

# SONGS AND SYSTEMATICS OF CARIBBEAN NEOCONOCEPHALUS (ORTHOPTERA: TETTIGONIIDAE)

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## ABSTRACT

At least 13 species of *Neoconocephalus* occur in the Greater and Lesser Antilles, Trinidad, Panama, and the Florida Keys. Three occur throughout the area: *triops* (L.), *affinis* (Beauvois), and *maxillosus* (Fabricius). The remainder are more restricted: *aduncus* (Scudder), Cuba; *carbonarius* (Redtenbacher), Cuba and Grand Cayman; *pipulus* n. sp., Jamaica; *pinicola* n. sp., Hispaniola; *punctipes* (Redtenbacher), St. Vincent, Trinidad, Panama, Jamaica; *occidentalis* (Saussure), Hispaniola; *retusifformis* n. sp., Puerto Rico and Mona; *susurratus* n. sp., Trinidad; *saturatus* (Griffini), St. Vincent, Grenada, Trinidad; and *spiza* n. sp., Panama. Sympatric species were initially distinguished by the characteristic calling songs of the males. Wing-stroke rates at 25 C ranged from 8 to 260 per second; calls of some species were regularly interrupted at intervals of 0.2-2 sec. Museum specimens can be identified by gross morphology and by details of the fastigium and stridulatory file.

Of the 36 names available for Caribbean *Neoconocephalus* (all proposed prior to 1900), only 8 are here considered valid. Newly classed as nomina dubia are *Conocephalus niети* Saussure, *C. prasinus* Redtenbacher, *C. simulator* Walker, and *C. tristani* Saussure and Pictet. The following new synonymy is proposed: *Conocephalus aztecus* Saussure and Pictet = *N. affinis*; *C. bilineatus* Thunberg = *N. triops*; *C. surinamensis* Redtenbacher = *N. punctipes*; *C. adustus* Redtenbacher = *C. carbonarius*.

## INTRODUCTION

Coneheaded katydids of the genus *Neoconocephalus* have a combination of features that makes them attractive subjects for collectors and for field studies of reproductive behavior. Adults are

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large, typically occur near the ground, and many species have high population densities. Males make loud penetrating calls that reveal their species identity and location. Once located, males can be captured, marked, and released; subsequently they can be repeatedly found and individually identified without recapture. Recent field studies of *Neoconocephalus* spp. include those of Whitesell (1974), Meixner and Shaw (1979), Shaw *et al.* (1982), and Greenfield (1983).

The Caribbean area is rich in *Neoconocephalus*, with as many as six species occurring in one locality (e.g. Arima, Trinidad) and four or five species occurring on each of the Greater Antilles. In trying to report the results of field studies of *Neoconocephalus* in the West Indies and Panama, we discovered that few of the species we had recognized could be named with certainty. Therefore, we undertook this taxonomic revision.

The last revision of *Neoconocephalus* that attempted to include all Caribbean species was 1891, when Josef Redtenbacher published his "Monographie der Concocephaliden." A few years later (1898) Saussure and Pictet treated the mainland species in the first Orthoptera volume of *Biologia Centrali-Americana*. Unfortunately, these two works added to, rather than resolved, the nomenclatural confusion that earlier, piecemeal descriptions of species had created. For example, Redtenbacher listed 20 species, including 12 previously undescribed, as occurring in the West Indies. Yet we conclude he had before him no more than 11 West Indian species and probably only 7! Saussure and Pictet (1898) took most of their treatment of *Neoconocephalus* spp. straight from Redtenbacher (1891) and described two additional species. The net effect of 19th century taxonomic studies of Caribbean *Neoconocephalus* was 36 specific names of uncertain application.

Taxonomists in the 20th century at first repeated the plethora of names for Caribbean *Neoconocephalus* (e.g. Rehn 1909, Karny 1912) and then picked among them with little or no explanation (e.g. Wolcott 1950, Zayas 1974). Only J.A.G. Rehn and Morgan Hebard directly addressed the nomenclatural problems in *Neoconocephalus*. In a joint paper (Rehn and Hebard 1915), they applied the specific name *triops* Linnaeus to the species now known by that name and made synonyms of other names widely used for it

(e.g. *mexicanus* Saussure and *fuscostriatus* Redtenbacher). Hebard (1927a,b) established the name *affinis* Beauvois for the species that had previously been called *guttatus* Serville and applied the name *maxillosus* Fabricius to specimens of what are here termed *maxillosus*, *spiza*, and *saturatus*. Walker and Whitesell (1978) restricted *maxillosus* to its present usage by assigning the name to tape-recorded specimens from the West Indies and southern Florida. None of these studies set names for nine of the *Neoconocephalus* species we recognize. Furthermore, many of the specific names applied to Caribbean *Neoconocephalus* in the 19th century have been neither synonymized nor assigned to recognizable species. Nomenclature at the species level is in disarray.

Nomenclature at the genus level has been slightly more orderly. All species here discussed were assigned to *Conocephalus* from 1831 to 1899, to *Conocephaloides* for approximately the next decade, and mostly to *Neoconocephalus* thereafter (Serville 1831, Perkins 1899, Kirby 1906, Karny 1907, 1912). Karny (1912) divided the species between two genera, *Neoconocephalus* and *Homocoryphus*, and distinguished the two by the presence or absence of a distinct gap between fastigium and frons. We do not recognize Karny's distinction because we found, as did Bailey (1975) for African species of *Ruspolia*, that the gap varies greatly even within demes and does not correlate with other distinguishing features. Only geography presently distinguishes *Ruspolia* (Old World) and *Neoconocephalus* (New World) (Karny 1912; Bailey 1975, 1979). If the two genera are eventually combined, the species here treated will take the older generic name, *Ruspolia*.

The New world genera most closely related to *Neoconocephalus* are *Caulopsis*, *Bucrates*, and *Pyrgocorypha*. We had no trouble separating species of these genera from species of *Neoconocephalus* using the features listed by Karny (1912): *Caulopsis*—metasternum compressed, its lobes rudimentary; very slender. *Bucrates*—hind tibiae with widened edges above; robust. *Pyrgocorypha*—fastigium triangular, flat above.

Our objective in this revision is to enable others to distinguish the species of *Neoconocephalus* we have recognized through field studies in the Florida Keys, Jamaica, Grand Cayman, Hispaniola, Puerto Rico, St. Croix, Trinidad, and Panama, and to assign them

specific names that will remain acceptable. By examining museum specimens, we broadened the geographic scope of our study to include all tropical land areas in or adjacent to the Caribbean and Gulf of Mexico (Greater and Lesser Antilles, Central America, eastern Mexico).

## METHODS

### *Field Work*

We undertook intensive field studies of Caribbean acoustical Orthoptera as follows: Florida Keys (more than 20 trips, 1958-1978, TJW, aided by J.J. Whitesell, 1970-1972, for 15 consecutive monthly trips; 24-25 Aug. 1981, MDG); Jamaica (11-12 July 1966 and 16-29 Nov. 1968; TJW; 12-25 June 1970, TJW aided by JJW and P.C. Drummond); Grand Cayman (26-28 June 1970, TJW aided by JJW, PCD); Hispaniola (4-21 Sep. 1973, TJW aided by J.C. Schuster); Puerto Rico (26-27 June 1966, TJW; 8-23 Jan. 1969, TJW aided by PCD); St. Croix (24-25 Jan. 1969, TJW aided by PCD); Trinidad (28 June-10 July 1966; TJW aided by J.B. Walker); Panama (28 Aug. 1978-11 Oct. 1979, Balboa, MDG; 8-18 Dec. 1980, Ft. Sherman, TJW aided by JJW).

Field work was mostly at night and included trips to geographical and ecological extremes of the areas studied. Males of *Neoconocephalus* were mostly collected by their songs; females were found in association with males or by searching vegetation with head lamps. A few specimens were collected at lights at night or were flushed during the day.

### *Acoustics*

Initial identification of species in the field was by the songs of males. Songs were tape recorded, usually with a Nagra III or IV tape recorder at 15 ips. To improve signal-noise ratio of field recordings, the microphone was fixed at the focal point of a 60 cm diam aluminum parabola, which was in turn aimed at the calling katydid. Captured males were sometimes held in small screen cages to get recordings of better quality and at more accurately known temperatures. All tapes were analyzed for wingstroke rate with a Kay audiospectrograph. One or more tapes of each species were further analyzed using a light-beam oscillograph (Honeywell Visicorder) and a Fourier frequency analyzer (Nicolet 660A, Fast Fourier Transform Computing Spectrum Analyzer). (Principal frequencies for all species fell between 10 and 16 kHz.)

### *Morphology*

The following measurements were made (in mm) of representative specimens of each species: total length (measured from the tip of the fastigium to the tip of the forewings), pronotal length (along the mid-line), hind femur (extreme length as viewed laterally), ovipositor (ibid), fastigial length (measured frontally, with plane of frons perpendicular to line of sight, anterior tip of fastigium to frontal tip), and

fastigial projection (the part of fastigial length distal to the point where the fastigium is widest viewed frontally as in Fig. 24a-36a). The first four measurements were made with dial calipers ( $\pm .05$  mm). The last two were made with an ocular micrometer and were used to calculate a *fastigial index* (fastigial projection as a proportion of fastigial length — i.e. projection/length). The specimens selected for measurement were the five first-collected males and five first-collected females from each major study area. (If five or fewer of a sex from an area were available, all were measured).

The left stridulatory files of sample males of each species were prepared for study by dissecting the files from the wings or by making casts of them (Bailey 1979). The number of teeth in each file (or cast) were counted with the aid of a microscope, and file length was measured in a straight line between first and last tooth.

#### *Distribution*

Because previous workers sometimes failed to distinguish similar species and were not consistent in their use of specific names, we ignored or discounted previously published records (other than type localities) in tabulating distributions. Knowing that male calling songs have often proved critical in recognizing sibling species of *Neoconocephalus* (e.g. Thomas 1933, Walker *et al.* 1973; but see Whitesell and Walker 1978), we made no attempt to be comprehensive in our examination of museum specimens of Caribbean *Neoconocephalus*. However, we did borrow pertinent specimens from University of Michigan Museum of Zoology (UMMZ), Academy of Natural Sciences of Philadelphia (ANSP), and United States National Museum (USNM) in an attempt to document the full West Indian distribution of the species we had recognized. Further field work is needed to resolve unexpected gaps in distributions and to determine whether populations that occur between *saturatus* (Lesser Antilles and Trinidad) and *spiza* (Panama) confirm or refute our conclusion that the two are species rather than extremes of a cline.

#### *Nomenclature*

Determining what names should be assigned to particular species of Caribbean *Neoconocephalus* was a major obstacle. Thirty-six specific names, all proposed prior to 1900, had been used for Caribbean *Neoconocephalus*, but only 4 of the 13 species we recognized were easily named by referring to 20th century taxonomic studies. Because the 36 original descriptions are generally inadequate for species identification, we could not determine how most specific names proposed for Caribbean *Neoconocephalus* should be used except by examining the specimen or specimens that formed the basis for the original description — i.e. the types. Unfortunately many type specimens have been lost or destroyed, and the remainder are scattered among at least six European museums. Furthermore, specimens purported to be types are not necessarily always authentic — for example, specimens that were subsequently identified as a particular species may be confused with valid types. In cases where there is a type series rather than a single type, more than one species of *Neoconocephalus* may be represented. This morass of problems may explain why recent orthopterists have made no attempt to resolve many of the available specific names.

In determining what names should be applied to particular species of Caribbean *Neoconocephalus*, we used these two principles: (1) Accept Rehn and Hebard's opinions for the specific names that they dealt with (e.g. Rehn and Hebard 1915; Hebard 1927a,b). (2) Resolve the usage of other names by examining their types. Accepting Rehn and Hebard's opinions let us avoid the troubles that others have had when they examined 18th or 19th century types and discovered them to conflict with 20th century usage. For example, Kevan (1962, 1963) reported that the Linnaean type specimens of *Gryllus campestris* were not the taxonomic species invariably known by that name but were instead the taxonomic species invariably known as *G. bimaculatus* DeGeer. Kevan proposed that for the purpose of nomenclature, the type material be considered as "lost" and designated a neotype. He applied to the International Commission of Zoological Nomenclature to sanction his actions. The net effect of his activity was that the usage of *campestris* did not change. Our fears of problems of this nature were increased by viewing colored slides taken by T.H. Hubbell of specimens in the Linnaean Collection at Uppsala, Sweden. Images of a female *Neoconocephalus*, labeled as the holotype of *triops* (described by Linnaeus as *Gryllus Tettigonia triops*) were not of the species that has been consistently called *triops* since 1915 and which is the most widely distributed and best known *Neoconocephalus*. If we had verified that the photographed female is at Uppsala and is labeled as the type of *triops*, we would have felt compelled to preserve current usage — by actions similar to those of Kevan for *Gryllus campestris* or by proposing that the specimen is not the authentic type but either a subsequently substituted specimen or an instance of subsequent mislabelling of Linnaeus's original material. Under no circumstances would we have thought it ethical to change the name of the species long known as *triops* and applied the name *triops* to another well known species of *Neoconocephalus* (the course of action the photographs seemed to call for). Because we have not seen the photographed specimen or confirmed its presumptive status, we need take no action. We see nothing to be gained by pursuing the existence, nonexistence, or likelihood of authenticity of specimens reputed to be Linnaeus's type of *triops*. The same can be said for the types of 15 other names that have had their usage stabilized by published actions of our predecessors. Our course of inaction permits nomenclatural stability and frees time for other, more productive, studies (both for us and for the curators who would otherwise have to deal with our requests for information and for loan of types).

In dealing with the remaining (i.e. not previously stabilized) names used for Caribbean *Neoconocephalus*, we queried seven museums and borrowed and examined 29 specimens of 11 nominal species. We concluded that four specific names not previously treated as synonyms should be so treated (see species accounts). Eleven names of importance to this study were not assignable to any Caribbean species and are treated in a separate section below.

#### Abbreviations

In the lists of principal specimens, collectors already identified in the description of field studies are denoted by their initials (e.g. TJW, MDG). Florida State Collection of Arthropods (curated by Division of Plant Industry, Florida Department of

Agriculture, Gainesville) is abbreviated FSCA. Other collections are abbreviated as indicated above in the section on Distribution. Specimens whose songs were tape recorded are identified by the numbers assigned their tapes in the University of Florida Tape Library — i.e. by their UFT numbers. Color morphs are designated B (brown) and G (green).

#### *Type Material*

All type specimens are in FSCA except for single male paratypes of *retusiformis* and *spiza* donated to ANSP, UMMZ, and USNM. Tape recordings are in University of Florida Tape Library, Department of Entomology and Nematology.

## RESULTS

#### *Nomenclature*

Table 1 summarizes our treatment of specific names used for Caribbean *Neoconocephalus*. Details are given in the Species Accounts except for the following 11 names that we could not assign to any of the 13 Caribbean species we recognize.

*Conocephalus nieti* Saussure 1859:208. Type locality: Mexico. Saussure's type is apparently lost. A male and female from Cuba (Museum d'Histoire Naturelle, Geneva), labeled "Conocephalus Nietoi Sauss." are *triops*. Rehn and Hebard (1915:406) noted that *nieti* had been applied to specimens of *triops* but did not synonymize the two because Saussure (1859:208) had described the incision between fastigium and frons in *nieti* as scarcely open. The incision in *triops* is always conspicuous. In the absence of type material, *nieti* becomes a nomen dubium. [*Conocephalus nietoi* Bolivar (1884:92) is an unjustified emendation of *nieti* Saussure that was adopted by Redtenbacher (1891:405) and Saussure and Pictet (1898:393).]

*Conocephalus simulator* Walker 1869:310. Type locality: Brazil? This name must be dealt with here because Kirby (1906) listed *C. adustus* Redtenbacher (1891:400; type locality, Cuba) as a junior synonym of it. Since the type locality of *simulator* is uncertain, we consider it a nomen dubium that should be ignored in naming species of *Neoconocephalus*.

*Conocephalus infuscatus* Scudder 1875:265. Type locality: eastern slope of Peruvian Andes. This name must be considered here because it was applied by Redtenbacher (1891:398) and Brunner (1893:608) to *Neoconocephalus* from Cuba, St. Vincent, Grenada, and Panama. Scudder's description is imprecise, and Griffini (1899:6) concluded that the lesser antillean specimens (at least) were distinct from *infuscatus* and proposed the name *saturatus* (see species accounts) for "C. *infuscatus* Redt. nec Scudder."

*Conocephalus pichincae* Bolivar 1881:498. Type locality: Pichincha, Ecuador. Bruner (1906) and Rehn (1909) identified specimens of *Neoconocephalus* from Cuba and Trinidad as *pichincae*. We doubt that the Ecuadorian species *pichincae* occurs in the Caribbean, but if it does, it probably is a junior synonym of *N. affinis* (Beauvois 1805). Our surmise is based on Redtenbacher's (1891) conclusion that *pichincae* and *C. guttatus* Serville (1839) differed chiefly in size. (*C. guttatus* is a junior synonym of *N. affinis*.)

*Conocephalus fuscineris* Redtenbacher 1891:427. Type locality: Cuba. Since Redtenbacher gave single measurements (rather than ranges) for this species, we expected there to be a single (female) type. Four specimens identically labeled "Conocephalus fuscineris Redtb" are in the collection of Museum d'Histoire Naturelle, Geneve: 3 very similar females bearing no locality labels and a male from Espirito Santo, Brazil. The females could be syntypes, but without locality labels or other evidence that the species they represent occurs in Cuba we leave the matter open. The presumptive syntypes resemble *N. carbonarius* (see species accounts) but are slenderer and bear a fine black line that crosses the pronotal disk ca. one-fourth back from the front margin.

*Conocephalus necessarius* Redtenbacher 1891:402. Type locality: Mexico. Female type from Naturhistorisches Museum Wien, Vienna, examined and identified as a *Neoconocephalus* sp. not familiar to us.

*Conocephalus gladiator* Redtenbacher 1891:406. Type locality: Mexico. Female type from Muséum d'Histoire Naturelle, Geneve, examined and identified as a *Neoconocephalus* sp. not familiar to us.

*Conocephalus frater* Redtenbacher 1891:399. Type localities: Cuba, St. Vincent, Trinidad, Brazil, Alto-Amazonas. This is a junior homonym of *Conocephalus vernalis* var. *frater* Kirby 1890:534. See *Conocephalus fratellus* Griffini.

*Conocephalus prasinus* Redtenbacher 1891:423. Type locality: Mexico. Types were in collections of Zoologische Institute and Museum, Universität Hamburg, and were destroyed in WWII. In the absence of type material, *prasinus* should be considered a nomen dubium.

*Conocephalus tristani* Saussure and Pictet 1898:391; Fig. 22, Plate 19. Type locality: Tucurrique, Costa Rica. Figure and description not adequate to place the name. Type not at Museum d'Histoire Naturelle. In the absence of type material, *tristani* should be considered a nomen dubium.

*Conocephalus fratellus* Griffini 1899:5. This name was proposed as a nomen novum for *C. frater* Redtenbacher (q.v.). Redtenbacher described *frater* as having a short fastigium that was distinctly conical when viewed from above. None of the species treated here fulfill that description. The species that comes closest, *saturatus*, has a name exactly as old as *fratellus*. If *saturatus* and *fratellus* prove to be synonyms, *saturatus* can remain the valid name.

#### *Species accounts.*

We recognize 13 species, 5 of which are new. The sequence of the species accounts juxtaposes similar species and matches the sequence of fastigial drawings (Fig. 24-36).

### ***Neoconocephalus affinis* (Beauvois)**

Fig. 6, 12, 18, 22, 24

*Locusta affinis* Beauvois 1805:219, pl. 7, fig. 5. Type locality: San Domingo.

*Conocephalus guttatus* Serville 1839:518. Type locality: Cuba. Hebard (1927a:337) treated *guttatus* as a junior synonym of *affinis*.

*Conocephalus crassus* Bolivar 1881:499. Type locality: Baeza, Ecuador. Hebard (1927a:338) synonymized *crassus* with *affinis* by treating the former as a subspecies of the latter.

*Conocephalus nigropunctatus* Redtenbacher 1891:391, fig. 32. Type localities: Alto-Amazonas, Brazil, Surinam, Cayenne, Cuba. Hebard (1924:223) treated *nigropunctatus* as a junior synonym of *crassus*, which he subsequently (1927a:338) synonymized with *affinis*.

*Conocephalus aztecus* Saussure and Pictet 1898:391. Type localities: Teapa in Tabasco, Mexico; Rio General, Pacific coast, Costa Rica. We examined 1 male and 1 female type from Teapa (Museum d'Histoire Naturelle, Geneve) and determined that they were *affinis*. (*New synonymy*)

This species occurs throughout the Caribbean and can be distinguished from all other species by its having 3 or 4 spines on the anterior ventral carina of the middle femur. Males are further distinguished by the stridulatory vein, viewed from above, exceeding 3 mm and being of near-uniform width. The fastigium is elongate, often with a prominent ventral tooth (Fig. 24). The mandibles and lower labrum are bright orange.

*N. affinis* is one of four species having stridulatory files with teeth spaced approximately the same throughout (Fig. 18, 19 vs. 20, 21). The other three (*occidentalis*, *retusifformis*, and *susurrator*) do not resemble *affinis* in other ways — they are smaller and have blunter fastigia and fewer file teeth.

MEASUREMENTS. — N=26 males, 19 females (Trinidad, 9; Panama, 10; Jamaica, 11; Grand Cayman, 2; Hispaniola, 6; Puerto Rico, 7). Total length  $\bar{x} \pm SD$ , range): 51  $\pm$  2, 47-59 (males); 63  $\pm$  4, 53-70 (females). Pronotal length: 7.8  $\pm$  0.6, 6.1-8.7; 8.5  $\pm$  0.7, 7.8-9.9. Hind femur: 24  $\pm$  2, 22-30; 29  $\pm$  3, 25-39. Ovipositor: 31  $\pm$  3, 26-34. Fastigial length: 1.5  $\pm$  0.1, 1.3-1.7, 1.8  $\pm$  0.2, 1.3-2.2. Fastigial index: 0.45  $\pm$  0.05, 0.36-0.54; 0.48  $\pm$  0.07, 0.39-0.63.

FILE. — Teeth evenly spaced (Fig. 18); 2.8-3.5 mm long; 129-151 teeth (Fig. 22).

SONG. — Bouts of rattling, mostly occurring between 1 to 4 h after sunset, with component sequences lasting 1 s to 5 min. or longer. Adjoining males loosely synchronize their bouts. Some males sing during daylight but only produce short sequences (lasting less than 2 s) at sporadic intervals (Greenfield 1983). The wingstroke rate is slower than for any other Caribbean *Neoconocephalus* (Table 2; Fig. 6, 12).

COLOR. — Of the 128 principal specimens, 72% are green (G) and 28% are brown (B) (94 males are 68 G, 26 B; and 27 females are 19 G, 8 B). *N. affinis* lacks conspicuous markings (except for one brown female from Jamaica that has dark lateral stripes). Small black dots occur on the tegmina and usually at the bases of the femoral spines. The fastigium has a cream-colored, transverse, dorso-frontal stripe. Beneath this pale stripe is a line of dark pigment, often broken medially, that may suffuse downward to darken a little or much of the frontal surface of the fastigium.

PRINCIPAL SPECIMENS (FSCA). — TRINIDAD: 3G  $\sigma$ , 1B  $\sigma$ , 4G  $\rho$ , 1B  $\rho$ , nr. Arima, 28 June-6 July 1966, TJW. PANAMA: 15G  $\sigma$ , 4B  $\sigma$ , 3G  $\rho$ , 2B  $\rho$ , Gamboa, 14 Oct. 1978 - 25 Apr. 1979, MDG; 2G  $\sigma$ , 2B  $\sigma$ , C. Campana, 18 Jan., 1 Mar. 1979, MDG; 1G  $\sigma$ , 3B  $\sigma$ , Summit, 8, 14 Feb. 1979, MDG; 3G  $\sigma$ , 3G  $\rho$ , Fort Sherman, 13 Dec. 1980, TJW, JJW. JAMAICA: 2G  $\sigma$ , Stoney Hill, 26 Oct.



1965, Duval Jones (UFT 185-4, 6); 10 G ♂, 3 B ♂, 11 mi n. of Kingston, 12 July 1966, TJW; 6 G ♂, 5 B ♂, 2 G ♀, 2 B ♀, St. Catherine Par., Worthy Park, 16-18 Nov. 1968, TJW; 2 G ♂, 1 B ♂, 1 G ♀, n. of Negril, 20 Nov. 1968, TJW; 1 G ♂, n. of Ecclesdown, 24 Nov. 1968, TJW; 1 G ♂, 1 B ♂, 3 G ♀, n. of Morant Bay, 25 Nov. 1968, TJW; 1 B ♀, St. Catherine Par., 2 May 1969, R.E. Woodruff; 1 G ♂, 1 B ♂, nr. Kingston, 8 May 1969, REW, PCD; 2 B ♂, Runaway Bay, 28 Dec. 1969, JJW; 1 G ♀, 1 B ♀, nr. Bath, 14 June 1970, TJW, JJW, PCD. GRAND CAYMAN: 2 B ♂, Georgetown, 26 June 1970, TJW, JJW, PCD. HISPANIOLA: 7 G ♂, 2 B ♂, 1 G ♀, Dom. Rep., nr. Miches, 14-16 Sep. 1973, TJW, JCS; 2 G ♂, Dom. Rep., nr. Bonao, 17 Sep. 1973, TJW, JCS; 1 G ♂, Dom. Rep., nr. Jarabocoa, 1100 m, 18 Sep. 1973, TJW, JCS. PUERTO RICO: 1 B ♀, Rio Piedras, 3 Oct. 1959, A. Boike; 5 G ♂, nr. Arecibo, 9 Jan. 1969, TJW, PCD (incl. UFT 69-70, 77); 3 G ♂, 1 G ♀, nr. Mayaguez, 10 Jan. 1969, TJW, PCD; 1 G ♂, nr. Aguada, 11 Jan. 1969, TJW, PCD; 1 G ♂, nr. Maricao, 13 Jan. 1969, TJW, PCD; 1 G ♂, nr. Orocovis, 15 Jan. 1969, TJW, PCD. FLORIDA KEYS: 3 G ♂, 24 Aug. 1981, Key Largo, MDG.

OTHER RECORDS. — JAMAICA: (UMMZ) 6 B ♂, 9 G ♂, 1 G ♀, Bath, 29 Mar.-15 Apr. 1937, C. Roys; 1 B ♂, 1 G ♂, Bog Walk, 9 Apr. 1937, C. Roys; 1 G ♂, Buff Bay, 19 Mar. 1937, C. Roys; 2 G ♂, Mandeville, 11 Apr. 1937, C. Roys; 1 G ♂, Mandeville, 14 Apr. 1959, Sanderson et al. (USNM) 1 B ♂, E. Buff Bay, 13 Nov. 1966, A.B. Gurney. CUBA: (ANSP) 1 G ♂, Cotorro, Havana Prov., 25 July 1920, José Cabrera. HISPANIOLA: (ANSP) 1 G ♂, Manabao, D.R., 22 Mar. 1922, E. Kaempfer; 1 G ♂, Samana, D.R., 2-6 July '15; 1 G ♂, Snachez, D.R., 13-18 June '15; 1 G ♂, Pivert, Haiti, 1 Apr. 1922. (UMMZ) 1 B ♀, 1 mi. w. of Ciudad Trujillo, Aug. 1944, J.J. Friant; 2 B ♂, nr. Puerto Plata, D.R., 10 May 1959, Sanderson and Farr. PUERTO RICO: (ANSP) 1 G ♂, Rio Blanca Valley, 20, 28 Jan. '14. (UMMZ) 1 G ♀, Utuado, 4 Jan. 1964, J. Stuart, J.A. Ramos. (USNM) 6 G ♂, Maricao, 8-11 Aug. 1961, Flint, Spangler, Martorell; 6 B ♀, Isla Maguay, Parguera, 18, 21 Dec. 1962, Paul & Phyllis Spangler. NEVIS: (UMMZ) 1 G ♂, s. side of Mt. Nevis, 1000 ft., 3 Jan. 1937, C. Roys. DOMINICA: (UMMZ) Roseau, 19 Jan. 1937, C. Roys. (USNM) 1 B ♂, 5 G ♂, 4 G ♀, Clarke Hall, 19 Sep. 1964, T.J. Spilman, 12 Nov.-16 Dec. 1964, P.J. Spangler, 6 Oct.-9 Nov. 1966, A.B. Gurney; 1 B ♂, Clarke Hall Est., 15 Apr. 1966, R.J. Gagne; 1 G ♂, 3 mi. e. of Pont Casse, 13-16 Oct. 1966, A.B. Gurney; 3 G ♂, S Chiltern, 10 July 1965, D.M. Anderson, 2 Nov. 1966, A.B. Gurney; 1 G ♀, Trafalgar, 10 June 1965, D.R. Davis; 1 G ♂, 1 G ♀, Warner Rd., 1 May 1964, O.S. Flint, Jr. GRENADA: (UMMZ) 1 G ♂, Lowlands, Aug. 1905, W.E. Broadway.

Specimens in ANSP, identified by M. Hebard as *affinis* and confirmed as *affinis* in 1968 by TJW, extend the range of *affinis* northward to Costa Rica and Nicaragua and southward to Venezuela, Colombia, Ecuador, Peru, and Brazil.

HABITAT. — *N. affinis* is characteristic of forest margins and lush secondary growth. It does not occur in dry or completely open habitats.



Fastigial length: 0.8,  $0.9 \pm 0.1$ , 0.9-1.0. Fastigial index: .33;  $.33 \pm .04$ , .27-.36.

FILE. — Teeth evenly spaced; 2.2-2.3 mm; 95-98 teeth (Fig. 22).

SONG. — Long-continued beady buzz; wingstroke rate ca. 50/s (Fig. 7, 14; Table 2). (Differences in the fine structure of the wingstrokes of *retusiformis* and *occidentalis* in Fig. 13 and 14 are not diagnostic.)

COLOR. — The neotype and four other males are brown; two males are green. The neotype and all other specimens have two pale yellow dorsal stripes, one on each side of the pronotal disc, each extending forward to the tip of the fastigium and rearward along the stridulatory area. Beneath this yellow stripe, along each side of the neotype and the other brown specimens, is a dark brown, generally diffuse stripe that continues rearward at least to the origin of vein  $R_2$ . Eye with a narrow oblique black stripe above a broad pale stripe.

SPECIMENS. — All collected west of Azua, on road to Barahona, Dominican Republic, 13 Sep. 1973, TJW, JCS (incl. UFT 73-411,428).

HABITAT. — Collected on bunches of grass in cactus desert.

### *Neoconocephalus retusiformis* n. sp.

Fig. 8, 14, 19, 22, 26

We name this species for its resemblance to *N. retusus* (Scudder) from southeastern United States. *N. retusiformis* is small and slender and has a very blunt fastigium. It is known only from Puerto Rico and Mona. Its closest relative, *occidentalis* from Hispaniola, is longer and has more widely spaced file teeth. Unlike *occidentalis*, most *retusiformis* (15 of 19) have the frontal incision closed rather than open (Fig. 26B, BB). Furthermore, the tegmina of males extend beyond the hind femora less than 10 mm.

MEASUREMENTS. — Total length: 42 (male holotype);  $42 \pm 2$ , 38-45 (17 male paratypes); 56 (female paratype). Pronotal length: 7.7;  $7.5 \pm 0.2$ , 7.0-7.7; 8.0. Hind femur: 23;  $22 \pm 1$ , 21-24; 26. Ovipositor: 27. Fastigial length: 0.9,  $1.0 \pm 0.1$ , 0.8-1.2; 1.2. Fastigial index: .35;  $.30 \pm 0.3$ , .22-.41; .33.

FILE. — Teeth evenly spaced (Fig. 19); 1.7-1.8 mm long; 92-100 teeth (Fig. 22).

SONG. — Long-continued, beady, weak buzz; wingstroke rate ca. 50/s (Fig. 8, 13; Table 2).

COLOR. — Holotype brown; male paratypes, 8 green, 9 brown; female paratype, brown. Dorsal yellow stripes, lateral brown stripes, and eye stripes like those of *occidentalis*.

TYPE SERIES (FSCA). — PUERTO RICO: Holotype: 1 B ♂, 8 mi. s. Arecibo on PR 10, 9 Jan. 1969, TJW, PCD. Paratypes: 1 G ♂, 2 B ♂, 1 B ♀, same data as holotype (incl. UFT 69-116); 3 G ♂, 3 mi. e. San Juan, 26 June 1966, TJW (incl. UFT 1966-15-J); 1 G ♂, Boca de Congrejos (nr. San Juan), 8 Jan. 1969, TJW, PCD (UFT 69-24, 58); 4 B ♂, PR 115, km 21.1 (nr. Aguada), 11 Jan. 1969, TJW, PCD; 1 G ♂, Las Tetras de Cerro Gordo (nr. Maricao) ca. 880 m., 13 Jan. 1969, TJW, PCD; 1 B ♂, PR 3, km 44.0 (nr. Fajardo), 16 Jan. 1969, TJW, PCD; 1 G ♂, PR 3, km 68.0 (nr. Naguabo), 16 Jan. 1969, TJW, PCD; 1 G ♂, 2 B ♂, PR 968, 0.7 m. n. of Palmer, 17 Jan. 1969, TJW, PCD.



**Neoconocephalus triops** (Linnaeus)

Fig. 5, 21, 22, 28

- Gryllus* (*Tettigonia*) *triops* Linnaeus 1758:430. Type locality: Indiis [=West Indies?].
- Conocephalus bilineatus* Thunberg 1815:275. Type locality: St. Domingo. Described from a juvenile. Walker (1869:306) wrote that its cone was "like that of *C. obtusus*," and we therefore propose this *New Synonymy*.
- Conocephalus obtusus* Burmeister 1838:705. Type locality: unknown. Kirby (1906:246) and later authors treated *obtusus* as a junior synonym of *triops*.
- Conocephalus dissimilis* Serville 1839:518. Type locality: North America. Kirby (1906:246) and later authors treated *dissimilis* as a junior synonym of *triops*.
- Conocephalus mexicanus* Saussure 1859:208. Type locality: Mexico. Rehn and Hebard (1915:405) treated *mexicanus* as a junior synonym of *triops*.
- Conocephalus hebes* Scudder 1879:92. Type localities: Cuba; St. Thomas; New Orleans; San Mateo del Mar, Tehuantepec; and unknown locality. Rehn and Hebard (1915:405) treated *hebes* as a junior synonym of *triops* (but noted that Scudder's type series included at least one other species).
- Conocephalus obscurellus* Redtenbacher 1891:397. Type locality: Cuernavaca, Mexico (selected by Hebard 1927b:136). Hebard (1927b:136) treated *obscurellus* as a junior synonym of *triops*.
- Conocephalus fuscostriatus* Redtenbacher 1891:399. Type localities: Georgia, Missouri, Carolina, Texas, ?Mexico, Cuba, Port-au-Prince, Quito. Rehn and Hebard (1915:405) treated *fuscostriatus* as a junior synonym of *triops*.
- Conocephalus nigrolimbatus* Redtenbacher 1891:401. Type locality: Cuba. Hebard (1927b:136) treated *nigrolimbatus* as a junior synonym of *triops*.
- Conocephalus macropterus* Redtenbacher 1891:402. Type locality: Mexico (selected by Hebard 1927b:136). Hebard (1927b:136) treated *macropterus* as a junior synonym of *triops*.

This species has the most extensive range of any *Neoconocephalus*. It occurs throughout the Caribbean area, north to southeastern Ohio, west to California, the Galapagos, and Lima, Peru, and southeast to Guyana. It can be distinguished from other Caribbean species by its large size in combination with a blunt fastigium (Fig. 28). The frontal gap is always open (Fig. 28B). Males have a distinctive longitudinal black line on the left of the stridulatory area.

MEASUREMENTS. — 33 males, 21 females (Trinidad, 9; Panama, 8; Jamaica, 9; Grand Cayman, 4; Hispaniola, 10; Puerto Rico, 10; St. Croix, 4). Total length ( $\bar{x} \pm 50$ , range): 56  $\pm$  3, 50-62 (males); 61  $\pm$  6, 46-76 (females). Pronotal length: 9.3  $\pm$  0.4, 8.2-9.9; 8.7  $\pm$  0.4, 7.9-9.2. Hind femur: 25  $\pm$  2, 22-28; 27  $\pm$  1, 23-29. Ovipositor: 28  $\pm$  2, 22-30. Fastigial length: 1.4  $\pm$  0.1, 1.1-1.7; 1.5  $\pm$  0.2; 1.2-1.8. Fastigial index: .42  $\pm$  .03, .34-.47; .44  $\pm$  .03, .39-.50.

FILE. — Teeth more widely spaced toward lateral end of file (Fig. 21); 1.8-2.4 mm long, 65-86 teeth (Fig. 22).

SONG. — Coarse buzz momentarily interrupted at intervals of ca. 0.6 sec. (Fig. 5). *N. triops* is the only ensiferan Orthopteran in which the course of normal develop-

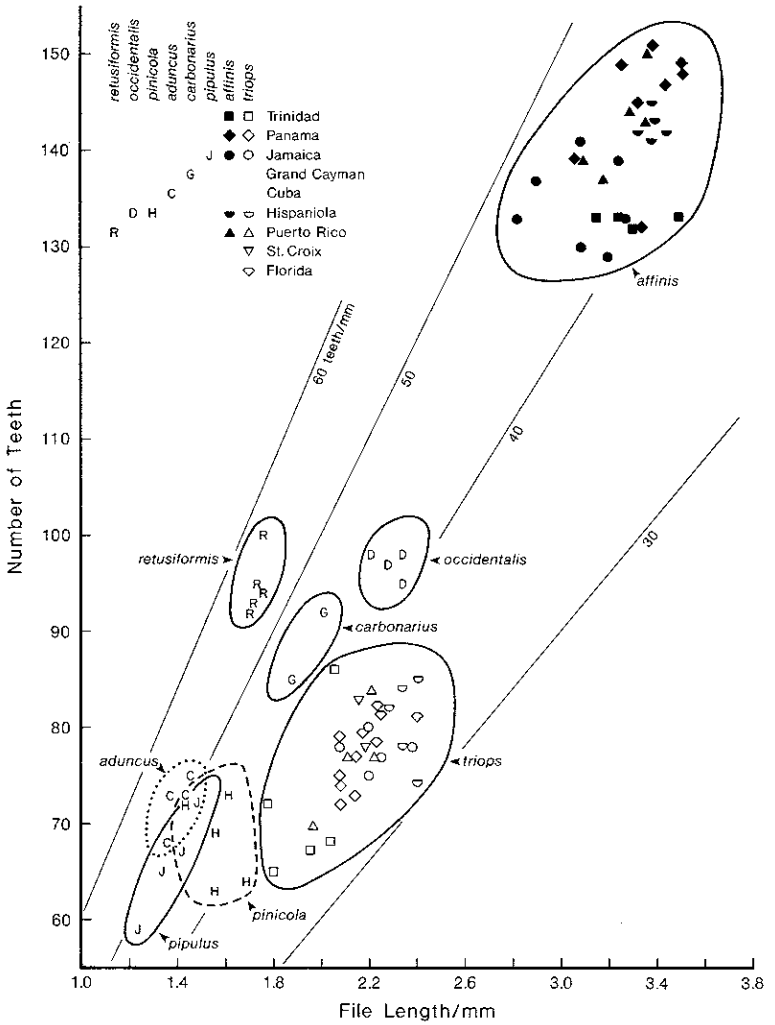


FIGURE 22. Number of teeth and length of stridulatory file of Caribbean *Neoconocephalus*.

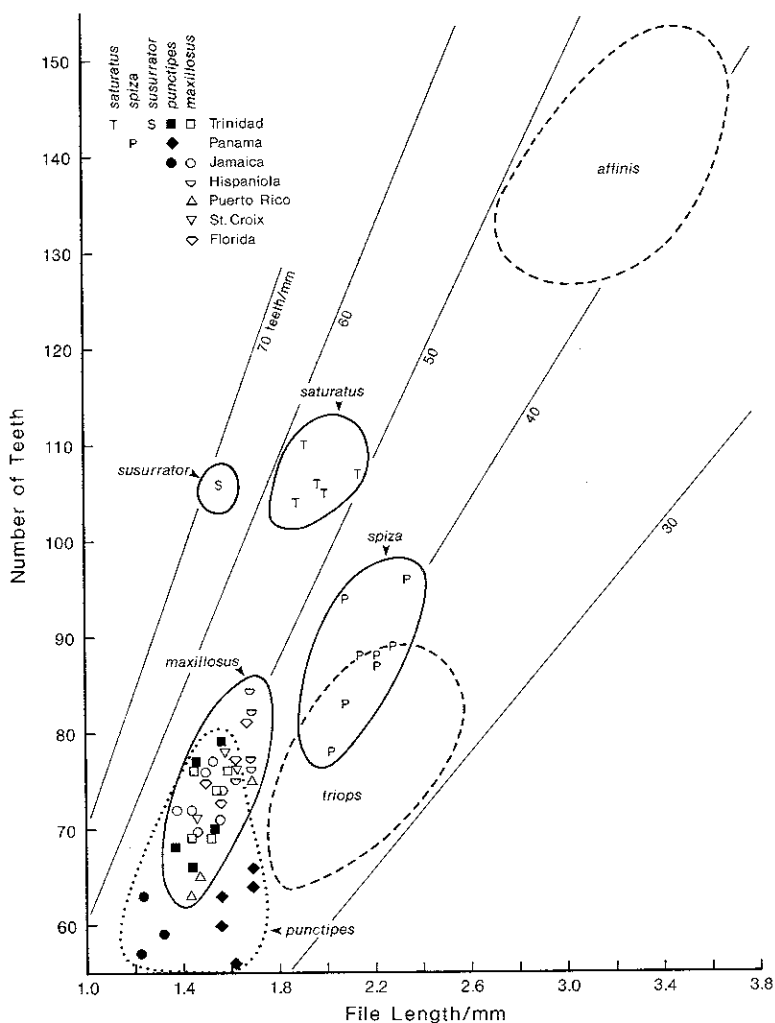


FIGURE 23. Number of teeth and length of stridulatory file of Caribbean *Neoconocephalus*.

ment is known to influence the nature of the calling song (Whitesell and Walker 1978). In temperate areas, fall-maturing adults are in reproductive diapause, and when they begin to call the following spring they have a significantly lower wingstroke rate than adults that call without diapausing (Table 2, Gainesville data). Stridulatory movements of *triops* are complex, with each wingstroke cycle including a partial and a full closure of the stridulatory apparatus (Walker 1975).

**COLOR.** — Of the 85 principal specimens, 64% are green and 36% are brown (61 males are 39 G, 22 B; and 24 females are 15 G, 9B). Green *triops*, and some brown ones, lack major markings other than a longitudinal dorsal black line on the left of the male stridulatory area. Most brown individuals have on each side a well defined to poorly defined dark line or infuscation starting at the fastigium, continuing along the pronotal angle, and ending on the tegmen at the origin of vein  $R_2$ . In some of those individuals the tegmina are flecked with dark brown. The fastigium of *triops* has a cream-colored, transverse, dorso-frontal stripe, beneath which is sometimes a narrow dark line.

**PRINCIPAL SPECIMENS (FSCA).** — TRINIDAD: 11 G ♂, 4 G ♀, Arima Valley, Waller Field, and St. Joseph, 28 June-6 July 1966, TJW. PANAMA: 5 G ♂, 4 B ♂, Gamboa, 23 Oct.-30 Dec. 1978, MDG; 1 B ♀, Penonome, 6 Dec. 1978, MDG; 1 G ♂, 4 B ♂, 2 G ♀, Fort Sherman, 9-14 Dec. 1980, TJW, JJW. JAMAICA: 1 B ♂, Kingston, 26 Oct. 1965, Duval Jones (UFT 199-31); 5 G ♂, 1 B ♂, Kingston, 12 July 1966, TJW; 1 B ♂, St. Catherine Par., Worthy Park, 22 Nov. 1968, TJW; 1 B ♀, Montego Bay, 11 Dec. 1969, E. G. Farnworth; 1 G ♂, 3 B ♂, 1 G ♀, Runaway Bay, 28 Dec. 1969, JJW; 3 G ♂, 1 B ♂, 1 G ♀, 1 B ♀, St. Catherine, St. Thomas, Hanover, and Westmoreland Par., 13 June-25 June 1970, TJW, JJW, PCD. GRAND CAYMAN: 2 G ♂, 2 B ♂, nr. Georgetown, 26 June 1970, TJW, JJW, PCD. HISPANIOLA: 1 G ♂, 4 G ♀, 1 B ♀, Haiti, Port-au-Prince, 4-5 Sep. 1973, TJW, JCS; 1 G ♂, Dom. Rep., nr. Cabo Rojo, 12 Sep. 1973, TJW, JCS; 1 B ♂, Dom. Rep., 5 km ne. Bonao, 17 Sep. 1973, TJW, JCS; 2 G ♂, 1 B ♂, Dom. Rep., San Jose de Las Matas, 19 Sep. 1973, TJW, JCS. PUERTO RICO: 2 G ♂, nr. San Juan, 8 Jan. 1969; 1 B ♂, 1 B ♀, 9 km n. Mayaguez, 10 Jan. 1969; 1 B ♀, nr. Adjuntas, 14 Jan. 1969; 1 G ♂, 1 B ♂, 3 G ♀, 4 B ♀, 600 m., nr. El Yunque, 17-19 Jan. 1969; (all TJW, PCD). ST. CROIX: 3 G ♂, 1 B ♂, nr. Little Fountain, West Pond, and nr. airport, 24 Jan. 1969, TJW, PCD.

**OTHER RECORDS.** — CUBA: (UMMZ) 3 B ♂, 1 B ♀, Santa Clara, Santa Clara Prov., 11 Aug. 1931, A. Greenhall; 1 B ♂, Las Villas, Santa Clara, 28 Dec. 1958, P.M. Pruna; 1 G ♂, 1 B ♀, Marti, Prov. Camaquey, 10, 13 July 1931, A. Greenhall; 1 G ♂, San Vicente, 6-10 July 1956, C.&P. Vaurie. BAHAMAS: (FSCA) 1 G ♀, Grand Turk, 21 Nov. 1963, C. Murvosh; 1 G ♀, Mayaguana, 25 Aug. 1963, C. Murvosh. BERMUDA: (UMMZ) 1 G ♂, 11 Aug. 1924, A. Avinoff. FLORIDA KEYS: Heard during each of the 12 months, 1969-71, J.J. Whitesell (1974). HISPANIOLA: 1 B ♂, 1 G ♂, 2 B ♀, 2 G ♀, Fortaleza, San Luis, Santiago, D.R. 25 Nov. 1918-22 Mar. 1919, H.B. Sherman; 1 G ♂, 1 B ♀, 1 G ♀, 1 mi. w. of Ciudad Trujillo, Aug. 1944, J.J. Friauf; 3 B ♂, 3 B ♀, 3 G ♀, Ciudad Trujillo, Oct. 1944, J.J. Friauf. MONA: (UMMZ) 1 B ♀, 6 Nov. 1960, H. Heatwole. PUERTO RICO: (UMMZ) 2 G ♀, San Juan Rio Piedras, 23 Aug., 18 Nov. 1960, H. Heatwole.

wole. (USNM) 1 B ♂, 3 G ♀, Luquillo Forest, 2 Jan. 1963, P. & P. Spangler; 7 B ♂, 1 G ♂, 4 B ♀, 1 G ♀, Maguey, Parguera, 18, 21 Dec. 1962, P. & P. Spangler; 1 G ♂, 2 B ♀, 2 G ♀, Maricao, 8-11 Aug. 1961, Flint, Spangler, Martorell; 1 G ♀, Mayaguez, 8 Aug. 1961, Flint and Spangler. ST. THOMAS: (UMMZ) 19 May 1937, C. Roys. ST. JOHN: (USNM) 1 B ♂, Lameshure Ranger Station, 28 Dec. 1958, C.F. Adams. ST. CROIX: (UMMZ) 2 B ♂, 3 G ♂, 1 B ♀, 11 G ♀, Christiansted, Oct. 1940-4 June 1941, H.A. Beatty. DOMINICA: (USNM) 3 B ♂, 21 G ♂, 12 G ♀, Clarke Hall, 11 Feb. 1964-31 Oct. 1966, D.F. Bray, A.B. Gurney, P.J. Spangler *et al.*; 1 B ♂, 10 G ♂, 2 B ♀, 8 G ♀, nine other localities, 13 Mar. 1964-31 Oct. 1966, A.B. Gurney, O.S. Flint, Jr., *et al.*

HABITAT. — *N. triops* is characteristic of open and disturbed areas including agricultural and urbanized lands. It has a greater tolerance than most species for cold and dry conditions as shown by its occurrence northward to Ohio and in xeric habitats such as salt flats and tropical scrub. It is a strong flier and is often collected at lights.

### ***Neoconocephalus pinicola* n. sp.**

Figs. 20, 22, 29

We name this species *pini* (=L. pine), *cola* (=L. dweller) because it lives in the open understory of pine forests. *N. pinicola* is small with a blunt fastigium. It differs from the other species exhibiting these two features (viz. *occidentalis*, *retusiformis*, and *surrator*) in having widely spaced teeth at the lateral end of the stridulatory file (cf. Fig. 19 and 20). The frontal incision is broadly open in *pinicola*, whereas in *occidentalis* it is partially closed by the ventral tooth of the fastigium (cf. Fig. 29B, 25B). The tegmina of males extend beyond the hind femora less than 10 mm.

MEASUREMENTS. — Total length: 46 (male holotype); 44±2, 42-46 (5 male paratypes;  $\bar{x}$ ±SD, range) 47, 51 (2 female paratypes). Pronotal length: 7.8, 7.5±0.2, 7.1-7.6; 6.5, 7.2. Hind femur: 23; 22+2, 21-25; 24, 26. Ovipositor: 20, 22. Fastigial length: 0.9; 0.9±0.1, 0.8-1.0; 0.9, 0.9. Fastigial index: .29, .35±.04, .32-.41; .32, .36.

FILE. — Teeth more widely spaced toward lateral end (Fig. 20); 1.4-1.7 mm long; 63-73 teeth (Fig. 22).

SONG. — Long continued buzz. The only tape recordings were on a reel that was lost.

COLOR. — Holotype and 3 male paratypes are brown. Female paratypes and 2 male paratypes are green. Color pattern is the same as in *occidentalis*.

TYPE SERIES (FSCA): Six males (including holotype) and 2 females collected at 700-1250 m in Baoruco Mts. of southwestern Dominican Republic (km 25-33 on Alcoa private road), 12 Sep. 1973, TJW, JCS.

HABITAT. — Males heard calling at night near ground in open pine forest. Females and most males were on grass. A few males were calling from forbs or ferns.



**Neoconocephalus maxillosus (Fabricius)**

Figs. 10, 16, 23, 30

*Locusta maxillosus* Fabricius 1775:284. Type locality: America.*Conocephalus heteropus* Bolivar 1881:496. Type locality: Itaparica, Brazil.Hebard (1927a:336) treated *heteropus* as a junior synonym of *maxillosus*.*Conocephalus muticus* Redtenbacher 1891:393. Type localities: Cuba, St. Vincent.Kirby (1906:244) treated *muticus* as a junior synonym of *maxillosus*.

This species occurs throughout the Caribbean. On most of the Antilles it is the only species with a short file and a medium fastigium. Where it occurs with *punctipes*, *maxillosus* can be distinguished by its larger size, its open fastigial incision, and its dark fastigial markings. On Jamaica, *maxillosus* and *pipulus* are easily confused (except by calling song). The latter has the entire ventral surface of the fastigium black or infuscated or lateral dark marks beneath the pale fastigial stripe. *N. maxillosus* generally has a central dark mark (Fig. 30A), sometimes divided, or a dark stripe beneath the pale fastigial stripe. Some specimens have further fastigial infuscation and one Jamaican specimen has the entire ventral surface of the fastigium black.

MEASUREMENTS. — 32 males, 2 females (Trinidad, 5; Jamaica, 5; Grand Cayman, 3; Florida, 5; Hispaniola, 5; Puerto Rico, 6; St. Croix, 5). Total length:  $52 \pm 2$ , 47-57 (males;  $\bar{x} \pm$  SD, range); 61 (P.R. ♀), 60 (Fla. ♀). Pronotal length:  $8.1 \pm 0.4$ , 7.4-8.7; 8.3, 7.6. Hind femur:  $24 \pm 1$ , 21-26; 28, 26. Ovipositor: 29, 27. Fastigial length:  $1.3 \pm 0.1$ , 1.2-1.5; 1.6, 1.6. Fastigial index:  $0.49 \pm .05$ , .39-.59; .56, .56.

FILE. — Teeth more widely spaced toward lateral end of file; 1.4-1.7 mm long; 63-84 teeth (Fig. 23).

SONG. — Long-continued buzz (Fig. 10); timed at 20-40 sec. in Jamaica. Each wingstroke cycle produces a major and a minor pulse (Fig. 16) as in the principal portions of songs of *triops* (Walker 1975). Wingstroke rates 130-145 at 25 C (Table 2).

COLOR. — Of the 53 principal specimens, 43% are green and 57% are brown (51 males are 23 G, 28 B; 2 females are B). Dark fastigial markings are highly variable. Nearly all specimens have beneath the pale fastigial stripe a dark mark that extends laterally to varying degrees and that is occasionally briefly broken medially. One specimen from Jamaica has no dark fastigial markings whereas another has the entire ventral surface of the fastigium black. Brown specimens often have a dark stripe starting at the fastigium and extending along each side onto the tegmina. The tegmina are flecked with brown or black to varying degrees. A few green specimens have a longitudinal dark stripe to the left of the stridulatory area but it is never as prominent as that of *triops*.

PRINCIPAL SPECIMENS (FSCA). — TRINIDAD: 6 G ♂, nr. Arima, Waller Field, 30 June, 6 July, 1966, TJW (incl. UFT 1966-4-C). JAMAICA: 1 B ♂, St. Catherine Par., Worthy Park, 16 Nov. 1968, TJW; 3 G ♂, 2 B ♂, nr. Orange Bay, 20 Nov. 1968 (incl. UFT 68-560, 570, 574); 2 G ♂, 1 B ♂, Negril, 20 Nov. 1968, TJW; 1 G ♂, St. Thomas Par., nr. Rozelle Falls, 25 Nov. 1968, TJW; 1 B ♂, Bath, 14 June

1970, TJW, JJW, PCD; 4 G ♂, 4 B ♂, n. of Negril, 21-22 June 1970, TJW, JJW, PCD (incl. UFT 70-250). GRAND CAYMAN: 1 G ♂, 2 B ♂, nr. Georgetown, 26 June 1970, TJW, JJW, PCD. HISPANIOLA: 1 G ♂, 3 B ♂, 8-13 km w. of Miches, 14 Sep. 1973, TJW, JCS; 4 B ♂, 3 km. n. Jarabacoa, 600 m, 18 Sep. 1973, TJW, JCS. PUERTO RICO: 1 G ♂, San Juan, 23 Sep. 1958, A. Boike; 3 G ♂, 1 B ♂, nr. San Juan, 8 Jan. 1969, TJW, PCD (incl. UFT 69-57, 213); 1 B ♂, nr. Aguada, 11 Jan. 1969, TJW, PCD; 1 B ♀, Mayaguez, 12 Jan. 1969, G. Miskimen. ST. CROIX: 5 B ♂, nr. Fredriksted, 24 Jan. 1969, TJW, PCD. FLORIDA: 1 G ♂, 1 B ♀, Homestead, 10 Sep., 29 Nov. 1969, JJW; 1 G ♂, 3 B ♂, Florida Keys, Cudjoe Key, 21 Aug. 1978, TJW.

OTHER RECORDS. — PANAMA: UFT 80-29 (see Table 1), Ft. Sherman, 11 Dec. 1970, TJW (specimen not collected). JAMAICA: (ANSP) 1 G ♂, 1 B ♂, Montego Bay, March 1913, M. Hebard, C.G. Hussey; 2 G ♂, 3 B ♂, Montego Bay, 28, 29 Oct. 1913, M. Hebard: 1 B ♂, Cumberland Dist., Clarendon, 15-18 Dec. 1919, 3000 ft.; 1 B ♂, Pleasant Hill, 3700-3800 ft., Blue Mts., 24 July 1923. (UMMZ) 1 B ♀, St. Andrew Parish, Clydesdale, 23 June 1948, D.E. Miller; 1 B ♂, St. Catherine, Bog Walk, 9 Apr. 1937, C. Roys. CUBA: (FSCA) 1 B ♂, Guantanamo Bay. (UMMZ) 1 G ♂, Marti, Prov. Camaquey, 6 July 1931, A. Greenhall; 1 G ♂, Santa Clara Prov., Santa Clara, 11 Aug. 1931, A. Greenhall; 1 G ♀, Oriente Prov., Gran Piedra, 30-31 May 1959, M.W. Sanderson. BERMUDA: (UMMZ) 1 B ♀, 10 Aug. 1924, A. Awinoff. PUERTO RICO: (ANSP) 1 B ♂, Naguabo, 7-9 Mar. '14. (UMMZ) 1 B ♂, San Juan Rio Piedras, 8 Sep. 1960, H. Heatwole. ST. JOHN: (USNM) 1 B ♀, Lameshur Ranger Station, 29 Nov. '58, C.F. Adams. ST. THOMAS: (UMMZ) 1 G ♀, s. side of island, 16 June 1937, C. Roys. ST. CROIX: (UMMZ) 9 B ♂, 2 G ♂, 4 B ♀, 9 G ♀, Christiansted, Oct. 1940-Jan. 1941, H.A. Beatty; 6 B ♂, 2 G ♂, 1 B ♀, 3 G ♀, Christiansted, 20 May-12 June 1941; H.A. Beatty. ST. KITTS: (UMMZ) 1 G ♀, Basseterre, 26 May 1937, C. Roys. DOMINICA: (ANSP) 1 G ♂, Laudet, 13 June 1911. (USNM) 1 G ♂, 1 B ♀, 1 G ♀, W. Cabrit, 3 Mar. 1964, D.F. Bray; 3 G ♂, 1 B ♀, 3 G ♀, Clarke Hall, 20 Mar. 1964, D.F. Bray, 8 May 1964, O.S. Flint, Jr., 23-26 Nov., 11-16 Dec. 1964, P.J. Spangler, 21-31 Jan. 1965, W.W. Wirth, 19 Apr. 1966, R.J. Gagne, 22-31 Oct. 1966, A.B. Gurney; 1 G ♂, 2 G ♀, Grande Savane, 20 May, 1 July 1964, O.S. Flint, Jr., 7-12 Oct. 1966, A.B. Gurney; 1 G ♀, airport, 14 May 1966, G. Steyskal; 1 G ♂, La Plaine, 29 Oct. 1966, A.B. Gurney. ST. LUCIA: (ANSP) 1 B ♂, Mar.-Apr. 1927, J. Bond.

HABITAT. — Open grassy areas, including roadsides, pastures, and old cane fields.

### *Neoconocephalus punctipes* (Redtenbacher)

Fig. 11, 17, 23, 31

*Conocephalus punctipes* Redtenbacher 1891:422. Type locality: St. Vincent. We examined the holotypic male (British Museum) and judged it to be conspecific with our material from Jamaica, Trinidad, and Panama.

*Conocephalus surinamensis* Redtenbacher 1891:423. Type localities: Surinam, West

TABLE 1. Status of specific names applied to Caribbean *Neoconocephalus*.

Name, author, year (original genus <sup>a</sup> )	Status
Names in bold face are those of known species from this region.	
<b>aduncus</b> Scudder 1879 (C.)	valid name
<i>adustus</i> Redtenbacher 1891 (C.)	= <i>carbonarius</i>
<b>affinis</b> Beauvois 1805 (L.)	valid name
<i>aztecus</i> Saussure and Pictet 1898 (C.)	= <i>affinis</i>
<i>bilineatus</i> Thunberg 1815 (C.)	= <i>triops</i>
<b>carbonarius</b> Redtenbacher 1891 (C.)	valid name
<i>crassus</i> Bolivar 1881 (C.)	= <i>affinis</i>
<i>dissimilis</i> Serville 1839 (C.)	= <i>triops</i>
<i>fratellus</i> Griffini 1899 (C.)	not Caribbean (Brazil) or = <i>saturatus</i>
<i>frater</i> Redtenbacher 1891 (C.)	junior homonym of <i>frater</i> Kirby 1890
<i>fuscinervis</i> Redtenbacher 1891 (C.)	unresolved (Cuba)
<i>fuscostrigatus</i> Redtenbacher 1891 (C.)	= <i>triops</i>
<i>gladiator</i> Redtenbacher 1891 (C.)	not Caribbean (Mexico)
<i>guttatus</i> Serville 1893 (C.)	= <i>affinis</i>
<i>hebes</i> Scudder 1879	= <i>triops</i>
<i>heteropus</i> Bolivar 1881 (C.)	= <i>maxillosus</i>
<i>infuscatus</i> Scudder 1875 (C.)	not Caribbean (Peru)
<i>macropterus</i> Redtenbacher 1891 (C.)	= <i>triops</i>
<b>maxillosus</b> Fabricius 1775 (L.)	valid name
<i>mexicanus</i> Saussure 1859 (C.)	= <i>triops</i>
<i>muticus</i> Redtenbacher 1891 (C.)	= <i>maxillosus</i>
<i>necessarius</i> Redtenbacher 1891 (C.)	not Caribbean (Mexico)
<i>nieti</i> Saussure 1859 (C.)	nomen dubium
<i>nigrolimbatus</i> Redtenbacher 1891 (C.)	= <i>triops</i>
<i>nigropunctatus</i> Redtenbacher 1891 (C.)	= <i>affinis</i>
<i>obscurellus</i> Redtenbacher 1891 (C.)	= <i>triops</i>
<i>obtusus</i> Burmeister 1838 (C.)	= <i>triops</i>
<b>occidentalis</b> Saussure 1859 (C.)	valid name
<i>pichincha</i> Bolivar 1881 (C.)	not Caribbean (Ecuador) or = <i>affinis</i>
<b>pinicola</b>	new species
<b>pipulus</b>	new species
<i>prasinus</i> Redtenbacher 1891 (C.)	nomen dubium
<b>punctipes</b> Redtenbacher 1891 (C.)	valid name
<b>retusiformis</b>	new species
<b>saturatus</b> Griffini 1899 (C.)	valid name
<i>simulator</i> Walker 1869 (C.)	nomen dubium
<b>spiza</b>	new species
<i>surinamensis</i> Redtenbacher 1891 (C.)	= <i>punctipes</i>
<b>susurrator</b>	new species
<b>triops</b> Linnaeus 1758 (G.)	valid name
<i>tristani</i> Saussure and Pictet 1898 (C.)	nomen dubium

<sup>a</sup>C. = *Conocephalus*, G. = *Gryllus* (*Tettigonia*), L. = *Locusta*.

Indies, St. Vincent. We examined a female syntype from St. Vincent (British Museum) and a male and a female syntype from Surinam (Naturhistorisches Museum Wien, Vienna). The specimen(s) in the type series from "Westindien" were in the collections of Zoologische Institute and Museum, Universität Hamburg, Hamburg, which were destroyed in WW II. We identify the St. Vincent syntype as conspecific with *punctipes*. The Surinam syntypes are similar to *punctipes* but apparently specifically distinct. We here treat *surinamensis* as a synonym of *punctipes* but will not restrict the actions of future taxonomists (dealing with Surinam *Neoconocephalus*) by designating a lectotype. (*New Synonymy*)

This species is known from St. Vincent, Trinidad, Panama, and Jamaica, but apparently is absent from St. Croix, Puerto Rico, Hispaniola, and Cuba. It is the smallest Caribbean species having a prominent fastigium. Only *retusiformis* and perhaps *carbonarius* share its feature of having the incision beneath the fastigium generally closed (Fig. 31B). The fastigium of *punctipes* has no ventral dark marks.

MEASUREMENTS. — 15 males (Trinidad, 5; Panama, 5; Jamaica, 5). Total length:  $47 \pm 2$ , 45-50 ( $\bar{x} \pm SD$ , range). Pronotal length:  $7.7 \pm 0.3$ , 7.2-8.3. Hind femur:  $20 \pm 1$ , 19-22. Fastigial length:  $1.4 \pm 0.1$ , 1.2-1.5. Fastigial index:  $.44 \pm .05$ , .39-.52.

FILE. — Teeth more widely spaced toward lateral end of file; 1.2-1.7 mm long; 56-79 teeth.

SONG. — Long-continued, intense, whiney buzz (Fig. 11). Wingstrokes simple (Fig. 17) and at rates exceeding 200/s (Table 2).

COLOR. — Of 22 principal specimens, 36% are green and 64% are brown (all male; 8 G, 14 B). The 5 specimens from Trinidad are green; most others are brown. *N. punctipes* is less boldly marked than most other *Neoconocephalus*. It has no conspicuous lateral dark stripes and no dark fastigial markings. A few to many dark dots sprinkle the tegmina of most brown specimens and some green ones. The cream-colored fastigial stripe splits and extends rearward along the pronotal angles and obliquely downward through the eyes to the genae.

PRINCIPAL SPECIMENS (FSCA). — TRINIDAD: 4 G ♂, nr. Arima, Waller Field, 6 July 1966, TJW (incl. UFT 1966-8-I, 10-H, 10-F); 1 G ♂, nr. Port of Spain, 7 July 1966, TJW. PANAMA: 1 G ♂, 3 B ♀, Gamboa, 12 Dec. 1978, MDG; 1 B ♂, Balboa, 30 Dec. 1978, M. Clark; 1 G ♂, 6 B ♂, Fort Sherman, 10, 13 Dec. 1980, TJW, JJW. JAMAICA: 3 B-♂, Hanover Par., nr. Orange Bay, 20 Nov. 1968, TJW (UFT 68-573, 576, 579); 1 G ♂, 1 B ♂, St. Catherine Par., nr. Port Henderson, 25 June 1980, TJW, JJW, PCD.

OTHER RECORDS. — JAMAICA; (ANSP) 1 G ♂, Montego Bay, 29 Oct. 1913, M. Hebard. TRINIDAD: (ANSP) 1 G ♂, Arima Valley, 22 Aug.-7 Sep. 1967, M.G. Emsley. TOBAGO: (ANSP) 1 G ♂, 1 mi n. Scarborough, 20 Aug. 1967, M.G. Emsley.

HABITAT. — Grassy fields and roadsides.

TABLE 2. Wingstroke rates during calling of Caribbean *Neoconocephalus*.

Species Locality	No. of tapes	°C (range)	Wingstrokes/s (range)	$\bar{X} \pm S.D.^a$
<i>affinis</i>				
Trinidad	11	21.0-25.8	9.3-11.8	11.2 ± 0.6
Jamaica	15	20.8-25.4	10.0-13.3	12.9 ± 0.4
Puerto Rico	3	23.8-26.2	8.2-9.6	8.8 ± 1.3
Panama	26	22.8-27.0	12.2-14.8	13.6 ± 0.4
Hispaniola	7	21.4-27.0	11.1-13.0	12.2 ± 0.6
<i>occidentalis</i>				
Hispaniola	5	26.0-27.6	49-56	49 ± 3
<i>retusiformis</i>				
Puerto Rico	8	19.6-27.5	44-63	49 ± 6
<i>susurrator</i>				
Trinidad	1	25.0	118	118
<i>triops</i>				
Trinidad	8	23.8-26.3	121-136	128 ± 8
Panama	4	24.4-27.0	120-137	123 ± 3
Jamaica	15	19.9-25.7	89-122	116 ± 5
Grand Cayman	3	27.0-27.8	123-126	111 ± 1
Hispaniola	5	21.6-27.0	93-120	109 ± 3
Puerto Rico	3	18.2-25.4	79-111	112 ± 6
St. Croix	3	22.4-24.0	98-106	111 ± 3
Fla. Keys				
May-Aug.	19	21.5-27.7	96-132	116 ± 7
Dec.-Apr.	24	20.0-27.2	80-118	106 ± 7
Gainesville, Fl.				
May-Aug.	16	22.0-27.3	96-129	112 ± 6
Dec.-Apr.	16	20.6-27.8	76-99	89 ± 7
<i>maxillosus</i>				
Trinidad	7	23.8-25.0	132-149	145 ± 5
Panama	1	27.0	142	129
Jamaica	10	23.6-25.3	123-155	142 ± 7
Grand Cayman	1	27.0	143	130
Puerto Rico	8	17.3-27.0	81-144	132 ± 2
St. Croix	2	23.2	116-120	130 ± 3
Florida	3	24.1-26.2	114-149	130 ± 19
Hispaniola	2	26.0	136-138	131 ± 2
<i>punctipes</i>				
Trinidad	5	23.0-25.0	236-248	251 ± 13
Panama	4	24.4-27.0	242-259	237 ± 10
Jamaica	4	24.6-26.2	243-257	248 ± 9
<i>carbonarius</i>				
Grand Cayman	1	25.4	202	198

TABLE 2. Continued.

Species Locality	No. of tapes	°C (range)	Wingstrokes/s (range)	$\bar{X}_{\hat{Y}_{25}} \pm S.D.^a$
<i>pipulus</i> Jamaica	3	23.5-24.5	251-256	267 ± 8
<i>saturatus</i> Trinidad	6	23.4-26.5	125-181	161 ± 19
<i>spiza</i> Panama	4	22.8-27.0	132-178	153 ± 17

<sup>a</sup>Mean value of wingstroke rates expected at 25°C ( $\hat{Y}_{25}$ ). For each tape recording, rate expected at 25 C was calculated using the formula:

$$\hat{Y}_{25} = 20 \frac{\hat{Y}_x}{x - 5}$$

where  $Y_x$  = wingstroke rate at temperature x C.

This formula is based on two premises (Walker 1975b): (1) wingstroke rate is a linear function of ambient temperature and (2) the line of best fit for wingstroke rate (of a species) vs. temperature extrapolates to zero rate at 5 C.

### Neoconocephalus carbonarius (Redtenbacher)

Fig. 4, 22, 32

*Conocephalus carbonarius* Redtenbacher 1891:424. Type locality: Cuba. We examined a male that is apparently the holotype (Museum d'Histoire Naturelle, Geneve) and consider it conspecific with our two specimens from Grand Cayman.

*Conocephalus adustus* Redtenbacher 1891:400. Type locality: Cuba. We examined the holotypic female (Instituto Espanil de Entomologia, Madrid) and believe it to be conspecific with the holotypic male of *carbonarius*. We choose *carbonarius* over *adustus* for the name of this species because the type of *carbonarius* is more certainly conspecific with our tape recorded specimens from Grand Cayman (*New Synonymy*).

This species is short but sturdy and is heavily marked with fuscus. It has a short fastigium and a medium file. Its song is easily recognized because no other Caribbean species produces uniform, long, well-separated buzzes. We found it only on Grand Cayman, but the type locality is Cuba. The fastigial incision is closed on the holotype (Fig. 32B) and narrowly open on the other three specimens.

MEASUREMENTS.— Total length: 46 (male holotype); 46, 45 (2 males from Grand Cayman); 53 (female holotype of *adustus*). Pronotal length: 8.6; 8.5, 8.3; 8.4. Hind

femur: 21; 22, 20; 24. Ovipositor: 22. Fastigial length: 1.2; 1.0, 1.2; 1.1. Fastigial index: .39; .38, .31; .36.

FILE. — (males from Grand Cayman) 1.9 mm, 85 teeth; 2.0 mm, 92 teeth.

SONG. — Intense regular buzzes lasting ca. 0.8 sec.; repeated at intervals of ca. 1.2 sec. (Fig. 4). Wingstroke rate ca. 200/s (Table 2).

COLOR. — The four specimens are brown and intensely marked with black and darker brown. All have a broad stripe on each side extending from the fastigium to the origin of vein  $R_5$ . The males have four longitudinal fuscus stripes on the disk of the pronotum; the central two stripes are narrowly separated medially, and each of the more lateral ones divides the remaining discal area equally. The dorsal pronotal stripes continue onto the head, ending at the tip of the fastigium. The fastigium has no ventral dark marks. The ventral surfaces of the hind femora are conspicuously darkened. The males are further darkened with black dots and fuscus areas. The female is generally lighter, providing greater contrast to the lateral dark stripes. Her pronotal disk lacks conspicuous longitudinal lines.

OTHER SPECIMENS. — CUBA: 2 B ♂, Cottoro, Havana Prov., 18 Dec. 1919, José Cabrera (ANSP).

HABITAT. — Males were heard and one was collected at each of two sites on Grand Cayman — a weedy pasture and a roadside through white mangrove.

### *Neoconocephalus pipulus* n. sp.

Fig. 3, 22, 33

This species is named for its call (*pipulus* = L. peep). It was encountered only in western Jamaica, where it was most numerous in a large freshwater marsh just inland from the coast. Except for its song, *pipulus* is difficult to distinguish from *maxillosus*, a species that occurs in the same area but that is more abundant on drier sites. Most specimens of the two species can be distinguished by their fastigial markings (as discussed under *maxillosus*).

MEASUREMENTS.— Total length: 48 (male holotype);  $50 \pm 1$ , 49-52 (6 male paratypes;  $\bar{x} \pm SD$ , range). Pronotal length: 8.3;  $8.3 \pm 0.2$ , 8.0-8.6. Hind femur: 23.5;  $24 \pm 1$ , 22-25. Fastigial length: 1.2;  $1.4 \pm 0.1$ , 1.2-1.6. Fastigial index: .52;  $.48 \pm .06$ , .39-.55.

FILE. — Teeth more widely spaced toward lateral end of file; 1.2-1.5 mm long; 59-72 teeth (Fig. 22).

SONG. — Brief uniform buzzes repeated at ca. 0.6 sec. intervals (Fig. 3). Wingstroke rate about 250/s at 24°C (Table 2). Neighboring males did not synchronize their buzzes (though they might do so in denser populations).

COLOR. — Holotype and five paratypes are brown; one paratype is green. The frontal fastigial surface of the holotype is darkened throughout, but more densely so laterally. Two of the brown paratypes resemble the holotype in fastigial markings, and the other three have the entire frontal surface black. The green paratype has frontal fastigial infuscation limited to a smudgy stripe immediately beneath the apical light strip. On the brown specimens an indistinct dark stripe extends from the fastigium rearward on each side beneath the pronotal angle. The tegmina are flecked with dark brown spots of various sizes.

HABITAT. — Most specimens were heard in a large freshwater marsh dominated by tall grass, ferns, and a pickerelweed-like plant. A few called from roadside and in grass and weeds beneath coconut palms.

TYPE SERIES (FSCA). — JAMAICA: (holotype) 1 B ♂, Hanover Parish, n. of Negril, 21 June 1970, TJW, JJW, PCD (UFT 70-364). (paratypes) 5 B ♂, Hanover Par., nr. Orange Bay, 20 Nov. 1968, TJW (incl. UFT 68-578); 1 G ♂, Hanover Par., n. of Negril, 22 June 1970, TJW, JJW, PCD.

### *Neoconocephalus saturatus* (Griffini)

Fig. 2, 23, 34

*Conocephalus saturatus* Griffini 1899:6. Type localities: St. Vincent, Grenada.

Griffini concluded that at least some of the material Redtenbacher (1891:398) identified as *Conocephalus infuscatus* Scudder was not the species Scudder had described. He proposed *saturatus* as a replacement name for "*C. infuscatus* Redt. nec Scudder" and listed only "S. Vincent, Grenada" as localities. We examined 1 female and 3 male syntypes of *saturatus* from St. Vincent (British Museum) and identified one male as conspecific with our specimens from Trinidad and designated it the lectotype.

This species has a prominent fastigium (Fig. 34B) and more stridulatory file teeth than any other species that has widely spaced teeth at the lateral end of its file. Its "zit-zit" calling song distinguishes it from all other species except *spiza*.

MEASUREMENTS. — Total length: 50 ± 2, 48-53 (5 males;  $\bar{x} \pm$  SD, range); 62 ± 1, 61-63 (3 females). Pronotal length: 8.1 ± 0.1, 7.9-8.3; 8.4 ± 0.5, 7.9-8.7. Hind femur: 23 ± 0, 22-23; 27 ± 1, 26-28. Ovipositor: 31 ± 1, 30-32. Fastigial length: 1.5 ± 0.2, 1.2-1.6; 1.8 ± 0.1, 1.7-2.0. Fastigial index: .57 ± .02, .56-.61; .57 ± .03, .55-.60.

FILE. — Teeth more widely spaced toward lateral end of file; 1.9-2.1 mm long; 104-110 teeth (Fig. 23). The file of the lectotype is 1.76 mm, with 113 teeth.

SONG. — A regular or irregular sequence of short, buzzy chirps. Each chirp consists of 7-10 wingstrokes at a rate of ca. 160/s. Maximum chirp rate is ca. 4.8/s.

COLOR. — Of 10 specimens from Trinidad 6 are green (4 males, 2 females) and 4 are brown (3, 1). The black on the frontal surface of the fastigium varies from a stripe bordering the cream-colored stripe to the entire surface being black. The cream-colored stripe extends obliquely through the eye and ends on the gena. Brown specimens have a dark stripe on each side extending from the fastigium to the origin of vein  $R_3$ .

PRINCIPAL SPECIMENS (FSCA). — TRINIDAD: 4 G ♂, 2 B ♂, 2 G ♀, Waller Field, nr. Arima, 30 June, 6 July 1966, TJW (incl. UFT 1966-7-H, 1966-12-L, M, N, 1966-13-A, B, C, D, E); 1 B ♂, 1 B ♀, outlet of Nariva Swamp, 1 July 1966, TJW (incl. UFT-7-I, J).

OTHER RECORDS. — ST. VINCENT: (BM) 1 B ♂ (lectotype), Windward side, H.H. Smith, 136. The other three BM St. Vincent syntypes of *saturatus* may be *maxillosus*; the two males have 78 and 93 file teeth. GRENADA: Listed by Griffini (1899) as a type locality. A green female in UMMZ (Lowlands, Aug. 1905, W.E. Broadway) is either *saturatus* or *maxillosus*.

HABITAT. — Roadside weeds, grass in marshy area, dense weeds and tall grass.

***Neoconocephalus spiza* n. sp.**

Fig. 1, 23, 35

We name this species *spiza* (Gr. chirp like that of sparrow) because of its sharply discontinuous call, which resembles that of *saturatus* (Fig. 1, 2). However, *spiza* differs morphologically from *saturatus* in having a blunter fastigium (Fig. 35B, 34B) and fewer teeth in its stridulatory file (Fig. 23). We encountered *spiza* only in Panama and do not know whether populations similar to *spiza* and/or *saturatus* occur in the mainland areas connecting the known ranges of the two species.

MEASUREMENTS. — Total length: 49 (male holotype);  $52 \pm 4$ , 47-61 (10 male paratypes;  $\bar{x} \pm SD$ , range);  $59 \pm 5$ , 50-65 (8 female paratypes). Pronotal length: 7.8;  $8.2 \pm 0.3$ , 7.8-8.5;  $8.3 \pm 0.6$ , 7.3-9.0. Hind femur: 23;  $24 \pm 1$ , 22-25;  $28 \pm 5$ , 22-40. Ovipositor:  $30 \pm 4$ , 22-33. Fastigial length: 1.2;  $1.2 \pm 0.1$ , 1.1-1.4;  $1.4 \pm 0.1$ , 1.2-1.5. Fastigial index: .54; .47 ± .05, .41-.55;  $.49 \pm .05$ , .45-.61.

FILE. — Teeth more widely spaced toward lateral end of file; 2.0-2.3 mm long, 78-96 teeth (Fig. 23).

SONG. — A highly regular to noticeable irregular sequence of short, buzzy chirps. Each chirp ("zit") consists of 6-8 wingstrokes produced at a rate of ca. 150/s. Maximum chirp rate is ca. 3.5/sec. Chirping occurs throughout the day and night. Singing males will temporarily cease when an *affinis*, *punctipes*, or *triops* calls nearby.

COLOR. — Of 44 specimens from Panama, 59% are green and 41% are brown (35 males are 19 G, 16 B; 9 females are 7 G, 2 B). Color pattern is like *saturatus* except that no specimens had the entire frontal surface of the fastigium black.

PRINCIPAL SPECIMENS (FSCA; holotype and paratypes). — PANAMA: 5 G ♂, 3 B ♂, 1 G ♀, 1 B ♀, Gamboa, 22 Oct., 1 Nov., 4 Nov., 14 Dec. 1978, MDG; 1 B ♀, Pedro Miguel, 9 Dec. 1978, M. Clark; 1 G ♀, Frijoles, 9 Dec. 1978, M. Clark; 5 G ♂, 4 B ♂, Curundu, 26 Dec. 1978, 5 Jan. 1979, MDG; 1 G ♂, 1 B ♂, Balboa, 30 Dec. 1978, M. Clark; 3 G ♂, 4 B ♂, 2 G ♀, Balboa, 14, 16 Jan. 1979, MDG; 1 B ♂, Cerro Campana, 1 Jan. 1979, MDG; 1 G ♂ (holotype), Fort Sherman, 10 Dec. 1980, TJW, JJW; 5 G ♂, 3 B ♂, 2 G ♀, Fort Sherman, 9, 10, 13, 14 Dec. 1980, TJW, JJW (incl. UFT 80-35).

HABITAT. — Grasses (0.5-3 m tall) in clearings, fields, and along ditches.

***Neoconocephalus aduncus* (Scudder)**

Fig. 22, 36

*Conocephalus aduncus* Scudder 1879:87. Type locality: Cuba.

This species is known only from Cuba and is easily distinguished from all other *Neoconocephalus* species by its fastigium ending in a decurved, sharp-tipped hook. The tegmina exceed the tips of the hind femora by no more than 8 mm.

MEASUREMENTS. — Total length:  $42 \pm 3$ , 39-45 (4 males;  $\bar{x} \pm SD$ , range) 46 (female). Pronotal length:  $7.6 \pm 0.2$ , 7.4-7.8; 7.0. Hind femur:  $24 \pm 2$ , 22-25; 27. Ovipositor: 25. Fastigial length:  $1.1 \pm 0.1$ , 1.0-1.2; 1.4. Fastigial index:  $.43 \pm .05$ , .37-.47; .43.

FILE. — Teeth more widely spaced toward lateral end of file; 1.4-1.5 mm long; 68-75 teeth (Fig. 22).

SONG. — Unknown.

COLOR. — Of five specimens examined, one male is brown and three males and a female are green. The spine on the fastigium is infuscated and a cream-colored stripe extends on each side from the fastigium obliquely to the eye and ends just beyond. Tegmina with few to numerous inconspicuous dark dots.

SPECIMENS EXAMINED (ANSP). — CUBA: 3 G ♂, 1 B ♂, Havana, 25 Dec. 1920, 12 June 1925, 19 Oct. 1925, J. Cabrera and Baker; 1 G ♀, Santiago, 21 Aug. 1920, M. Hebard.

HABITAT. — The only data on habitat is that one male was labelled, "in low grass."

#### DISCUSSION

Reconstructing zoogeographic and phylogenetic events responsible for the 13 species of Caribbean *Neoconocephalus* and their distributions is made difficult by the scarcity of diagnostic differences among the species and by most differences being so minor that they could easily evolve independently in two or more phyletic lines. Nevertheless, some relationships can be discerned. For example, the allopatric distribution and complex but similar calling songs of *saturatus* and *spiza* indicate that they are sister species. Similarly *pipulus* and *carbonarius* are probably sister species, and the same is likely for *occidentalis* and *retusiformis*. In the latter pair, the evenly spaced file teeth strengthen the likelihood of sisterhood and suggest that *susurrator* is the extant species next most closely related. Finally, *punctipes* and *pinicola* have similar files and songs and are allopatric.

The species that are more difficult to relate to the above groups are *aduncus* (endemic to Cuba, song unknown) and three species that occur throughout the Caribbean: *affinia*, *triops*, and *maxillosus*. These three are the largest Caribbean *Neoconocephalus* and hence likely to be the strongest fliers, in keeping with their pan-Caribbean distributions. The evenly spaced file teeth of *affinis* suggest a phylogenetic closeness to *retusiformis* - *occidentalis* - *susurrator*, whereas the regularly interrupted calling song of *triops* suggests closeness to *saturatus* - *spiza* and *pipulus* - *carbonarius*. *N. maxillosus* shares an uninterrupted song and unevenly spaced file teeth with *punctipes* - *pinicola*.

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