and perhaps elsewhere in the West Indies.

The lack of records of *nola* from the Florida Keys is puzzling. The records for *confusa,* a species occupying the same kind of habitat as *nola,* show that intensity of collecting in the Florida Keys is not likely to be the entire explanation.

One *Cyrtoxipha* male in the ANSP collection is labeled Nogales, Ariz., Santa Cruz River Bottoms. Its stridulatory file is like *columbiana,* but its genitalia are unique. If correctly labeled it represents a 5th

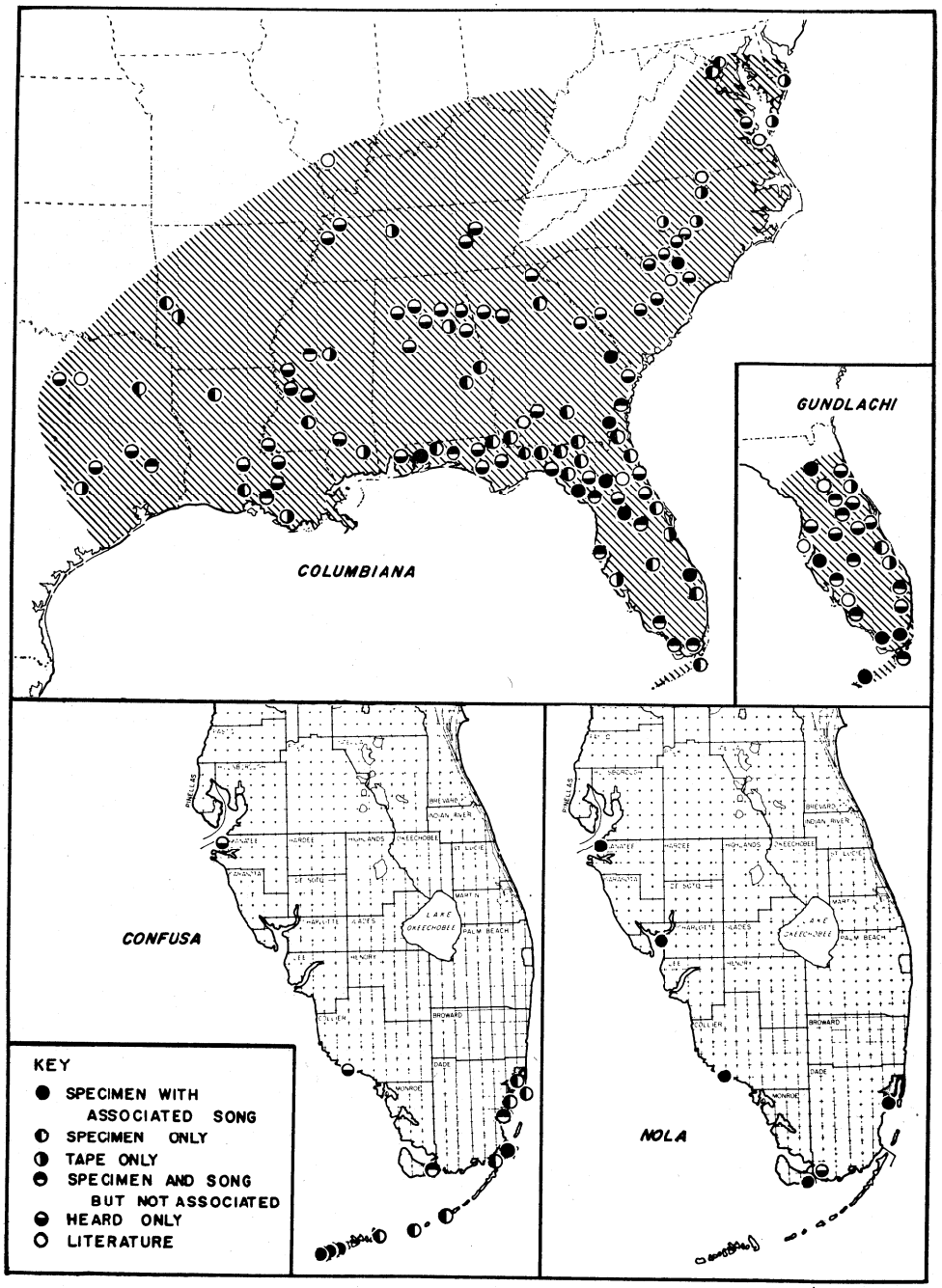

FIG. 1.—Distribution of *Cyrtoxipha* in the United States. Peripheral records are substantiated in the text. For *columbiana* and *gundlachi* the predicted distribution is shaded, and the points show county records except that the Upper and Lower Florida Keys are plotted independently of continental Monroe County, Fla. For *confusa* and *nola* all locality records are plotted except for records within a few miles of a plotted record.

U.S. species. I know of no other records of *Cyrtoxipha* from the Southwest.

Peripheral records of *columbiana* are Austin Co., Tex. (UFT 622-19); Tarrant Co., Tex. (TJW); Jackson Co., Ill. (Hebard 1934); Washington, D.C. (USNM); Worcester Co., Md. (UFT 622-29); Key Largo, Fla. (FSCA). Peripheral records of *gundlachi* are Gainesville, Fla. (UFT 621-13, 14, 16) and Key West, Fla. (ANSP).

HABITAT RELATIONSHIPS

C. columbiana and *gundlachi* occur on a large variety of broad-leaved trees and shrubs. *C. nola* and *confusa* occur only in the mangrove areas of south

Florida. Specific records for *nola* include black mangrove, *Avicennia nitida* Jacq.; white mangrove, *Laguncularia racemosa* (L.) Gaertn. f.; and buttonwood, *Conocarpus erectus* L. *C. confusa* was taken most frequently on red mangrove, *Rhizophora mangle* L., but also on black and white mangrove and buttonwood. *C. gundlachi* has been taken on all these plants, and *columbiana* has been taken on red mangrove. *C. gundlachi* has been found on the same tree with each of the other species. The other species have been found only with *gundlachi*. *C. nola* and *confusa* have been found together in the same mangrove area but not necessarily on the same plants (JDS tapes, 25 Dec. 1965, Flamingo). I have found only 1 population of *Cyrtoxipha* on herbaceous plants; 17 *gundlachi* were swept from Spanish needle, *Bidens bipinnata* L., in a vacant lot on Key Largo.

SEASONAL LIFE HISTORIES

The 2 species of *Cyrtoxipha* that are best known—*columbiana* and *gundlachi*—have contrasting seasonal life histories. *C. columbiana* is largely or entirely univoltine, with adults occurring for only a few months each year and with the egg being the only overwintering stage. At Raleigh, N. C., adults occur from mid-July to mid-October (Fulton 1951). At Gainesville, Fla., adults are heard from early June through October, and the greatest numbers occur from mid-June to mid-August. In some habitats there is apparently an increase in numbers in October, suggesting a partial 2nd generation. The seasonal life cycle of *columbiana* in south Florida is not known, but to date all records of adults fall between 18 June and 24 Aug.

On the other hand, adults of *gundlachi* occur throughout the year even in the northernmost portion of its range (Gainesville, Fla.) R. E. Love (personal communication) studied a population at Gainesville and discovered 2 yearly increases in the numbers of singing adults, one in March and the other in September. This bimodality probably reflects the maturation of 2 principal groups of juveniles, and it should result in 2 principal mating periods, one occurring before and the other after the principal mating period of *columbiana* (which inhabits the same trees as *gundlachi*). Whether some eggs and juveniles of *gundlachi* are present at all times of the year in Gainesville and whether seasonal peaks of adults occur in the southern parts of the range of *gundlachi* are questions that remain to be investigated.

The 2 remaining U.S. *Cyrtoxipha*—*nola* and *confusa*—are known from only a few field trips and miscellaneous collections by other investigators. From these data it is obvious that adults of both species are present at all seasons, but no conclusions can be reached as to whether eggs and juveniles occur at all seasons or whether the adults in a particular locality show seasonal peaks of abundance. Temporal variations in occurrence and abundance of adults have been pronounced from field trip to field trip to the same locality, but these variations could result from population fluctuations as well as seasonal changes in population structure. (The months that adults have *not* been taken are January, February, March, June, September, and October for *nola*, and September, October, and November for *confusa*.)

CALLING SONGS

The specific status of *columbiana*, which Blatchley (1920) considered a race of *gundlachi*, and the existence of *nola* and *confusa* were first made clear to me by their distinctive calling songs (Fig. 2–9). The songs of *gundlachi* and *columbiana* are tinkling chirps, while those of *nola* and *confusa* are trill-like.

The chirps of *gundlachi* and *columbiana* differ as to number of wing strokes and wing-stroke rate. The chirp of *columbiana* has twice as many wings strokes as that of *gundlachi* (4–6 vs. 2–3). However, in *columbiana* the wing-stroke rate is twice as fast as in *gundlachi* (Fig. 6), making the chirp *duration* in the 2 species similar. The chirp *rate* of the 2 species is also similar.

Neighboring males of *columbiana* characteristically synchronize their chirps, and males of *gundlachi* sometimes do so. Occasionally *columbiana* and *gundlachi* sing at the same time in the same trees. Since their chirp rates are similar, they may be able to maintain interspecific synchrony, a phenomenon not yet reported among singing insects.

The songs of *nola* and *confusa* are sequences of paired pulses (Fig. 4, 5), a characteristic shared with many *Cycloptilum* (Mogoplistinae) and 1 *Orocharis* (Eneopterinae, Walker 1969). *C. confusa* has a higher wing-stroke rate (within a pair) and a higher pair rate than *nola* (Fig. 7–9). The sequence of pairs in *confusa* is so rapid that the song sounds like a beady trill. In *nola*, on the other hand, the effect is more a melodious, prolonged tinkle. The duration of the sequences is generally longer in *confusa* than *nola* (2–6 sec vs. 0.5–1.0 sec at 25°C). The intervals separating consecutive sequences are about the same for the 2 species (0.3–1.0 sec at 25°C).

Above 26°C, the wing-stroke rate of *confusa* exceeds 100/sec, usually considered the upper limit for synchronous muscles in insects. Asynchronous muscle is not known among Orthoptera (Pringle 1965).

The frequency (kilocycles per second) of cricket songs is much more variable than the wing-stroke rate. Among U.S. *Cyrtoxipha* at a given temperature, the frequencies are broadly overlapping, although *confusa* is usually higher and *gundlachi* is often lower than any individual of the other species. In each of the 4 species, the frequency of the song increases approximately linearly with wing-stroke rate (and temperature) (Fig. 10).

MORPHOLOGY

The 4 U.S. *Cyrtoxipha* are not easily distinguished morphologically. However, the males can be identified by characters of the genitalia and stridulatory vein, and the females can sometimes be identified by a dimension of the ovipositor. The lateral processes of the phallus (Fig. 11–14) are sometimes visible in preserved specimens without special preparation.

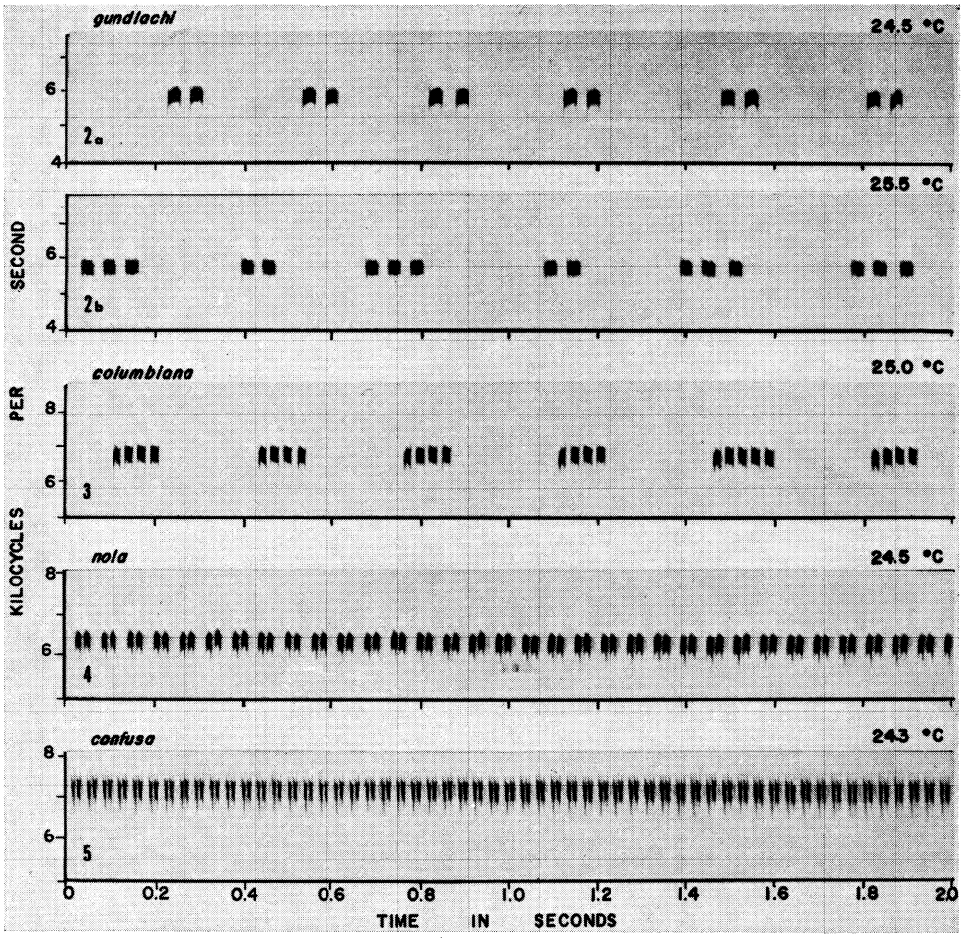

FIG. 2–5.—Audiospectrograms of calling songs of U.S. *Cyrtoxipha*. 2a, Martin Co., Fla. UFT 621–9; 2b, Stock Island, Fla. UFT 621–11; 3, Lake Co., Fla. UFT 622–9–a; 4, 5, holotypes, UFT 623–3–a, and 624–5–a, respectively.

However, in most instances the phallus has to be teased out with a hooked needle or by gentle pressure on the subgenital plate. Dried specimens must be relaxed. The phalli of *Cyrtoxipha* show greater asymmetry than those of any other U.S. crickets. The asymmetry is not characteristic of the subfamily, for U.S. species of *Anaxipha,* an apparently closely related genus of trigonidiine crickets, have symmetrical phalli (Fulton 1956).

Males of all 4 species of *Cyrtoxipha* can be identified by the number of teeth in the stridulatory file (Table 1). The teeth can be counted by removing the wing, mounting it upside down in alcohol on a microscope slide, and examining it at 400×. The wing can then be dried and glued to a card point on the same pin as the rest of the specimen.

The length of the file is of limited value in identification (Table 1). Indeed this character is better for separating Alachua County *gundlachi* from Dade-Monroe County *gundlachi* than for separating some of the species. The variation in the file length and in teeth per millimeter in *gundlachi* is correlated with no measured variation in song.

C. columbiana also shows geographic variation in characters of the stridulatory file (Table 1). Specimens from south Florida (Collier, Monroe, and Dade Counties) have more teeth and more teeth per millimeter than do those from central Florida (Palm Beach, Martin, and Highlands Counties) and farther north. Again the variation in the file is correlated with no detected variation in song.

The length of the stridulatory vein, as measured from above without removing the wing, will identify *confusa* and *nola* but will not separate *gundlachi* from *columbiana.* The measurement is made in a straight line along the stridulatory vein from the inside of the vein intersected on the left to the inside of the vein intersected on the right. For 8 *confusa* males the range (in millimeters) was 0.75–0.83; for 11 *nola,* 0.85–0.98; for 38 *gundlachi,* 1.00–1.25; and for 7 columbiana, 1.08–1.21.

The only character useful in identifying females is the length of the ovipositor blade, measured in a straight line from the posterior of the dorsum of the basal piece to the apex (see Fig. 17, Fulton 1956). For 20 ♀ of *columbiana* the range (in millimeters) was 2.32–2.95; for 14 *gundlachi,* 1.40–1.58; and for 9 *confusa,* 1.83–2.00. The only female believed to be *nola*

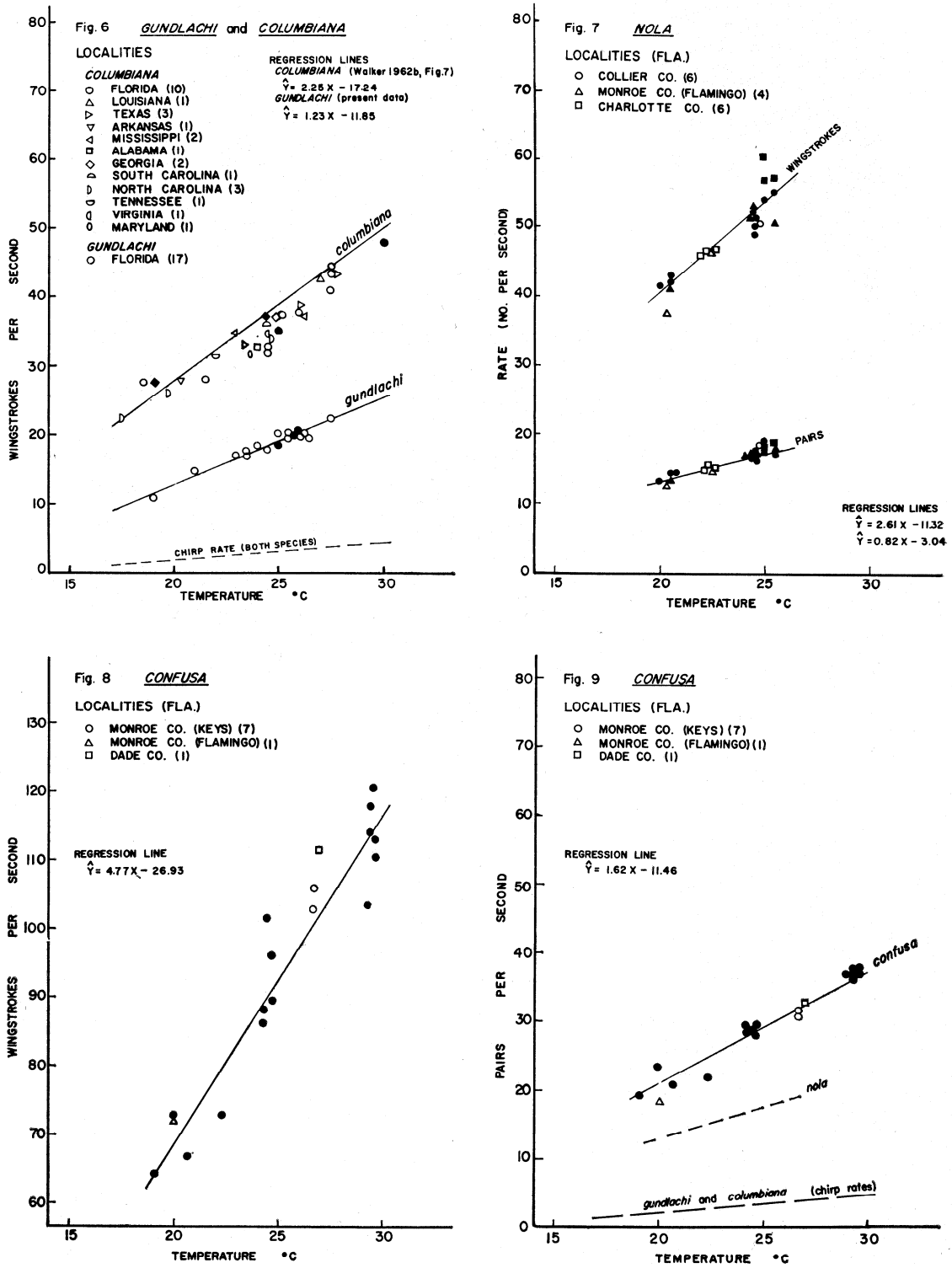

FIG. 6–9.—Effect of temperature on calling songs of U.S. *Cyrtoxipha*. Solid symbols indicate laboratory recordings of caged individuals; open symbols indicate field recordings. The number in parentheses after each locality is the number of taped individuals from that locality.

Table 1.—Characteristics of the stridulatory file of the U.S. species of *Cyrtoxipha*.

Species	Localities	n	No. teeth Mean±SD	No. teeth Range	Length (mm) Mean±SD	Length (mm) Range	Teeth/mm Mean±SD	Teeth/mm Range
gundlachi	Fla.	10	192± 3	186–193	1.34±0.08	1.23–1.50	143± 8	131–155
	Alachua Co., Fla.	(4)	192± 4	186–193	1.44± .04	1.42–1.50	134± 3	131–138
	S Fla. (2 counties)	(6)	191± 3	186–193	1.28± .02	1.23–1.30	150± 4	143–155
columbiana	Fla., Ga., and S. C.	17	150±11	135–169	1.29± .08	1.17–1.44	117±14	100–143
	Ga., S. C.; N Fla. (3 counties)	(9)	143± 5	135–152	1.32± .07	1.18–1.44	108± 4	100–114
	Cen. Fla. (3 counties)	(4)	149± 4	144–154	1.34± .03	1.30–1.38	112± 2	109–113
	S Fla. (3 counties)	(4)	169	168–169	1.19± .01	1.17–1.20	142± 1	141–143
nola	Fla. (4 counties)	7	120± 4	113–126	1.04± .03	0.98–1.06	115± 3	110–119
confusa	Fla. (2 counties)	6	88± 2	85–90	0.85± .02	0.82–0.88	104± 4	98–110

was collected near a male and has an ovipositor blade of 1.42 mm. *C. gundlachi* was singing in the same habitat.

Key to *Cytoxipha* of the United States

The 4 *Cyrtoxipha* species are the only small (body less than 9 mm) green crickets in the United States.

1. Sex male 2
1′. Sex female 5
2(1). Stridulatory vein from above less than 1.00 mm long (measured along a straight line *between* the 2 longitudinal veins it intersects); calling song a trill or a tinkle (Fig. 4, 5); habitat always mangrove 3
2′. Stridulatory vein from above more than 1.00 mm long; calling song a 2–7 pulse chirp (Fig. 2, 3); habitat mangrove or other 4
3(2). Stridulatory vein from above less than 0.84 mm long; right lateral phallic process acuminate (Fig. 14); less than 95 teeth in stridulatory file; song a trill (Fig. 5) ..... ***confusa***
3′. Stridulatory vein from above more than 0.84 mm long; right lateral phallic process not acuminate (Fig. 13); more than 105 teeth in stridulatory file; song a tinkle (Fig. 4) ..... ***nola***
4(2′). Left lateral phallic process obtuse (Fig. 11); more than 180 teeth in stridulatory file; 2–3 pulses per chirp (Fig. 2) ..... ***gundlachi***
4′. Left lateral phallic process acuminate (Fig. 12); less than 175 teeth in stridulatory file; 4–7 pulses per chirp (Fig. 3) ..... ***columbiana***
5(1′). Ovipositor blade more than 2.3 mm long; (measured on a straight line from posterior of dorsal base to tip; see Fig. 17, Fulton 1956) ***columbiana***
5′. Ovipositor blade less than 2.3 mm long 6
6(5′). Ovipositor blade more than 1.8 mm long ... ***confusa***
6′. Ovipositor blade less than 1.6 mm long ..... ***nola*** (probably) and ***gundlachi***

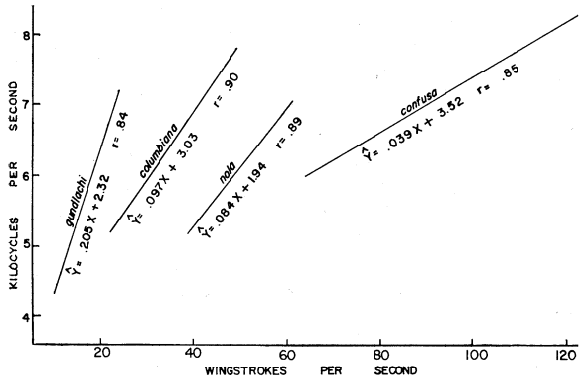

FIG. 10.—Calculated linear correlation between wingstroke rate and frequency in calling songs of U.S. *Cyrtoxipha*. The data were taken from the same tapes as used for Fig. 6–9.

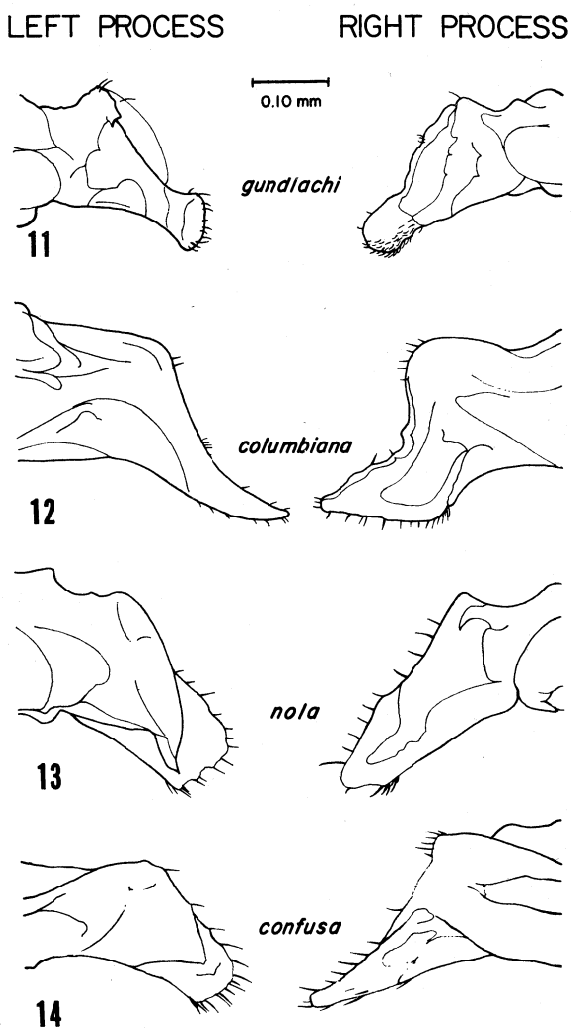

FIG. 11–14.—Lateral views of the left and right lateral processes of the phallus of U.S. *Cyrtoxipha*. Scale for all drawings above Fig. 11. 11, 12, Taped specimens (UFT 621–8, Dade Co., Fla.; UFT 622–4, Gainesville, Fla.); 13, 14, holotypes. (Drawings by R. E. Love.)

PHYLOGENY AND ZOOGEOGRAPHY

The 4 species of U.S. *Cyrtoxipha* are closely related and have no near relatives among other U.S. crickets. Song, genitalia, and other characters set *Cyrtoxipha* apart from the superficially similar crickets of the genus *Anaxipha*. Outside the United States, *Cyrtoxipha* species are too poorly known to suggest relationships with U.S. species or to even justify conjectures about Caribbean distribution of the U.S. species.

The U.S. species differ in so few of the characters studied that I see no basis for considering any two of the four most closely related.

The probable evolutionary relationship of the song rhythms of *confusa* and *columbiana* is clarified by the intermediate rhythms of *nola* and *gundlachi* (Fig. 2–5). An evolutionary sequence of Fig. 3, 2b, 2a, 4, 5 involves no incredible change at any step, but I see little basis for considering the ancestral condition in *Cyrtoxipha* to be at one end or the other or in the middle of the proposed sequence. However, if one assumes that *Anaxipha*—with its symmetrical genitalia and more usual cricket color—is more representative of primitive trigonidiines than is *Cyrtoxipha*, then the *columbiana*-type song (Fig. 3) is more likely primitive, because only that and simpler rhythms are known for *Anaxipha*.

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