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Source: Journal of Orthoptera Research, 13(1) : 149-154

Published By: Orthopterists' Society

On some morphological and karyological problems of the generic classification of Landrevinae (Orthoptera, Gryllidae) with descriptions of two new species

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Abstract

Correlation between morphological and karyological characters in the different genera of Landrevinae is discussed. Difficulties distinguishing the genera Duolandrevus and Repapa are considered. Two new species, male genitalia of 1 species and karyotypes of 6 species are described for the first time. A new synonymy for one species is established.

Key words

cricket, taxonomy, karyology, new species

Introduction

The subfamily Landrevinae was described by Saussure (1878: p. 371) as the legion Landreves for 2 genera: Landreva Sauss., divided into 4 subgenera and Odontogryllus Sauss. Later, these subgenera of Landreva were all considered as genera, and several new genera were described; but all genera of Landrevinae were included in the tribe Gryllomorphini of the subfamily Gryllinae (Chopard 1967). Then, Gorochov (1982) restored Saussure’s Landreves as a separate subfamily and Otte & Alexander (1983) independently described this group as a new tribe of Gryllinae.

From 1988 to 2000, numerous new genera were described (Gorochov 1988, 1990, 2000; Otte 1988); Otte (1988) included Landrevinae (as a tribe) in the subfamily Pteroplistinae, but Gorochov (1990) disagreed with this opinion, and considered some of the above-mentioned genera as subgenera in the genus Duolandrevus Kirby (Gorochov 1996, 2000).

The most recent state of this study is as follows: Landrevinae are probably more related to Eoneopterinae and Hemigyllinae than to Pteroplistinae and Phalangopsinae, which are closely related to each other (Gorochov 2001a); the tribe Odontogryllini, described for Odontogryllus with 2 other genera, and included in Pteroplistinae sensu Otte (De Mello 1992), is in need of correction of its systematic position (Gorochov 2003); the generic classification within this subfamily and the subgeneric classification of the genus Duolandrevus now have many problems.

These problems deserve special discussion. The external morphology of Landrevinae is rather monotonous, but there are numerous cases of parallel reduction or disappearance of wings, stridulatory apparatus, and tympanal organs. On the other hand, the male genitalia of different species are well distinguished, but often don’t offer any possibility of generic or subgeneric classification, and we must take single characters (which may be symplesiomorphies or results of convergence) for separation of these superspecific taxa from each other.

Moreover, if we synonymize these taxa with each other, we shall have a few very diverse genera which can neither be separated from each other, nor from all other genera of Landrevinae. But many of these taxa are strongly distinguished from each other if we reject numerous intermediate forms from our study.

The way out of this situation is a search for additional characters. Karyological data seem very promising for the generic classification of Landrevinae, as the previous study (Warchalowska-Sliwa et al. 1997) showed some conformity of structure of karyotype with generic classification based on genital morphology (3 species of Duolandrevus have almost identical karyotypes, but the karyotype of 1 species of Vasilia Gor. is well distinguished from them). The new karyological data mainly support this regularity, but some exclusions are possible (one of them will be considered below).

The present study gives cytogenetic information concerning 6 species belonging to 3 genera and 2 subgenera: the genus Duolandrevus with the subgenera Duolandrevus s. str. and Bejorama Otte, the genus Ectodrelanva Gor., and possibly the genus Repapa Otte. Karyotypic data on these species are published here for the first time.

Taxonomy

Genus Duolandrevus Kirby, 1906

Subgenus Duolandrevus s. str.

Gorochov (2000) included in this subgenus 11 species distributed from Malacca to the Philippines and Komodo. At present, such a subgenus seems heterogeneous, as some of these species are more similar to the subgenus Bejorama in the structure of the male anal plate (see below), and other ones are insufficiently studied or have a very peculiar structure of the epiphallus (D. salator B.-Bien., D. luzonis Otte, D. balabacus Otte, D. gingoogus Otte, and D. fruhstorferi Gor.). Now the nominotypical subgenus probably contains only 2 Javanese species: D. brachypterus (Haan) and D. iocolonianus (Sauss.). These two differ from all other congeners in the following combination of characters: male anal plate simple and with rather wide apex (Figs 11 - 13), hind median process of epiphallus distinct and undivided into 2 lateral lobes (Fig. 8).

Duolandrevus (Duolandrevus) brachypterus (Haan, 1842) = Duolandrevus karnyi Otte, 1988, syn. n.

Java: 10 ♂♂, 4 ♀♀, 20-25 km SE of Bogor, Mts Pangrango, 1000 m, environs of Cemande, 27 XI.-7 XII. 1999, A. Gorochov leg. (Zoological Institute, St Petersburg).
Note. The study of these specimens shows that the small differences between the neotype of *D. brachypterus* shows that the holotype of *D. karnyi* are within the limits of species variability. Descriptions of this species are in Saussure (1877: Figs XXV, 3), Otte (1988: Figs 8B, 20F), and Gorochov (1996: Figs 36, 43, 51-53).

**Duolandrevus (Duolandrevus) ?coulonianus** (Saussure, 1878)
(Figs 1-3, 8-13)

Java: 3 ♂, 1 ♀, 20-25 km SE of Bogor, Mts Pangrango, 1000 m, environs of Cemande, 27 XI-7 XII.1999 (1 male and female collected as nymphs, imago reared respectively III and VI, 2000). A. Gorochov leg. (Zoological Institute, St Petersburg).

Note. This species was described without any mention of its male genitalia. For this reason we give only a preliminary determination of these specimens, as their external morphology is approximately in accordance with Saussure’s description.

### Description

Species very similar to *D. brachypterus* (these species distinguished from each other only in male genitalia). Head clearly depressed dorsoventrally, hardly wider than pronotum, with slight longitudinal wrinkles under antennal cavities; rostrum roundly angular (in profile), almost as wide as scape; coloration of head and pronotum uniformly dark reddish brown, but with slightly lighter palpi, postclypeus, base of antennae, and with yellowish ocelli. Venation of dorsal part of male tegmina and structure of male metanotum (with hind wings) as in Figs 1, 2; lateral part of male tegmina with only 5 to 6 longitudinal and almost straight veins; dorsal part of female tegmina as in Fig. 3; their lateral part with 4 to 5 slightly arched veins; tegmina attaining 5<sup>th</sup> to 6<sup>th</sup> abdominal tergites in male and middle part of 1<sup>st</sup> abdominal tergite in female; coloration of tegmina dark brown with transparent and semitransparent stridulatory areas in male. Ptero thorax and abdomen brown with somewhat lighter dorsal part provided with several more or less distinct darkish spots; legs almost light brown with slightly darker reddish brown distal part of hind femora and dark brown upper surface of hind tibiae between spines. Male anal plate as in Figs 11-13; male genitalia similar to those of *D. brachypterus*, but epiphallus with different shape of proximal part, long hind median process, and curved apical part of hind lateral processes (Figs 8-10).

**Duolandrevus (Bejorama) modestus** Gorochov, sp. n.
(Figs 4, 5, 14-19)

**Holotype.**— Male, West Sumatra: 20 km E of Sasak, environs of Nat. Park Harau Valley, 600 m, equator, 24-26.XI.1999 (collected as nymph, imago reared XII, 1999). A. Gorochov leg. (Zoological Institute, St Petersburg).

### Description

Male similar to that of *D. ?coulonianus*, but distinguished from it by the following characters: size distinctly smaller, head somewhat narrower (not wider than pronotum) and slightly less depressed dorsoventrally, pronotum clearly longer (but somewhat transverse), tegmina extending to basal part of 6<sup>th</sup> abdominal tergite with distinctly longer strial veins and clearly larger oval mirror (Fig. 4), metanotal gland and hind wings clearly smaller (Fig. 5), distal part of anal plate with longitudinal dorsal cavity and row of setae along apical edge of this cavity (Figs 17-19), epiphallus of genitalia with different shape of proximal edge and deeply bifurcated hind median process, genital guiding rod long (much longer than above-mentioned process) and with characteristic distal part, mold of spermatophore attachment plate long, apodeme of this mold short (Figs 14-16) and with a rather light coloration to the upper surface of the hind tibiae. Female unknown.

**Length (mm).**— Body 17; pronotum 3.1; tegmina 7.8; hind femora 10.2.

### Comparison

The new species is well distinguished from all other species of *Bejorama* by the presence of distinct rudiments of hind wings, the shape of its anal plate, and the characteristic structure of the epiphallus and guiding rod in the genitalia.

**Duolandrevus (Bejorama) improvisus** Gorochov, sp. n.
(Figs 6, 7, 20-25)

**Holotype.**— Male, Sumatra, Jambi: 35 km N of Sungaipenuh, Nat. park Kerinci-Seblat, Mt Kerinci, 1500-2000 m, 18-22.XI.1999 (collected as nymph, imago reared I, 2000). A. Gorochov leg. (Zoological Institute, St Petersburg).

**Paratype.**— Female, same data as holotype.

### Description

Male very similar to that of *D. modestus*, but distinguished by the following characters: slightly smaller, pronotum somewhat shorter (shape of its disc almost as in *D. ?coulonianus*); tegmina extending to middle of 5<sup>th</sup> abdominal tergite, stridulatory vein shorter (but relatively longer than in *D. ?coulonianus*), mirror much narrower (but relatively larger than in *D. ?coulonianus*) (Fig. 6); hind wings hardly shorter; metanotal gland with central cavity slightly smaller and with structure of hind edge of this cavity somewhat different (for comparison see Figs 5 and 7); distal part of anal plate narrower and with unwidened apical part of dorsal cavity (Figs 23-25); epiphallus of genitalia with much shorter and less deeply bifurcated hind median process, genital guiding rod shorter and with different shape of distal part, mold of spermatophore attachment plate short and with clearly longer apodeme (Figs 20-22).

Female similar to male, but slightly larger, with somewhat darkened upper part of hind tibiae, very short tegmina extending to base of 1<sup>st</sup> abdominal tergite (their coloration, venation, and shape of lateral part similar to those of *D. ?coulonianus*), but dorsal part much shorter.
hind edge of these parts of both tegmina together seem roundly notched, the median part of this “notch” protruding behind hind pronotal edge by 0.5 mm). Other characters also similar to those of D. ?coulomianus.

Length (mm).— Body: ♂ 16, ♀ 18; pronotum: ♂ 2.6, ♀ 2.9; tegmina: ♂ 6.5, ♀ 2; hind femora: ♂ 9, ♀ 19; ovipositor 11.5.

Comparison.— The distinctions from D. modestus are listed above. From all other species of Bejorama, D. improvisus differs by the same characters as D. modestus and the peculiariy of shape of male genital structures.

Genus Repapa Otte, 1988

In this genus, 5 species were included (Otte 1988; Gorochov 2000, 2001b). Three of them, distributed from Borneo to Palawan [R. brevipes (Chop.), R. sapagaya Otte. R. tenomphoiae Otte], are very similar to each other and to preceding ones only in the shape of the hind median epiphallic process (long and undivided); this character was a single distinct difference between Repapa and Duolandrevus, but after the description of male genitalia of D. ?coulomianus, the independence of these genera seems questionale. The latter species has the karyotype almost identical to all other studied congeners of Duolandrevus, and One possible species of Repapa (♂ R. paradoxa), has karyotype very different from that of Duolandrevus (see chapter “Karyology”). It is possible that Repapa differs from Duolandrevus mainly in karyotype, but possibly also that ♂ R. paradoxa is an aberrant representative of Duolandrevus. I cannot exclude that all other species of Repapa or part of them belong to Duolandrevus. This problem may be decided by future karyological study of the other representatives of Repapa.

♂ Repapa paradoxa Gorochov, 2001

Note. The material from Thailand used in this study (1 male – holotype and 4 females – paratypes) was sufficiently described by Gorochov (2001b: Figs 1-4).

Genus Ectodrelana Gorochov, 2000

This genus is well distinguished from all other genera of Landrevinae in the structure of male genitalia and the male metanalot gland. There are also some distinct differences in the karyotype (see below).

Ectodrelana paramarginalis Gorochov, 2000

Note. The material from Cambodia used here (1 male – holotype) was sufficiently described by Gorochov (2000: Figs 50, 67).

Karyology

Methods

The testes and ovarioles were excised, incubated in hypotonic solution (0.9% sodium citrate), fixed in ethanol:acetic acid (3:1), and squashed. The squash technique used an air-dried preparation, the C-banding technique (Sumner 1972). Chromosomes were classified according to Levan et al. 1964.

Results

The karyotype of Duolandrevus (Duolandrevus) brachypterus (Sauss.), D. (D.) ?coulomianus (Sauss.), D. (Bejorama) modestus sp. n., and D. (B.) improvisus sp. n. consists of 2n=19 (XO) in the male and 2n=20 (XX) in the female. All autosomes were acro- or subacrocentric, the metacentric X chromosome was the largest element in size (Fig. 26). Location of C-heterochromatin and NORs of these species were similar. The C-banding pattern was characterized by the presence of paracentromeric (thin) bands in all autosomes and the X chromosome.

In ♂ Repapa paradoxa Gor., the chromosome complement is reduced to 2n=11 (XO) in the male. In this case, all chromosomes including the X chromosome are metacentric. Paracentromeric C-bands appear in all autosomes and in the X chromosome (Figs 27, 28). In a second pair, variation of the centromeric C-bands (thin/thick) occurred.

The chromosome complement of Ectodrelana paramarginalis Gor. 2n=21 (XO) in the male was characterized by the presence of subacrocentric and acrocentric pairs of autosomes, and the metacentric X chromosome. The paracentromeric C-heterochromatin bands appear in all chromosomes (Fig. 29).

Discussion

Chromosome number in the Gryllidae ranges from 2n=11 to 29 in the male — the most common number being 19 or 21. The sex chromosome mechanism is generally typical XO(♂); XX(♀) type and the X chromosome is metacentric. Crickets have been evaluated for their cytotoxonal implications and dynamic changes of chromosome number, morphology, as well as sometimes sex chromosome mechanism (Ohmachi 1935, Manna 1979, Hewitt 1979).

Karyological information regarding species which belong to subfamily Landrevinae is not extensive and concerns 10 species belonging to 4 genera (Warchalowska-Sliwa et al. 1997, present study). Among these species, the highest chromosome number was found in Ectodrelana paramarginalis 2n=21 (XO) in the male, with subacro- or acrocentric autosomes and the metacentric X chromosome. Analysis of chromosome complement, location of C-heterochromatin of 7 species of 3 subgenera of Duolandrevus (Duolandrevus s. str., Eulandrevus Gor., and Bejorama Otte), and NORs of 3 species of one subgenus (Eulandrevus) (Warchalowska-Sliwa et al. 1997, present study) from Vietnam, Sumatra, and Java, showed the same karyotype, 2n=19 (XO) with acro- or subacrocentric autosomes and metacentric X chromosome, similar C-bands, and NORs location. These species are also similar in morphology and mode of life. The karyotype of Vasilia vietnamensis Gor., belonging to another genus, is composed of 2n=17 (XO) in the male, with one metacentric pair and the submetacentric X chromosome (Warchalowska-Sliwa et al. 1997). On the other hand, the chromosome number of ♂ Repapa paradoxa from eastern Thailand, has been reduced to 2n=⩾11 (XO), thus all chromosomes are metacentric. Clearly Robertsonian fusion is prevalent in this species. Within group, this species is the most advanced in structural evolution of the karyotype.

Results obtained in the cytological analysis of 10 species of 4 genera described earlier with results reported here, indicate the presence of a more intensive karyotype evolution in this subfamily. The origin of different patterns of karyotype in these cases is owing to a complex of translocation. However, discussion about karyotypes and the basic/ancestral number of chromosomes in this subfamily...
is difficult because of the small amount of data.

All the analysed species can be divided into 4 groups according to their karyotype pattern. These groups probably correspond to 4 genera of Landrevinae. Three of these groups (Duolandrevus, Vasilia, and Ectodrelanva) are also well separated morphologically.

References


Figs 1-7. Duolandrevus. 1-3, D. ?coulonianus Sauss.; 4, 5, D. modestus sp. n.; 6, 7, D. improvisus sp. n. Dorsal part of right male tegmen (1, 4, 6); female pterothorax from above (3), male metanotum with hind wings from above (2, 5, 7).
Figs 8-25. *Duolandrevus*, male. 8-13, *D. ?coulonianus* Sauss.; 14-19, *D. modestus* sp. n.; 20-25, *D. improvisus* sp. n. Genitalia from above (8, 14, 20), below (9, 15, 21), and the side (10, 16, 22); anal plate from above (11, 17, 23), and its distal part from the side (12, 18, 24) and behind (13, 19, 25).
Fig. 26, *Duolandrevus improvisus* sp. n., male diakinesis with C-bands; Figs 27, 28, *Repapa paradova* Gor. male: 27, metaphase I; 28, karyotype of mitotic metaphase; Fig. 29, *Ectodrelana paramarginalis* Gor., male, diakinesis. Bar equals 10 µm and applies to Figs 26-29.