

New Hapithini (Orthoptera: Grylloidea: Podoscirtidae: Hapithinae) from the Lesser Antilles

LAURE DESUTTER-GRANDCOLAS AND ROGER BLAND

(LDG) ESA8043 CNRS, Département Systématique et Evolution, Muséum National d'Histoire naturelle, 45 rue Buffon. F - 75005 Paris FRANCE. Email : desutter@mnhn.fr. (RB) Biology Department, Central Michigan University, Mt. Pleasant, MI 48859 USA

ABSTRACT

Ten new species of Hapithinae crickets are described from the Lesser Antilles: *Hapithus crucencis*, *Orocharis fuscifrons*, *O. albifrons*, *O. proalbifrons*, *Orocharis n. sp. affinis albifrons*, *O. maximus*, *O. angustus*, *O. minutus*, *O. saussurei* and *Orochirus maculatus*. *Hapithus* Uhler, 1864 is recorded here for the first time from the Lesser Antilles. *Orocharis* Uhler, 1864 appears extremely diversified in the West Indies and 4 species groups are defined. *Orochirus* Bolivar, 1888 is characterized as a valid taxon and its synonymy with *Laurepa* Walker, 1869 is invalidated. A key to the genera of Hapithinae is proposed.

The calling songs of *Orocharis proalbifrons*, *O. fulvescens* and *Orochirus maculatus* are described and the stridulatory files of all the species are illustrated. Buzzing calling songs are documented here for the first time in crickets and discussed from a functional point of view.

INTRODUCTION

The tribe Hapithini Gorochoy, 1986 (Podoscirtidae, Hapithinae) is a neotropical clade known by over 50 species (Chopard 1968; Otte 1994) originating mostly from Central and, to a lesser extent, South America (Desutter 1987, 1990). According to present taxonomic knowledge, 18 species are known today from the West Indies, including only 4 from the Lesser Antilles. Observations of unidentified material from the Lesser Antilles revealed that this clade has experienced an unsuspected, wide taxonomic diversification in this area.

Three genera are presently recognized in Hapithini, *Hapithus* Uhler, 1864, *Orocharis* Uhler, 1864 and *Laurepa* Walker, 1869. To these genera we add *Orochirus* Bolivar, 1888, which has been synonymized with *Laurepa* (Kirby 1906); although unargued from the point of view of the characters, this synonymy has been followed by subsequent authors until now (Chopard 1968; Otte 1994).

In the present paper, we describe a new species of *Hapithus* from the Virgin Islands, which extends the known geographic distribution of the genus to the Lesser Antilles. We also describe 8 new species belonging to the genus *Orocharis*; these species are arranged into 4 species groups clearly characterized by their external morphology and by characters of male genitalia and stridulatory file. Finally, we reestablish *Orochirus* as a valid taxon and describe a new species, *O. maculatus*, from St. Eustatius.

Calling songs are documented here for three species, two of which emit buzzing calls. To our knowledge, such calls have never been documented and analyzed for crickets before, even though some have been mentioned for a few North American *Orocharis* species (Walker 1969). They will be briefly discussed

below, together with the probable functioning mechanism of the stridulatory apparatus of the concerned species.

Specimens are deposited in the Academy of Natural Sciences of Philadelphia, PA [ANSP], the Muséum National d'Histoire naturelle, Paris [MNHN], the University of Michigan Museum of Zoology [UMMZ] and the Zoologisk Museum, Copenhagen [ZMC].

In the descriptions, the following measurements are indicated in millimeters (mean value in parentheses): Lpron, length of pronotum; LFIII, length of hindfemora; Lovip, length of ovipositor; LTIII, length of hindtibiae; Lteg, length of tegmina; Lwing, length of wing; wpron(a, p), width of pronotum (anterior, posterior); wteg, width of tegmina at the level of the anterior angle of the mirror. Male genitalia are named according to Desutter (1987); membranous parts are figured with dots. The following abbreviations are used in the figures: do, dorsal cavity; ec a, ectophallic apodeme; ec f, ectophallic fold; EEL, epi-ectophallic invagination; en s, endophallic sclerite; ep, epiphallic sclerite; ep v l, epiphallic ventral lobes; lo, epiphallic lophi; r, rami; sp, spermatheca; sp d, spermathecal duct.

Tegminal venation is named according to Desutter-Grandcolas (2003). The following abbreviations are used in the text: MA, anterior median; MP, posterior median; CuA, anterior cubital; CuP, posterior cubital; A2, A3; second and third anal veins.

Songs have been recorded by one of us (R.B.), with a Radio Shack VSC-2002 voice-activated cassette recorder. Analysis was done with ANA software (Richard 1991) using an Amiga computer at frequencies of 12 and 24 KHz.

Tribe Hapithini

Hapithini Gorochoff, 1986: 521; Desutter 1987: 221; Desutter 1988: 362.

Hapithini present the general characters found in the family Podoscirtidae (Desutter 1988, 1990):

Size medium to large. General shape elongated, most species having well-developed tegmina and wings.

Head.— Small, somewhat flattened above. Ocelli always present, although variously arranged. Last joint of maxillary palpi enlarged apically. Scape never greatly enlarged.

Legs.— Median tarsomeres enlarged and flattened. Hindtibiae serrulated and with at least 5 subapical spurs on each side; apical spurs short, the median the longest on the outer side and the upper one the longest on the inner side; first hindtarsomeres short with few strong dorsal spines.

Male.— When present, stridulum complete; harp with 1 or 2 transverse veins.

Male genitalia.— Endophallic sclerite U-shaped. Endophallic cavity variable in size, located between the endophallic sclerite and the apex of the ectophallic fold. Epi-ectophallic invagination only slightly sclerotized.

Female.— Ovipositor not flattened dorso-ventrally, its apex elongated and not truncated.

Podoscirtidae should not be confounded with Tafaliscinae (Eneopteridae), which can be recognized by their rounded head, the subapical spurs of their hindtibiae (4 or 5, very strong on each side), the female ovipositor (flattened dorso-ventrally, with a truncated apex, except in Diatrypini), the venation of male stridulum when present (harp veins longitudinal) and the male genitalia (endophallic sclerite located at the level of the ectophallic arc, i.e. quite posteriorly; endophallic cavity very small, except in Diatrypini; epi-ectophallic invagination sclerotized laterally, with well-developed apodemes) (Desutter 1988, 1990).

Among Podoscirtidae, Hapithini present the following characters:
Legs. Hindtibiae with 6, occasionally 5 inner, and 8, occasionally 7 outer subapical spurs, most often with two more outer spurs than inner spurs.

Male.—Stridulum always present. In the observed taxa, the file always shows a distinct swelling, which is variable in length and height, and which may bear a few teeth; the diagnostic value of this feature will have to be checked, however, with the observation of podoscirtid taxa other than Hapithini.

Male genitalia.—Symmetrical. Epiphallus characterized by its wide and rounded lophi, an apex prolonged ventrally between the lophi and the lack of distinct epiphallic parameres; ectophallic fold usually very long and pointing well beyond the epiphallic apex; ectophallic apodemes short, often not clearly sclerotized; endophallic sclerite U-shaped but very short, surrounding the base of the dorsal cavity which is subdivided longitudinally into three parts (Desutter 1987, 1988, 1990).

Juvenile characters.— The material at hand includes 2 juvenile specimens (Dutch West Indies, St Eustatius, R. Bland and D. Valek, UMMZ), which present very distinctive coloration. Their general coloration is of a light yellowish green, but their dorsum is distinctly colored. In the youngest specimen, the vertex, the midpart of the dorsal disc of pronotum, and the mesonotum, metanotum and abdomen are reddish brown; the lateral parts of the dorsal disc of the pronotum are yellowish green, the reddish coloration being limited according to a concave and neat line; tergites 2 and 3 bear large whitish parts in their middle, while other tergites bear small whitish spots. The oldest specimen, with small ovipositor and wing pads, shows no marks on the head and pronotum, but its abdomen is still reddish, although less clearly so, with large, diffuse whitish parts, except for a brown tergite I. Such colorations seem quite common in juvenile Hapithinae and give living specimens an ant-like appearance (Desutter-Grandcolas, pers. obs.).

Key to Genera

A key for hapithine genera, without *Orochirus*, was proposed for the first time by Chopard (1956) for the whole neotropical fauna and later restricted to Central America by Nickle (1992). It was based mostly upon the number of foretibia tympana, *Orocharis* being attributed two tympana, *Hapithus* and, erroneously, *Laurepa* only one. Only *Hapithus* possesses one tympanum on the foretibia, and *Orocharis*, *Orochirus* and *Laurepa* have two tympana. A key for Hapithini genera could consequently be modified as follows:

- 1 Foretibiae with one inner tympanum *Hapithus* Uhler
- 1' Foretibiae with 2 tympana 2
- 2 Head, pronotum and legs strongly pubescent. Femora strongly compressed, lamellar. Outer genicular lobes of hindfemora elongated *Orochirus* Bolivar
- 2' Head, pronotum and legs not strongly pubescent. Femora not compressed. Outer genicular lobes of hindfemora not elongated *Orocharis* Uhler, *Laurepa* Walker

In the present state of knowledge, and according to the taxonomic diversity of the genus *Orocharis* as documented below, no definite set of characters can be objectively proposed to separate *Laurepa* and *Orocharis*.

Male genitalia are quite homogenous for the whole tribe and the differences between the taxa are minor.

HAPITHUS Uhler

Hapithus Uhler, 1864: 546

Type species.— *Hapithus agitator* (Uhler, 1864)

Distribution.— Neotropical region.

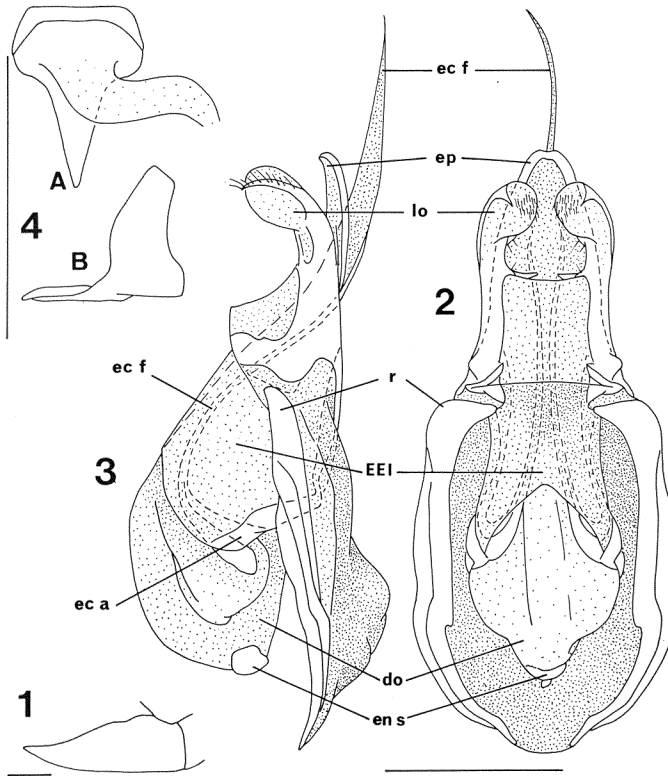
Hapithus species have been recorded in the entire Neotropical region, and especially in Central America and the Greater Antilles. We describe here a new species from the Virgin Islands, which extends the present distribution of the genus to the northern Lesser Antilles.

Hapithus crucencis Desutter-Grandcolas, new species

Figs. 1 - 4, 48, 55,

Diagnosis. Small species originating from the Lesser Antilles (Virgin Islands) and characterized by its color pattern, male subgenital plate (color, shape), male genitalia (lophi largely separated, almost entirely membranous; ectophallic fold very long), male stridulatory file (teeth number and file shape) and female ovipositor length and copulatory papilla.

Male holotype and female allotype.— Virgin islands: Christiansted, St. Croix, XI-1940, on bush (H. A. Beatty) [ANSP].



Figs 1-4. *Hapithus crucencis*. 1, male subgenital plate, right lateral view. 2-3, male genitalia, respectively in dorsal and right lateral view. 4, female copulatory papilla, in dorsal (A) and right lateral view (B). Scales 1 mm.

Description.— Size small. General shape moderately elongate with long tegmina and wings, in both males and females. *Coloration.* Light yellowish brown, at least in dried specimens, with numerous small dark spots: on the face, several small dots aligned along two convergent lines from the episternal suture to under the median ocellus; a dark fleck behind each ocellus; a round dot under the eye, with an additional dark line on the cheek; on the vertex, 4 dots arranged in a row between the posterior margins of the eyes; brown rings on many antennal joints; a dark spot on coxae I and II; many small dots on the lateral lobes and the dorsal disc of the pronotum, except on the pyriform inscriptions, and on all femora and the dorsal sides of tibiae I and II. Cerci light yellowish brown, without brown marks. *Head.* Ocelli large, separated by a distance greater than their own width, and almost arranged in line, the median ocellus slightly ahead of the lateral ones. 5th joint of maxillary palpi longer than the 3rd, their anterior and posterior margins slightly concave; apex slightly enlarged and truncated straight. *Legs.* Hindtibiae abundantly serrulated and with 5 (or 6) outer and 7 inner subapical spurs; their dorsal side large, more or less abundantly mottled with brown, at least at the base of the spurs. Subapical spurs brown apically. *Male.* Metanotum with a large rounded area densely covered with long setae (Fig. 48). Tegmina light yellowish brown; MP thickened and yellow, veins otherwise similar in coloration to the tegmina, but with numerous brown, small dots; a brown fleck on the outer angle of the mirror. Stridulum similar to that of the whole tribe; file quite regular, except for its inner part, which is slightly inflated (Fig. 55); except for 3-4 small teeth over the inflated part of the file, teeth somewhat slanted, regularly distributed over the file and more or less similar in size. Teeth number: 29-34 (mean 32, n = 4). Tergites 8-9 and subgenital plate with a dark median line. Subgenital plate extremely elongate (Fig. 1). *Male genitalia.* Similar to those of the other species of the genus (Desutter 1990). Epiphallus almost entirely membranous, except for narrow bands over the lophi and median process (Figs. 2, 3). Epiphallic lophi with strong setae over their inner border and at their apex. Ectophallic fold very long, well beyond the median process of epiphallus. *Female.* Tegmina coloration similar to that of the male, but CuA and to a lesser extent CuP yellow at their base, CuA somewhat enlarged; at midlength, MA enlarged and yellowish. Subgenital plate dark in the middle. Ovipositor shorter than hindfemora (see the measurements). *Female genitalia.* Copulatory papilla having the form of a sclerotized ring, elongated ventrally (Fig. 4).

Paratypes.— 13 males, 10 females. Virgin Islands: Christiansted, St. Croix (H.A. Beatty), 1 male, X-1940, on bush [ANSP]; 1 male, XI-1940, on tree [ANSP]; 1 male, XI-1940, on bush [ANSP]; 2 males, 2 females, 1940 [ANSP]; 2 males, XII-1940, on bush [ANSP]; 1 female, XII-1940, on grass [ANSP]; 3 males, 1 female, on grass, IV-1941 [ANSP]; 2 females, I-1941, on bush [ANSP]; 1 female, I-1941, ex pasture [ANSP]; 2 males, X-1940, on bush [MNHN]; 1 female, XI-1940, on bush [MNHN]; 1 female, XII-1940, on bush [MNHN]; 1 male, 1 female, on grass, IV-1941 [MNHN].

Measurements.— Males (n = 4). Lpron: 2.5 - 2.6 (2.6); LFIII: 10.5 - 11.1 (10.8); LTIII: 10.6 - 11.2 (11); Ltég: 12.9 - 13.5 (13.2); Lwing: 13.3 - 15.6 (15); wpron: 3.6 - 3.9 (3.7); wteg: 3.9 - 4.1 (4). Females (n = 4). Lpron: 2.8 - 2.9 (2.9); LFIII: 11.6 - 11.8 (11.7); LTIII: 11.1 - 11.9 (11.5); Lovip: 9.8 - 10.6 (10.2); Ltég: 14.1 - 15.1 (14.6); Lwing: 15.8 - 16.9 (16.4); wpron: 3.6 - 4 (3.8).

Etymology.— Species named after its geographical origin.

OROCHARIS Uhler, 1864

Orocharis Uhler, 1864: 544.

Type species.— *Orocharis saltator* Uhler, 1864

Distribution.— Neotropical region. Presently, 5 *Orocharis* species are recognized in the Greater Antilles and 4 have been described from the Lesser Antilles: *O. antillarum* Saussure, 1874 (Guadeloupe), *O. fulvescens* Saussure, 1878 (St. Martin), *O. saulcyi* Guérin-Méneville, 1844 (Martinique) and *O. unicolor* (Olivier, 1791) (Guadeloupe) (Chopard 1968; Otte 1994). Among the material examined in the present paper from the Lesser Antilles, 11 different species have been separated belonging to 4 distinctive species groups each characterized chiefly by their coloration, body shape and male genitalia and stridulum. Only *O. unicolor* cannot be incorporated into these species groups because Olivier's original description is, unfortunately, too brief.

Species of *Orocharis* from the Lesser Antilles

fuscifrons group

fuscifrons Desutter-Grandcolas, new species

albifrons Desutter-Grandcolas, new species

proalbifrons Desutter-Grandcolas, new species

Orocharis n. sp. affinis *albifrons* Desutter-Grandcolas, new species

antillarum Saussure, 1874 (?)

fulvescens group

fulvescens Saussure, 1878

maximus Desutter-Grandcolas, new species

saulcyi (Guérin-Méneville, 1844)

angustus group

angustus Desutter-Grandcolas, new species

minutus Desutter-Grandcolas, new species

saussurei group

saussurei Desutter-Grandcolas, new species

Fuscifrons group

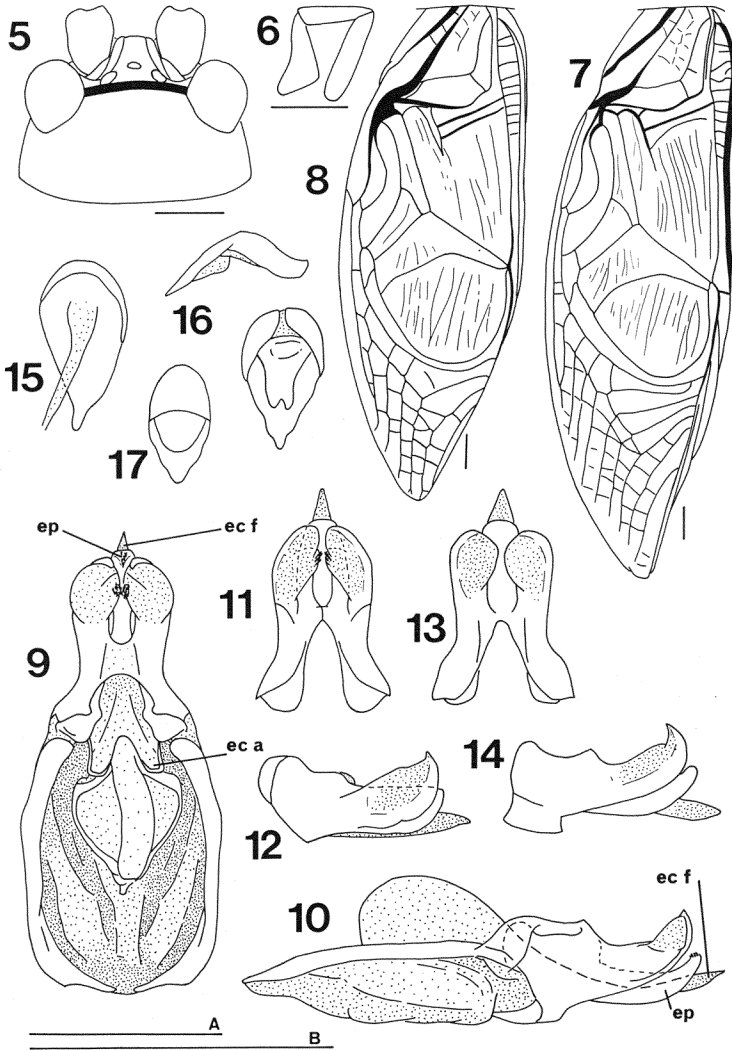
This species group includes *O. fuscifrons*, *O. albifrons*, *O. proalbifrons*, *Orocharis* n. sp. *affinis albifrons* and perhaps *O. antillarum*. All these species are small, with enlarged tegmina in males. Ocelli are arranged in a triangle (Fig. 5). Their general coloration is green in living specimens, turning yellow or light brown in dried specimens, with few distinctive markings; the legs are yellow or very light brown, and the subapical spurs and spines of hindtibiae are yellow with a black apex. Metanotum is glandular in males (Fig. 49). Male tegmina have a very thick MP, yellow over the whole length of the intermediate area; the mirror is larger than long, contrary to the other species groups; the stridulatory file has a long straight part, the first teeth being located on a very small swelling (Fig. 56). In male genitalia, the epiphallic lophi are small and vertical, the median process of the epiphallus without ventral lobes, the ectophallic fold long and narrow and the ectophallic apodemes very short and globular.

Orocharis fuscifrons Desutter-Grandcolas, new species

Figs. 5-7, 9, 10, 15, 56

Diagnosis. In the *fuscifrons* species group, species characterized by the coloration of its head, male (shape of epiphallic lophi) and female genitalia (copulatory papilla), and stridulatory file (less than 100 teeth).

Holotype.— Male. Guadeloupe: Trois Rivières (D. Vitrac), Finot collection, labeled *Paroecanthus*, sp. *nova* near *tibialis* Saussure [MNHN]. *Allotype.* Female. Guadeloupe: Saut de la Lezarde, VII-21-22-1999 (S. Hugel) [MNHN].



Figs 5-17. *Orocharis. Fuscifrons* species group. 5, head, *fuscifrons*, dorsal view. 6, last joints of maxillary palpi, *fuscifrons*. 7-8: male right tegmen. 7, *fuscifrons*. 8, *albifrons*. 9-14: male genitalia, dorsal and right lateral views, scale A. 9-10, *fuscifrons*. 11-12, *albifrons*. 13-14, *proalbifrons*. 15-17: female copulatory papilla, scale B. 15, *fuscifrons*, dorsal view. 16, *albifrons*, dorsal (A) and right lateral (B) views. 17, *Orocharis* n. sp. affinis *albifrons*. Scales 1 mm.

Description.— Size medium for the genus. Tegmina enlarged in both sexes at midlength and shorter than the wings. **Head.** Small and rounded, the eyes small and somewhat protruding. Ocelli quite large, arranged in a low triangle, the distance between the lateral ocelli being larger than the distance between one lateral and the median ocelli (Fig. 5). Fastigium large with raised margins. 5th joint of maxillary palpi as long as the 3rd and regularly enlarged toward the apex (Fig.

6). Behind the lateral ocelli, a transverse brown line extending between the eyes. Eyes reddish. *Pronotum*. Wider than long. Posterior margin of dorsal disc bisinuated. *Legs*. Tibiae I inflated at the level of the two large, ovoid tympana. Legs yellow, without any colored mark. *Male*. Tegmina quite long, the apical field elongate (Fig. 7). File with 86 teeth ($n = 1$) (Fig. 56). Metanotal gland similar to that of *O. albifrons* (cf. *infra*). *Male genitalia*. Lophi quite thin in lateral view, their apex small (Figs. 9, 10). *Female*. Tegmina: MA bordered with yellow, CuA brown on its second quarter. Ovipositor smaller than hindfemora, its apex rounded and small, with 4 large teeth dorsally. Posterior margin of subgenital plate deeply indented. *Female genitalia*. Copulatory papilla having the shape of a very narrow ring, elongated backwards and slightly convex dorsally (Fig. 15).

Paratype.— 1 male. Guadeloupe: Mission Antilles, route forestière de Grosse Montagne, IV-20-1979 (J.J. Menier) 1 male [MNHN].

Measurements.— Males ($n = 2$). Lpron: 2.1 - 2.2; LFIII: 10.3 - 10.9; LTIII: 9.8 - 10.2; Lteg: 16.3 - 16.7; wpron: 4 - 4.2; wteg: 5 ($n = 1$). Female ($n = 1$). Lpron: 2.6; LFIII: 11.3; LTIII: 11.4; Lovip: 10.7; Lteg: 19.9; wpron: 4.3.

Etymology.— Species named after its head coloration.

Variation.— In dried specimens, fastigium somewhat whitish. Inner side of hindfemora sometimes with a large brownish band.

Orocharis albifrons Desutter-Grandcolas, new species

Figs. 8, 11, 12, 16, 49

Diagnosis.— Species very close to *O. fuscifrons*, from which it can be separated by its coloration and size, male tegminal venation and stridulatory file, and male and female genitalia.

Holotype.— Male. Virgin Islands: St. Croix, Christiansted, "on bush", VII-14-1941 (H.A. Beatty) [ANSP]. *Allotype*. Female. Virgin islands: St. Croix, Christiansted, "on bush", XII-1940 (H.A. Beatty) [ANSP].

Description.— Species smaller than *O. fuscifrons* (compare the measurements). *Head*. Eyes separated by a transverse, ivory colored line, located at the level of the lateral ocelli, replacing the brown line of *O. fuscifrons*. *Male*. Metanotal gland well developed (Fig. 49). Tegminal venation similar to that of *O. fuscifrons*, except for its shorter apical field (Fig. 8) and longer stridulatory file (teeth number: 124 - 132, $n = 2$). *Male genitalia*. Epiphallic lophi thicker than those of *O. fuscifrons*, their apex more distinctly spine-like (Figs. 11, 12). *Female genitalia*. Copulatory papilla shorter and more strongly convex dorsally than that of *O. fuscifrons* (Fig. 16)

Paratypes.— 2 males. Virgin Islands: St. Croix, Christiansted, I-1941 (H.A. Beatty) 1 male [MNHN]. St. Thomas: III-31-1912 (Ujhelyi) 1 male [MNHN].

Measurements.— Males ($n = 3$). Lpron: 2; LFIII: 9.7 - 10 (9.8); LTIII: 9.6; Lteg: 13.8 - 14.8 (14.3); wpron: 3.5 - 4 (3.8); wteg: 4.7- 4.9 (4.8). Female ($n = 1$). Lpron: 2.3; LFIII: 11.2; LTIII: 11; Lovip: 9.1; Lteg: 16; wpron: 4.4.

Etymology.— Species named after the ivory band located between the eyes just behind the lateral ocelli.

Orocharis proalbifrons Desutter-Grandcolas, new species

Figs. 13, 14, 61, Table 1

Diagnosis. Species very similar to *O. albifrons*, from which it can be distinguished by its stridulatory file and male genitalia.

Holotype.— Male. Dutch West Indies, St. Eustatius: 1 km W. Fort de Windt, VIII-16-1999 (R. Bland and D. Valek) [MNHN].

Description.— Size and coloration similar to that of *O. albifrons*, including the head. *Male*. Metanotal glands similar to that of *O. fuscifrons* and *O. albifrons*. Stridulatory file with distinctively more teeth (163-167, $n = 2$) than *O. fuscifrons* and *O. albifrons*. *Male genitalia*. Epiphallic lophi with a pronounced angle on its outer

margin distad and having the shape of a large spine apically (Figs. 13, 14). *Female*. Unknown.

Paratypes.—4 males. Dutch West Indies, St. Eustatius: 1.5 km W. Fort de Windt, VIII-17-1999 (R. Bland and D. Valek) 2 males [UMMZ, MNHN]; 1.5 km W. Fort de Windt, III-10-1998 (R. Bland) 2 males [UMMZ, MNHN].

Etymology.—Species named after its similarity to *O. albifrons*.

Measurements.—Males (n = 3). Lpron: 2.1; LFIII: 9.8 - 9.9 (9.8); LTIII: 9.5 - 9.8 (9.7); Lteg: 14.5 - 15.2 (14.8); wpron: 4.1 - 4.2 (4.1); wteg: 4.9 - 5.2 (5).

Habitat.—*O. proalbifrons* is a common species, that occurs in subtropical dry forest scrub; on low forbs in dry, grassy fields, grass 0.3-0.6 meters tall; on Croton (large-leaf shrub) and other shrubs at height of 1.5-3 meters (R. Bland, pers. obs.).

Calling song.—The calling song of *O. proalbifrons* is made of high-pitched trills of irregular duration (Fig. 61, Table 1). Short trills with a mean duration of 468 ms and comprising a mean number of 13 pulses prevail in the songs at hand. At irregular intervals, a long trill is emitted, which may last more than 3 s and comprise a mean number of 84 pulses. Within short trills, the pulse duration is about 22 ms and that of the interpulse 17 ms; these values are slightly higher in long trills (Table 1). The maximal sound energy is emitted over quite a large frequency band, the mean values of which are comprised between about 6000 and 7100 Hz at - 38 dB, without significant differences between short and long trills (Table 1).

Orocharis n. sp. affinis albifrons Desutter-Grandcolas, new species

Fig. 17

Diagnosis. We distinguish here a unique female which presents a distinctive coloration pattern (a small brown dot between each antennal pit and the transverse white line at the level of the lateral ocelli similar to that of *O. albifrons*) and copulatory papilla (apex much larger than in the above species, Fig. 17).

Specimen examined.—1 female. PUERTO RICO: Mona island, IV-17-23-1954 (J. Maldonado Capriles) [ANSP].

Measurements.—Female (n = 1). Lpron: 2.3; LFIII: 10.4; LTIII: 10.4; Lovip: 9.5; Lteg: 15.6; wpron: 4.

Fulvescens group

The *fulvescens* species group includes *O. fulvescens*, *O. maximus* and perhaps *O. saulcyi*. These are species of moderate to very large size, with large ocelli arranged in a curved line, not in a triangle (Fig. 18). Their general coloration is light brown, the lateral margins of the tegmina being bordered with yellow and the veins diversely, but always scarcely mottled with brown. Males seem to lack metanotal glandular structures (Figs. 50, 51). The male stridulatory file is very small and has very few teeth, which are located first on a very large swelling and then on a small narrow portion of the stridulatory vein (Fig. 57). The male genitalia are larger than in the *fuscifrons* group; the median process of the epiphallallic sclerite presents a pair of sclerotized ventral lobes surrounding the ectophallic fold; the ectophallic fold is shorter or equal in length to the median process of the epiphallus; and the ectophallic apodemes are long and well sclerotized, exceeding in length the endophallic cavity.

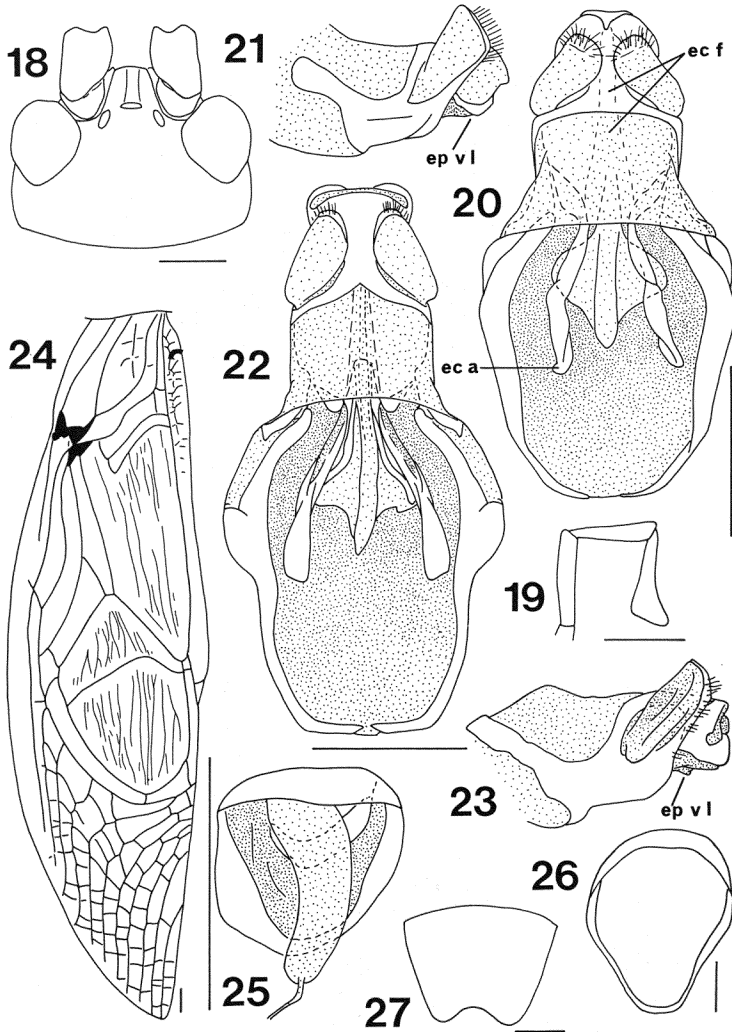
Orocharis fulvescens Saussure, 1878

Figs. 18 - 21, 50, 62, Tables 2, 3

Orocharis fulvescens Saussure, 1878: 612.

Diagnosis.—In the *fulvescens* group of species, species characterized by its size, pronotal shape and male genitalia.

Description.—Size large; face lighter brown than the rest of the body and with



Figs 18-27. *Orocharis. Fulvescens* species group. 18, head, *fulvescens*, dorsal view. 19, last joints of maxillary palpi, *fulvescens*. 20-23: male genitalia, dorsal and right lateral views. 20-21, *fulvescens*. 22-23, *maximus*. 24, male right tegmen, *maximus*. 25-26: female copulatory papilla, dorsal view. 25, *maximus*. 26, *saulcyi*. 27, female subgenital plate, *saulcyi*. Scales 1 mm.

a light yellow line between each lateral ocellus and the eye, this line bordered with dark brown and prolonged toward the median ocellus. Last joint of maxillary palpi somewhat smaller than the third and enlarged toward the apex, which is truncated straight (Fig. 19). *Legs*. Hindtibiae with 8 inner and 6 outer subapical spurs (Saussure's description mentions 9 inner subapical spurs in the type specimen). *Male*. Venation similar to that of the species of the *fuscifrons* group. File located on the straight part of the stridulatory vein and comprising 6 small teeth located on the vein swelling and 19 larger and slanted teeth thereafter, of which the

first 8 ones are larger and the 11 following ones are smaller. Metanotum with two indistinct areas of longer setae, but no clearly glandular zone (Fig. 50). *Male genitalia*. Epiphallic sclerite only partly sclerotized (Fig. 21); lophi as in figure 20. *Female*. Subgenital plate similar in shape to that of *O. saulcyi* (see *infra* and Fig. 27), but its size somewhat larger. *Female genitalia*. Copulatory papilla ring-like, its sclerotized part larger than in *O. saulcyi* and of more regular width than in *O. maximus*. Spermathecal duct very short, its base greatly enlarged.

Specimens examined.— 8 males, 2 females. Dutch West Indies, St. Eustatius: new trail to Quill crater, III-12-1998 (R. Bland) 1 male (UMMZ); III-13-1998 (R. Bland) 1 male (MNHN); 200 m above trail head to Quill, VIII-18-1999 (R. Bland and D. Valek), 1 male (UMMZ). DUTCH WEST INDIES, SABA: Windwardside, The Level, VIII-11-1999, (R. Bland and D. Valek) 2 males [UMMZ], 2 males, 1 female [MNHN]; Cottage Club, VIII-13-1999 (R. Bland and D. Valek), 1 male [UMMZ].

Measurements.— Males (n = 2). Lpron: 3.5; LFIII: 13.8 - 13.9; LTIII: 13.4; Lteg: 19.9 - 20.3; wpron: 4.8 - 4.9; wteg: 5.5 (n = 1). Female (n = 1). Lpron: 3.5; LFIII: 15.1; LTIII: 14.4; Lovip: 13.8; Lteg: 21.2; wpron: 4.8.

Habitat.— *O. fulvescens* is a common species, which occurs on tall shrubs at heights of 2-5 meters, and has been observed feeding on flowers (R. Bland, pers. obs.).

Calling song.— The song of *O. fulvescens* is a buzzing call, made by the regular repetition of short buzzes (Fig. 62). Each buzz has a mean duration of 173 ms and two successive buzzes are separated by a mean duration of 1026 ms (Table 2). Contrary to most cricket calls, there is no unique dominant frequency: the energy of the emitted sounds is distributed over a large frequency band, with several frequency peaks (Fig. 62 and Table 3). The mean frequency band is about 3600 - 5400 Hz at -38 dB, the mean frequency peaks being distributed every 200 Hz in this interval.

Orocharis maximus Desutter-Grandcolas, new species

Figs. 22 - 25, 51, 57

Diagnosis. Among the *fulvescens* species group, this species can be recognized by its unusually large size (see the measurements), and its male genitalia and stridulatory file.

Holotype.— Male. Guadeloupe: Basse Terre, Commune de Saint-Claude, road D11, "Maison du Volcan", VII-23-2000 (S. Hugel) [MNHN]. *Allotype*. Female. Basse Terre, Commune de Saint-Claude, road D11, "Maison du Volcan", VII-26-2000 (S. Hugel) [MNHN].

Description.— Species of very large size. Coloration entirely ochre brown; legs I and II mottled with brown; subapical spurs of hindtibiae brown at their base and apex. *Male*. Metanotum without glandular structure (Fig. 51). Tegmina: right tegmen with a relatively narrow inner border and a very long apical field (Fig. 24); file with a very large swelling devoid of teeth followed by 23 slanted teeth (Fig. 57). Tegminal coloration: MP largely bordered with yellow (with sometimes several indistinct small, brown spots), a yellow spot at the left of the file, where A2 and A3 meet, and a brown spot at the right angle of the mirror. *Male genitalia*. Epiphallic sclerite elongated, the lophi not closely set (Figs. 22, 23). *Female*. Tegmina: MA yellow and black over the posterior two third of its length. Apex of ovipositor valves ornamented ventrally only. *Female genitalia*. Copulatory papilla having the shape of a low, irregular ring (Fig. 25). Spermathecal duct greatly enlarged at its base.

Paratypes.— 2 males. Guadeloupe: Basse Terre, Commune de Vernou, "Saut de la Lezarde", VII-28-2000 (S. Hugel) 1 male [MNHN]; Basse Terre, road D23, between Vernou and Mahaut, "Maison de la forêt", VII-18-2000 (S. Hugel) 1 male [MNHN].

Other specimens examined.— (2 males. Guadeloupe: Basse Terre, Commune de Vernou, "Saut de la Lézarde", VII-28-2000 (S. Hugel) 1 male [MNHN]; Basse Terre, Fort de Ste Marie, VI-15-30-1977 (A. Villiers) 1 male [MNHN].

Measurements.— Males (n = 3). Lpron: 4.2-4.9 (4.6); LFIII: 20.2 - 20.9 (n = 2); LTIII: 18.4 - 21.4 (20); Lteg: 27.5 - 30.4 (29); Lwing: 35.2 - 38 (36.9); wpron: 6-6.6 (6.4); wteg: 6.9 - 7.7 (7.4). Female (n = 1). Lpron: 4.5; LFIII: 17.9; LTIII: 17; Lovip: 22.2; Lteg: 27.5; Lwing: 33.7; wpron: 5.8.

Etymology.— Species named after its size, which is very large for the genus.

Orocharis saulcyi (Guérin-Ménéville, 1844)

Figs. 26, 27

Platydactylus saulcyi Guérin-Ménéville, 1844: 330

Orocharis saulcyi Saussure, 1874: 498.

Diagnosis.— In the *fulvescens* group, species characterized by its smaller size and the shape of the female copulatory papilla. Male unknown.

Description.— The examined female fits the description by Guérin-Ménéville for size, general body shape, coloration, ocelli size and shape, and locality. The following are additions to Guérin-Ménéville's characters: hindtibiae with 8 outer and 6 inner subapical spurs, their apex dark brown, with a subapical light yellow spot. Subgenital plate apical margin deeply concave (Fig. 27). Ovipositor straight, except for the ventrally bent apex; dorsal valves with strong teeth on their ventral side. *Female genitalia*. Copulatory papilla having the shape of a small, low and rounded ring, slightly elongated anteriorly (Fig. 26).

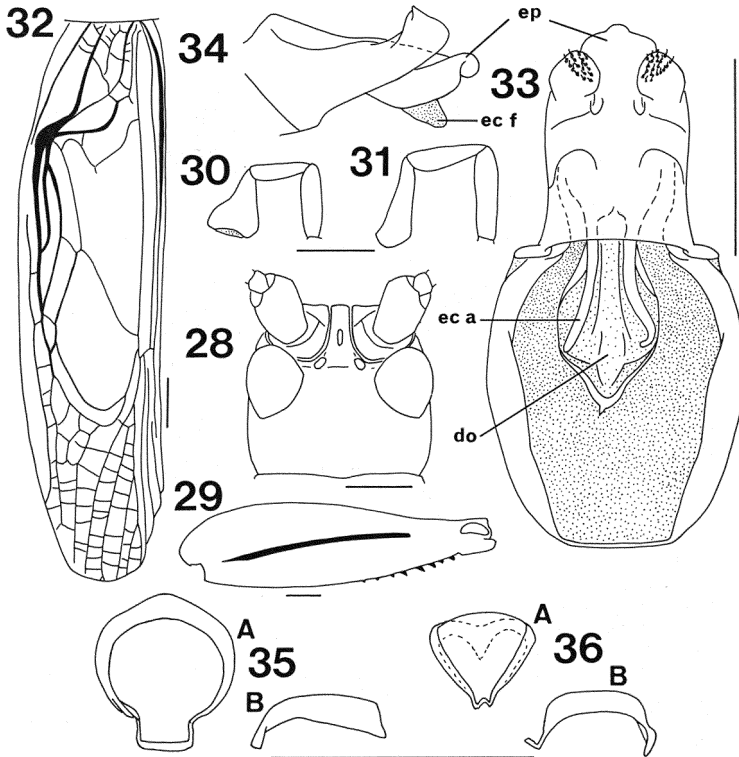
Specimen examined. 1 female. Martinique: VII-1932 (L. Berland) [MNHN].

Measurements.— Lpron: 2.9; LFIII: 12.2; LTIII: 11.8; Lteg: 16.6; Lovip: 11.

Discussion.— Saussure (1874) completed Guérin-Ménéville's original description, but based his observations upon additional material originating from Cuba. Saussure's specimens differ from the female examined here by their contiguous ocelli and by the relative length of their hindfemora and ovipositor. We could not examine these Cuban specimens, and owing to the high diversification of Hapithini in the West Indies it cannot be ascertained that they actually belong to the same species as the material from Martinique.

Angustus group

The *angustus* species group includes *O. angustus* and *O. minutus*. Compared to species of other species groups, these are small species with very narrow tegmina, even in males. Their ocelli are of moderate size and arranged in a large triangle (Fig. 28). The pronotum is only slightly longer than wide, and only slightly enlarged backwards, thus having an almost hemi-cylindrical appearance. Body coloration is very light yellowish brown, distinctly shining and with distinctive brown lines behind the eyes and along the lateral margin of the pronotum on one hand, and along the hindfemora on the other. Hindfemora have a row of spines along their ventral, outer carina (Fig. 29). Males have large metanotal glands, at least in *O. angustus* (Fig. 52). Male tegmina lack very distinctive yellow lines along the outer margins; the stridulatory vein looks twisted before the file (Fig. 58) and presents a small swelling with a few tiny teeth, and a long straight part with more numerous teeth (Fig. 58). Male genitalia are wide, with thick lophi; the median process of the epiphallus is also wide, and without distinct ventral lobes; the ectophallic fold is short and large, well shorter than the epiphallus, and the ectophallic apodemes longer than in the *fuscifrons* group and well-sclerotized, but well shorter than in the *fulvescens* group.



Figs 28-36. *Orocharis. Angustus* species group. 28, head, *angustus*, dorsal view. 29, hindfemora, *angustus*. 30-31: last joints of maxillary palpi, *angustus*. 30, male. 31, female. 32, male right tegmen, *angustus*. 33-34, male genitalia, dorsal and right lateral views, *angustus*. 35-36: female copulatory papilla, dorsal (A) and right lateral (B) views. 35, *angustus*. 36, *minutus*. Scales 1 mm.

Orocharis angustus Desutter-Grandcolas, new species

Figs. 28 - 35, 52, 58

Diagnosis.— In the *angustus* species group, species characterized by its larger size, and its male and female genitalia.

Holotype.— Male. DUTCH WEST INDIES, St. Eustatius: New trail to Quill crater, III-13-1998 (R. Bland) [MNHN]. Allotype. Female. St. Eustatius: 200 m above trail head to Quill, VIII-20-1999 (R. Bland and D. Valek) [MNHN].

Description.— Head flat above, even at the level of the ocelli and fastigium. Last joint of maxillary palpi short and very large in male (Fig. 30), longer and narrower in female (Fig. 31). Head very light brown, somewhat darker above. Antennae quite thick, light brown. *Pronotum*. Dorsal disc light brown with large pyriform inscriptions of a lighter color, and a distinct transverse furrow along the posterior margin. Lateral lobes very light yellowish brown with many brown dots and a brown line along their upper margin. *Legs*. Quite short and stout, especially the tibiae, their coloration almost uniformly of a very light yellowish brown. Foretibiae higher than wide in section, and with two large, oval tympana, the foretibia upper surface large and furrowed on part of its length. Hindtibiae much shorter than the

hindfemora (see measurements); their upper surface large and entirely furrowed, bearing 9 inner and 6 outer subapical spurs, in addition to a few strong spines. **Abdomen.** Tergites 7-9 and supra-anal plate blackish brown, the sternites and the other tergites yellowish brown and more or less mottled with brown. **Male.** Metanotal gland large and complex (Fig. 52). Tegmina (Fig. 32) characterized by a unique harp vein (instead of the usual two), a longer than wide mirror, a very long apical field with numerous and regular veins and a slightly developed inner border. Subgenital plate elongate and quite flat. **Male genitalia.** As in figures 33, 34. **Female.** Tegmina with numerous, strong, parallel longitudinal veins, separated by numerous and regular transverse veins. Subgenital plate wider than long, its posterior margin concave. **Female genitalia.** Copulatory papilla small, having the shape of a low slightly concave ring somewhat elongated distad and cephalad (Fig. 35).

Paratype.— 1 female. DUTCH WEST INDIES, St. Eustatius: New trail to Quill crater, III-11-1998 (R. Bland) [MNHN].

Measurements.— Male (n = 1). Lpron: 2.6; LFIII: 9.3; LTIII: 7.6; Lteg: 11.1; Lwing: 14.4; wpron: 3; wteg: 2.7. Females (n = 2). Lpron: 3 - 3.2; LFIII: 11.6 - 12.1; LTIII: 10 - 10.7; Lovip: 12.2 - 13.9; Lteg: 13.9 - 15.7; Lwing: 17.1 - 19.5; wpron: 3.6 - 3.7.

Etymology.— Species named after its very narrow body shape.

Habitat.— *O. angustus* occurs on large-leaf shrubs at a height of about 2 meters (R. Bland, pers. obs.).

Orocharis minutus Desutter-Grandcolas, new species

Fig. 36

Diagnosis.— In the *angustus* group, *O. minutus* differs from *O. angustus* by its smaller size (see the measurements), its paler, distinctly more whitish coloration, its relatively long ovipositor (well longer than the hindfemora) and by its copulatory papilla (Fig. 36).

Holotype.— Female. DUTCH WEST INDIES, St. Eustatius: 1 km W. Fort de Windt, III-9-1998 (R. Bland) [MNHN].

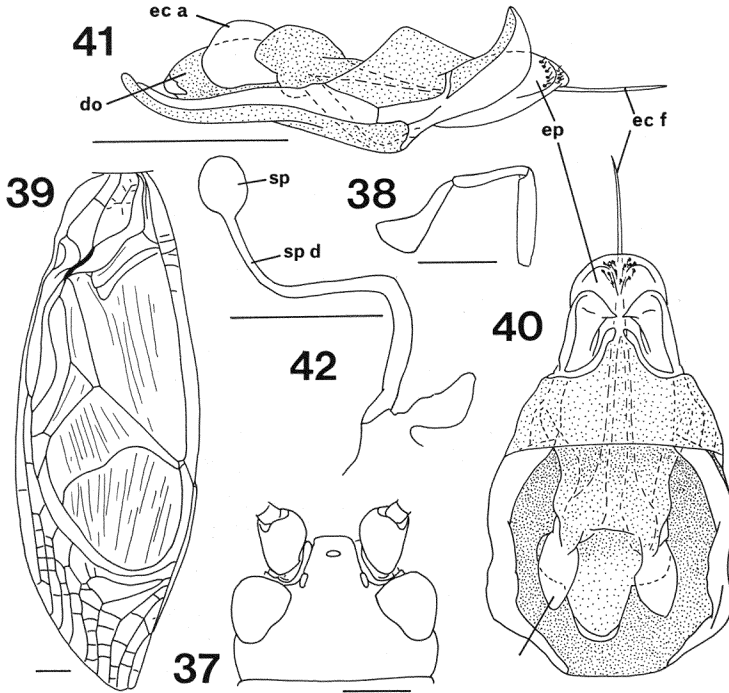
Measurements.— Female (n = 1). Lpron: 2.8; LFIII: 10.4; LTIII: 9; Lovip: 12; Lteg: 12.8; Lwing: 15.8; wpron: 3.2.

Etymology.— Species named after its small size.

Habitat.— The female was collected in the dry scrub zone on tall shrubs (Barbados cherry, *Malpighia emarginata* Sessé & Moc. ex DC), at a height of 3 m (R. Bland, pers. obs.).

Saussurei group

The *saussurei* group includes only *O. saussurei*. Compared to the species of other species groups, *O. saussurei* is a small, non-shining species with slightly enlarged tegmina. Its ocelli are moderately large and arranged in a very large triangle (Fig. 37). Its pronotum is distinctively narrowed cephalad, toward the small head. Its coloration is quite dark dorsally, compared to that of the other species groups, but very light ventrally, and the pronotum and tegmina have a large, yellow band along their lateral margins. Males have a glandular metanotum (Fig. 53). The stridulatory file is not as modified as in the other species groups, the swelling being much longer than high and not interrupting the file distribution; along the file, the teeth are variable in size, orientation and distribution (Fig. 59). In male genitalia, the epiphallus is broad and long, triangular in shape, with long and wide lophi and a broad, rounded median process; the ectophallic fold is very long and thin and the ectophallic apodemes very wide, but short. The endophallic cavity is low, with a large median lobe.



Figs 37-42. *Orocharis saussurei* species group, *O. saussurei*. 37, head, dorsal view. 38, last joints of maxillary palpi. 39, male right tegmen. 40-41, male genitalia, dorsal and right lateral views. 42, female genitalia. Scales 0.5 mm for Fig. 42, otherwise 1 mm.

Orocharis saussurei Desutter-Grandcolas, new species

Figs. 37 - 42, 53, 59

Diagnosis.— As only one species is presently known in the *saussurei* group, the diagnosis characters of the species are those of the species group.

Holotype.— Male. Martinique: Trace des Jésuites, VIII-5-1999 (S. Hugel) [MNHN]. **Allotype.** Female. Martinique: Trace des Jésuites, VIII-5-1999 (S. Hugel) [MNHN].

Description.— **Head and pronotum.** Fastigium very large, concave before the median ocellus and at the level of the ocellar triangle; a black transverse line before the median ocellus. Maxillary palpi: 5th joint almost as long as the 3rd, greatly enlarged only in its apical third (Fig. 38). Pronotum greatly narrowed cephalad (see measurements). Head and pronotum light brown dorsally, mottled with dark brown; face, cheeks and lateral lobes of pronotum whitish. Scapes whitish, with a black spot on their inner sides. Antennae light brown with numerous, small brown articles regularly set along their whole length. **Legs.** Foretibiae with two large, ovoid tympana. Fore and middle tibiae not furrowed dorsally. Hindtibiae furrowed and abundantly serrated dorsally along their whole length, and with 7 outer and 5 inner subapical spurs. Legs very light brown, almost whitish, mottled with brown; knees blackish brown. **Male.** Metanotum with 2 small, closely-set areas of moderately long dense setae (Fig. 53). Tegmina slightly enlarged at the

level of the mirror (Fig. 39). Stridulatory file running along the entire straight part of the stridulatory vein, including the vein swelling which is much longer than high; file comprising 23 teeth of variable size, orientation and distribution (Fig. 59). *Male genitalia*. Epiphallus long and large at its base, triangular, its median process large and rounded; lophi long and large (Figs. 40, 41). Ectophallic fold very long and thin, going well beyond the posterior margin of the epiphallus. Ectophallic apodemes wide and quite short, their apex not going beyond the endophallic cavity. Endophallic cavity small, clearly trilobed, its median lobe the biggest. *Female*. Subgenital plate missing in the only specimen available. Ovipositor small, well shorter than the hindfemora. *Female genitalia*. No differentiated copulatory papilla; spermathecal duct very short, slightly enlarged at its base and leading to a small, membranous pouch (Fig. 42).

Measurements.— Males (n = 2). Lpron: 2-2.5; LFIII: 11.3 - 11.4; LTIII: 11 - 11.1; Lteg: 12.4 - 13.5; Lwing: 15.7 - 16.4; wprona: 2.2; wpronp: 3.2 - 3.3; wteg: 4.8 - 4.9. Female (n = 1). Lpron: 2.8; LFIII: 12.8; LTIII: 13; Lovip: 10.8; Lteg: 16.6; Lwing: 20; wprona: 2.6; wpronp: 3.7; wteg: 4.1.

Etymology.— Species dedicated to the great orthopterist Henri de Saussure (1829-1905).

OROCHIRUS Bolivar, 1888

Orochirus Bolivar, 1888: 47.

Type species.— *Orochirus krugi* (Saussure, 1878), as designated by Saussure (1897: 279)

This genus has been synonymized with *Laurepa* Walker, 1869 by Kirby (1906). Both taxa are, however, clearly distinct: the type species of *Laurepa*, *L. valida* Walker, 1869, is described as “testaceous, shining”, and one of the characters given for the genus is the presence of 4 inner and 7 outer subapical spurs on hindtibiae. According to Saussure (1897), *Orochirus* is characterized by “the surface of the head, pronotum and legs somewhat wrinkled and strongly pubescent (not even and shiny, as in *Apithes* [= *Hapithus*] and *Orocharis*)... The femora and the intermediate tibiae are so much compressed as to be nearly lamellar; the posterior femora are not clubbed at the base. . . . The elytra are elongated: . . . in the males produced in a long apical field, and with a rhomboidal speculum, which is narrower and more elongate than in *Apithes* [= *Hapithus*] and *Orocharis*. The males are somewhat depressed. These insects are generally of a grey colour, with black dots and stains.”. Bolivar (1888) also noticed that *Orochirus* species have carinated foretibiae and that their outer genicular lobe of forefemora is much elongated.

Chopard (1912) described *Laurepa maroniensis* from French Guiana and compared it to the species then classified in *Orochirus*. According to the structure of its male genitalia, however, *L. maroniensis* clearly belongs to another taxonomic entity than the species described in *Orochirus* by Saussure and Bolivar, although their general appearance is quite similar (Desutter 1990).

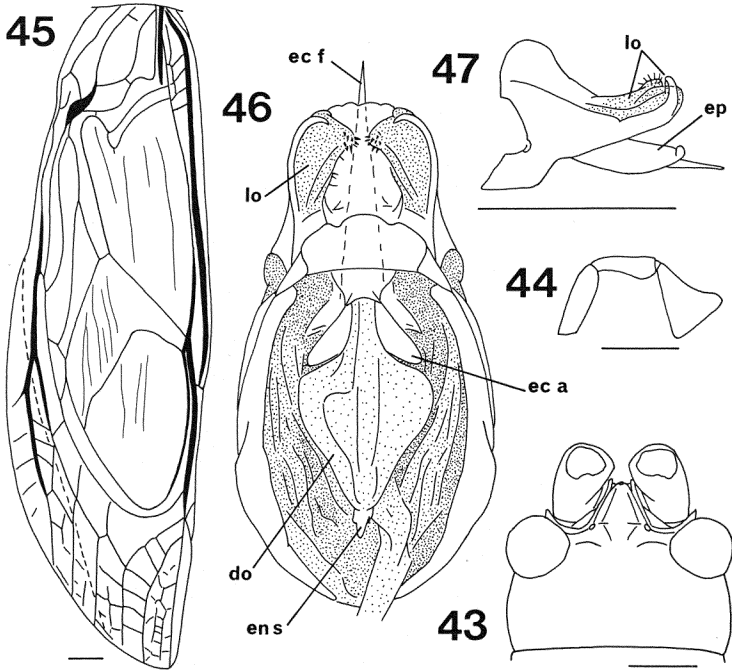
According to Bolivar (1888) and Saussure (1897), the following species belong to *Orochirus*: *O. krugi* (Saussure, 1878) and *O. pilosus* Bolivar, 1888 from Cuba, *O. corrugatus* Saussure, 1897 described from Mexico and Panama (types not examined) and *O. musicus* Saussure, 1897 from Panama. We describe here one species from the Lesser Antilles, *O. maculatus* n. sp., characterize for the first time the male genitalia of the genus and greatly extend its geographical distribution.

***Orochirus maculatus* Desutter-Grandcolas and Bland, new species**

Figs. 43 - 47, 54, 60, 63, Table 4

Diagnosis.— Species characterized by its coloration pattern and by the shape of its maxillary palpi and male genitalia.

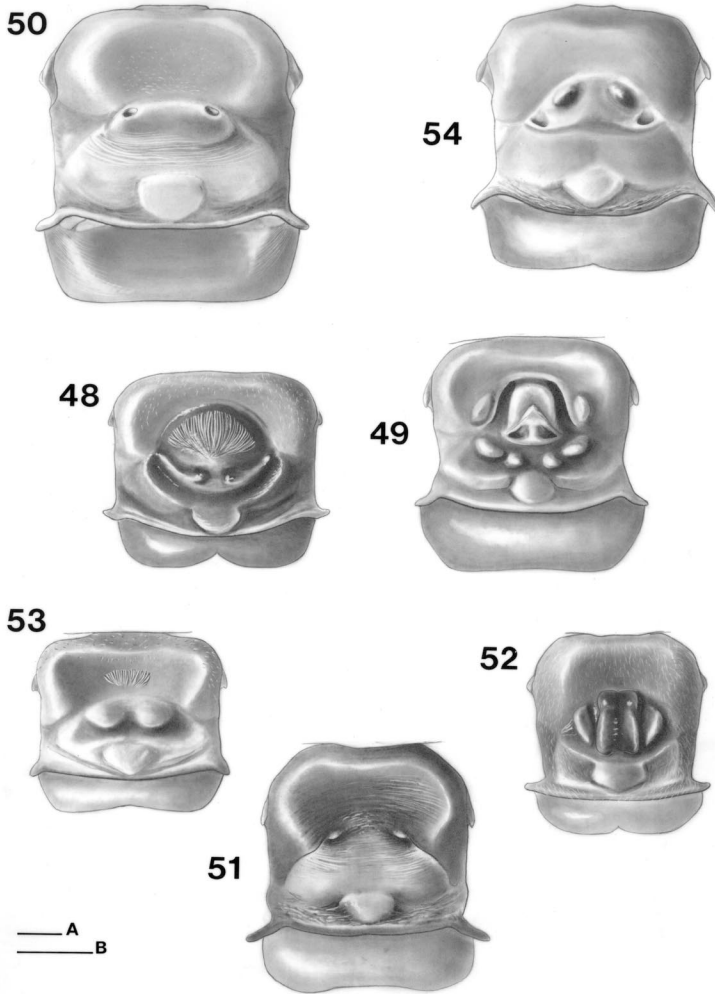
Holotype.— Male. Dutch West Indies, St Eustatius: 200 m above trail head to



Figs 43-47. *Orochirus maculatus*. 43, head, dorsal view. 44, last joints of maxillary palpi. 45, male right tegmen, its inner fold figured with a dashed line. 46-47, male genitalia, dorsal and right lateral views. Scales 1 mm.

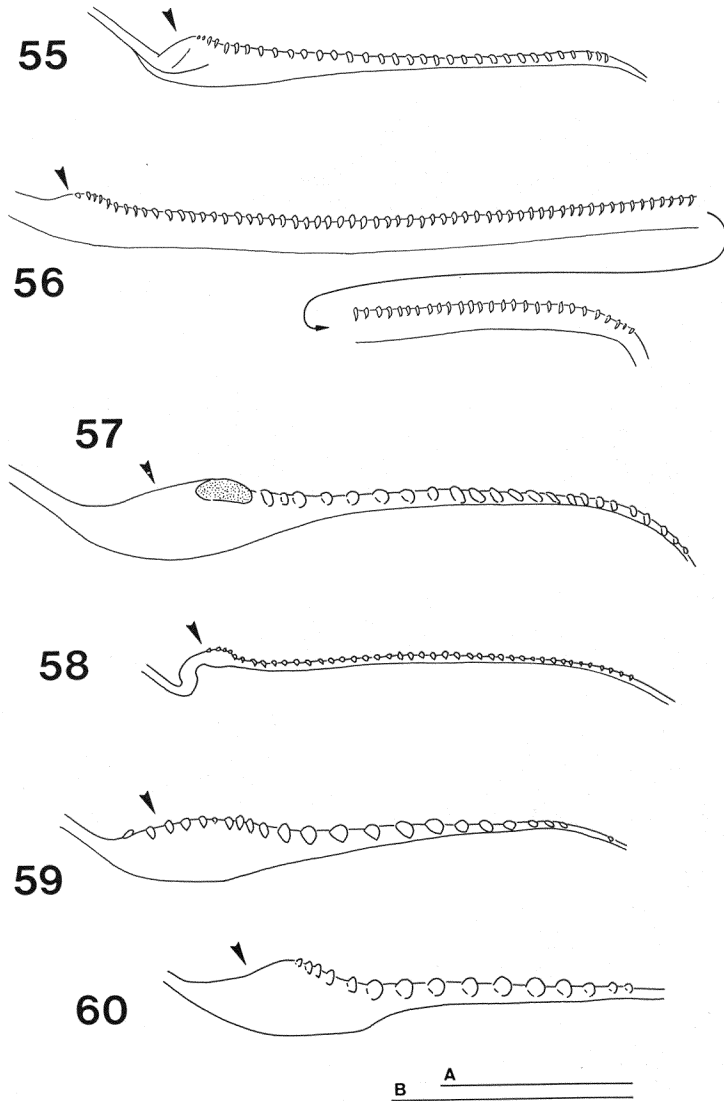
Quill, VIII-20-1999 (R. Bland and D. Valek) [MNHN].

Description.—Species brownish grey, entirely flecked with yellow, brown and black, thus resembling bark. General shape long and thin, the legs compressed and thin and covered with long, white setae. **Head.** Rounded and small, with small prominent eyes. Fastigium narrowed distad, deeply furrowed longitudinally and with a longitudinal cone forming each lateral margin at the level of the lateral ocelli (Fig. 43). Ocelli small, arranged as a triangle. Last joint of maxillary palpi greatly enlarged at the apex (Fig. 44). Head coloration: frons and vertex yellow, entirely maculated with dark brown spots. Face with a brownish black triangular fleck under the median ocellus down to the ventral margin of the antennal pits, and with a large and low brownish black, triangular area along the epistomal suture; both dark triangles separated by a light yellow band, which is prolonged on the cheeks. Scape and first antennal joint dark brown on their lower and upper sides. Antennae with yellow, brown and brownish black joints. **Pronotum.** Wider than long, its surface corrugated; straw-colored, entirely flecked with brown and black. Dorsal disc: Anterior margin with a line of black spots; posterior margin bisinuated, yellow with small dark spots. Lateral lobes separated from the dorsal disc by a large, longitudinal carina, bordered with black. **Legs.** Foretibiae carinated dorsally and inflated at the level of the tympana (see infra: variation). Genicular lobes of forefemora both enlarged, the inner one much longer and spine-like than the outer one. Tibiae II compressed, higher than wide. Femora III carinated longitudinally, its genicular lobes both long. Tibiae III with 8 inner and 7 outer subapical spurs,

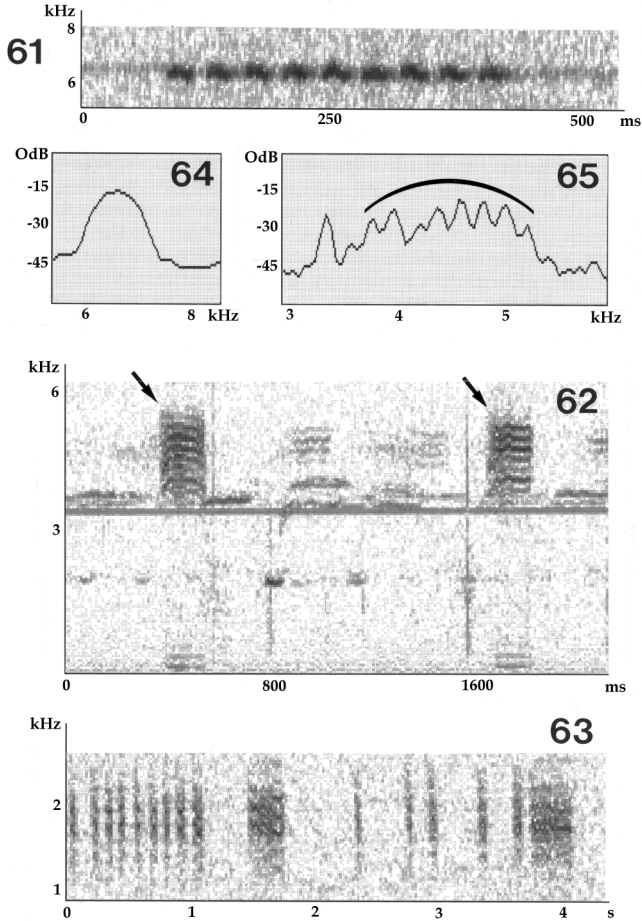


Figs 48-54. Hapithini metanotal structures in males. 48, *Hapithus crucencis*. 49, *Orocharis albifrons*. 50, *O. fulvescens*. 51, *O. maximus*. 52, *O. angustus*. 53, *O. saussurei*. 54, *Orochirus maculatus*. Scales A (Fig 51), B (other figures) 1 mm.

the distal outer spur very small; outer spurs much longer than the inner ones, straight, only the apex curved. Hindtibiae margins serrulated over their whole length, except between the first and the second subapical spurs, on both sides. Tarsomeres almost entirely greyish black, the first hindtarsomere largely ivory colored dorsally. *Male*. Metanotum smooth, without evident glandular structure (Fig. 54). Tegmina long and narrow. Stridulum complete (Fig. 45); mirror very long and narrow, crossed with one transverse vein; chords very long and very close to each other; file located on the straight part of the stridulatory vein only and comprising a large swelling bearing 5 indistinct teeth that are quite flat and not clearly separated, and 10 large and slanted teeth (Fig. 60). Apical field short



Figs 55-60. Hapithini stridulatory files in upper lateral view. 55, *Hapithus crucencis*. 56, *Orocharis fuscifrons*. 57, *O. maximus*. Note the flat part on the swelling, represented with dots. 58, *O. angustus*. 59, *O. saussurei*. 60, *Orochirus maculatus*. Swelling of the file vein indicated with an arrow. Scales A (Fig 57), B (other figures) 0.5 mm.



Figs 61-65. Hapithini calling songs. 61-63, sonograms of the calls. 61, *Orocharis proalbifrons*, one chirp. 62, *O. fulvescens*, two buzzing chirps, each indicated by an arrow. 63, *Orocharis maculatus*. 64-65, energy diagram. 64, *O. proalbifrons*, one chirp. 65, *O. fulvescens*, one buzz.

compared to the stridulum and clearly separated into quadrate cells. Bases of MP and CuA largely separated. Inner margin of right tegmen greatly enlarged on its apical half and enveloping the lateral field of the left tegmen. Lateral field with numerous sinuous and parallel veins. Wings longer than tegmina. Subgenital plate rounded at apex, its lateral margin dull yellow. Cerci yellowish with elongated black spots. *Male genitalia*. General features similar to that of the tribe (Figs. 46, 47), but with the following characteristics: Epiphallus wide and short; lophi mostly membranous, sclerotized only on their outer side and with a membranous process bearing strong setae on their inner margin. Ectophallic apodemes

short and large. *Female*. Unknown.

Variation.— The tympana of the male holotype are different on both forelegs. On the left foreleg, both tympana are ovoid, the outer being much smaller; on the right foreleg, both tympana are lacking and only a small inner depression is present. The male paratype has normally developed tympana.

Habitat.— *O. maculatus* has been found on *Pisonia fragrans* Dum.-Cours. and other low trees at heights of 4-10 meters in moist forests (R. Bland, pers. obs.).

Calling song.— The calling song of *Orochirus maculatus* is an irregular suite of short and long buzzing sounds, emitted without definite temporal pattern (Fig. 63). The song may comprise short buzzes grouped in irregular motives, the successive motives being separated by irregular durations. Longer buzzes are usually emitted after a few, more separate, short buzzes, and are either alone or a few.

Short buzzes have a duration of 30 to 80 ms (mean value 65), those emitted in isolation being perhaps a little shorter (Table 4). Long buzzes last from 219 to 374 ms (mean duration 290). Sounds are emitted in wide frequency bands, without a clear dominant frequency; for a value of - 38 dB of excess attenuation, the frequency band runs from about 1460 to about 2370 Hz, without clear differences between short and long buzzes (Table 4). The frequency peaks are not distributed regularly, as in the call of *Orocharis fulvescens*.

Paratype.— 1 male. Dutch West Indies, St Eustatius: 200 m above trail head to Quill, VIII-18-1999 (R. Bland and D. Valek) [UMMZ].

Measurements.— Male (n = 1). Lpron: 2.5; LFIII: 14.4; LTIII: 15.1; Ltleg: 18.7; Lwi: 22.8; wpron: 4.6; wteleg: 4.7.

Etymology.— Species named after its coloration pattern.

DISCUSSION

Hapithini have undergone an important taxonomic diversification in the West Indies as shown by the present paper: several species have been described and several species groups clearly characterized, on the basis of an undetermined material which was not initially gathered for any specific purpose. Even though many additional species would certainly be discovered with adequate sampling efforts in the whole area, a preliminary taxonomic scheme based on as many characters as possible is proposed here: it will probably be completed and perhaps modified by future taxonomic developments, but for now it may help avoid taxonomic confusion frequently resulting from isolated and often unargued species descriptions, especially when all potentially informative characters are not documented.

Calling songs are documented here for three species, *Orocharis proalbifrons*, *O. fulvescens* and *Orochirus maculatus*. The song of *O. proalbifrons* presents the characteristics usually associated with cricket songs, in terms of temporal stereotypy and carrier frequency (Bennet-Clark 1989). The songs of the other two species are much more complex in spectral properties and also, for *O. maculatus*, temporal pattern. The call of *O. fulvescens* consists of buzzing sounds emitted at regular time intervals. The call of *O. maculatus* has similar buzzing pulses, but the pulses are either numerous and short, and gathered in chirps of irregular duration, or few and longer, both pulse types being emitted without clear temporal motive. Spectral diagrams of these buzzing pulses show in both species multiple sidebands (Fig. 62), for which two alternative explanations exist (Gerhardt 1998): either the calls are repetitive frequency-modulated sounds or they comprise numerous harmonics of the song carrier frequency. In this last alternative, however, and according to the sonogram of *O. fulvescens* call (Fig. 62), the carrier

frequency of the call would be 100 - 200 Hz. Such a low carrier frequency has never been documented in crickets (Bennet-Clark 1989) and seems highly unlikely, because of the presence of the tegminal resonator.

To our knowledge, no such buzzing sounds have ever been described for crickets, although buzzing calls have been mentioned in some North American *Orocharis* species before (Walker 1969). The emission of buzzing sounds, i.e. sounds modulated in frequencies, could mean that the tegminal resonator includes several areas vibrating at different resonant frequencies and that these tegminal areas are put into vibration simultaneously or during overlapping time durations. Tegminal vibrations at very different frequencies in constant ambient conditions have been documented in some Eneopterinae and Phalangopsidae cricket species (Desutter-Grandcolas 1998). These vibrations occurred successively and produced broad-frequency modulations, which were correlated to modifications in the file structure, such as the presence of deeply furrowed teeth or of particular file teeth distribution. The species recorded here present a particular file structure, with some teeth located upon a variable swelling of the file vein (Figs. 55-60). However, this feature is present, although variable, in all recorded species, including *O. proalbifrons*, and consequently cannot be responsible alone for the observed spectral properties of the calls.

ACKNOWLEDGEMENTS

We thank J. Marshall (Natural History Museum, London), M. O'Brien (University of Michigan Museum of Zoology, Ann Arbor), D. Azuma and D. Otte (Academy of Natural Sciences of Philadelphia, Philadelphia) for loan of material, and S. Hugel for material collecting. Metanotal structures have been drawn by G. Hodebert (MNHN). D. Valek (Central Michigan University, Mt. Pleasant) in particular provided valuable assistance in locating and collecting specimens from St. Eustatius and Saba.

LITERATURE CITED

- Bennet-Clark, H.C. 1989. Songs and the physics of sound production. In F. Huber, T.E. Moore & W. Loher *Cricket behavior and neurobiology* (pp: 227-261). Ithaca and London: Comstock Publishing Associates.
- Bolivar, I. 1888. Énumération des Orthoptères de l'île de Cuba. *Mém. Soc. zool. Fr.* 1: 1-49.
- Chopard, L. 1912. Contribution à la faune des Orthoptères de la Guyane française. *Annls. Soc. entomol. Fr.* 81: 401-432.
- Chopard, L. 1956. Some crickets from South America (Grylloidea and Tridactyloidea). *Proc. U.S. Nat. Mus.* 106: 241-293.
- Chopard, L. 1968. Pars 12. Fam. Gryllidae: Subfam. Mogoplistinae, Myrmecophilinae, Scleropterinae, Cachoplistinae, Pteroplistinae, Pentacentrinae, Phalangopsinae, Trigonidiinae, Eneopterinae. Fam. Oecanthidae, Gryllotalpidae. Dr. W. Junk N.V.'s Gravenhage. Pp. 215-500.
- Desutter, L. 1987. Structure et évolution du complexe phallique des Gryllidae (Orthoptera) et classification des genres néotropicaux de Grylloidea. 1ère partie. *Annls. Soc. entomol. Fr. (N.S.)* 23: 213-239.
- Desutter, L. 1988. Structure et évolution du complexe phallique des Gryllidae (Orthoptera) et classification des genres néotropicaux de Grylloidea. 2ème partie. *Annls. Soc. entomol. Fr. (N.S.)* 24: 343-373.
- Desutter, L. 1990. Étude phylogénétique, biogéographique et écologique des Grylloidea néotropicaux (Insectes, Orthoptères). Thèse de Doctorat. Université Paris XI-Orsay. Orsay. 347 pp.
- Desutter-Grandcolas, L. 1998. Broad-frequency modulation in cricket (Ortho-

- ptera, Grylloidea) calling songs: two convergent cases and a functional hypothesis. *Can. J. Zool.* 76: 2148-2163.
- Desutter-Grandcolas, L. 2003. Phylogeny and the evolution of acoustic communication in extant Ensifera (Insecta: Orthoptera). *Zool. Sci.* (in press).
- Gerhardt, H.C. 1998. Acoustic signals of animals: recording, field measurements, analysis and description. In S.L. Hopp, M.J. Owren & C.S. Evans *Animal acoustic communication. Sound analysis and research methods* (pp. 1-25). Berlin: Springer.
- Gorochoy A.V. 1986. System and morphological evolution of crickets from the family Gryllidae (Orthoptera) with description of new taxa. *Communication 1. Zool. Zh.* 65: 516-527.
- Guérin-Meneville, F.E. 1844. *Iconographie du règne animal de G. Cuvier*. J. B. Baillière. Paris. 576 pp.
- Kirby W.F. 1906. A synonymic catalogue of Orthoptera. Vol. II. Orthoptera altatoria. Part I. (Achetidae and Phasgonuridae). British Museum (Natural History). London. 562 pp.
- Nickle D.A. 1992. The crickets and mole crickets of Panama (Orthoptera: Gryllidae and Gryllotalpidae). In A. A. Quintero (Ed.) *Insects of Panama and Mesoamerica*. Oxford University Press. London. Pp. 185-197.
- Olivier M. 1791. *Encyclopédie méthodique. Histoire naturelle. Insectes*. VI. Panckoucke. Paris. 704 pp.
- Otte, D. 1994. Orthoptera species file. 1. Crickets (Grylloidea). Orthopterists' Society and the Academy of Natural Sciences of Philadelphia. Philadelphia, Pennsylvania. 120 pp.
- Richard, J.P. 1991. Sound analysis and synthesis using an Amiga micro-computer. *Bioacoustics* 3: 45-60.
- Saussure, de H. 1874. *Mission scientifique au Mexique et dans l'Amérique centrale. 6ème partie: études sur les Myriapodes et les Insectes*. Imprimerie impériale. Paris. 531 pp.
- Saussure, de H. 1878. *Mélanges orthoptérologiques. VIème fascicule. Gryllides (2ème partie)*. *Mém. Soc. Physique & Hist. nat. Genève* 25: 369-702.
- Saussure, de H. 1897. *Biologia Centrali-Americana. Insecta. Orthoptera*, pp. 216-284.
- Uhler, P.R. 1864. Orthopterological contributions. *Proc. entomol. Soc. Wash.* 2: 543-555.
- Walker, F. 1869. Catalogue of the specimens of Dermaptera Saltatoria, and supplement to the Blattariae, in the collections of the British Museum. British Museum (Natural History). London. 224 pp.
- Walker, T.J. 1969. Systematics and acoustic behavior of the United States crickets of the genus *Orocharis* (Orthoptera: Gryllidae). *Annls. Entomol. Soc. Amer.* 62: 752-762.

Table 1. Calling song of *Orocharis proalbifrons*. The total duration of the analyzed song is 26.3 s. Frequency band has been measured for an excess attenuation of - 38 dB.

	Number	Duration (ms)	Frequency band (Hz)
Long trills	2	3068 - 3487(3278)	
Pulses	78 - 89 (84)	21-25 (23, n=20)	5821 - 6021 / 7025- 7192 (5969 / 7113, n=10)
Interpulses		15-19 (16, n=20)	
Short trills	21	174-1036 (468)	
Pulses	5-27(13)	19-24 (22, n=20)	5921-6147 / 7025-7176 (6032 / 7092, n=10)
Interpulses		15-19 (17, n=20)	

Table 2. Calling song of *Orocharis fulvescens*. Frequency band measured for an excess attenuation of - 38 dB.

	Duration (ms)	Frequency band (Hz)
Buzz	159-199 (173, n=15)	3545-3677 / 5282-5420 (3624 / 5366, n=8)
Interbuzz	847-1290 (1026, n=10)	—

Table 3. Peak frequencies (in Hz) in 5 calling songs of *O. fulvescens*, for an excess attenuation up to -38 dB. For each peak, the value of excess attenuation is indicated in parentheses. See text for explanation.

Song 1	Song 2	Song 3	Song 4	Song 5
3814 (-27)	3814 (-29)	3663-3763 (-29)	3613 (-29)	3663 (-27)
4015 (-23)	4015 (-22)	3914 (-28)	3763-3813 (- 32)	3914 (-27)
4266 (-29)	4215 (-21)	4115 (-22)	4014 (-26)	4115 (-21)
4416 (-21)	4416 (-23)	4315 (-22)	4215 (-31)	4316 (-21)
4617 (-18)	4617 (-17)	4516 (-21)	4416-4466 (-22)	4517-4567 (-22)
4868 (-19)	4818-4868 (-20)	4717 (-17)	4616 (-14)	4717 (-17)
5069 (-20)	5069 (-21)	4917 (-18)	4817-4867 (-17)	4918 (-18)
5269 (-29)		5118 (- 23)	5068 (- 25)	5119 (- 18)
			5269 (- 30)	

Table 4, Calling song of *Orochirus maculatus*. Frequency band measured for an excess attenuation of - 38 dB.

	Number	Duration (ms)	Frequency band (Hz)
Long buzz	5	219-374 (290)	1422-1505 / 2358-2409 (1469 / 2384, n=3)
Short buzz	35 (grouped) 10 (isolated)	35-80 (65) 30-80 (55)	1405-1488 / 2325-2397 (1456 / 2368, n=5)