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***Poecilimon bosphoricus* group (Orthoptera, Phaneropterinae): iteration of morpho-taxonomy by song characteristics**

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Abstract

More than 20 species were reported under the circum Black Sea lineage *Poecilimon bosphoricus* group (Orthoptera, Tettigonioidea, Phaneropterinae). The taxonomy of the group has for a long time been controversial; once these species were transferred to *Eupoecilimon* and many new species have been described since the revision by Ramme (1933) or synonyms have been suggested/re-established. This study aims to test the classification of the group presently based on morphological characters by bioacoustic data. The following results were obtained or conclusions arrived. First, several qualitative morphological characters previously used in descriptions/diagnoses of the species are variable and overlap between species. Those are the elevation and widening of pronotum in metazona, the emargination of caudal margin of pronotal disc and the structure of male subgenital plate at caudal margin. Thus, still the male cercus, especially the orientation of denticles, is the most productive structure may allow more objective delimitation of species. As in qualitative morphology the general morphometry seems uninformative for the taxonomy of the group. Second, male calling song and partly the number of stridulatory pegs are more useful characters both for delimitation of species and describing their relationships. Especially, the pattern of the syllable, the number of impulses per syllable and the duration of early part of syllable in species group allow us a more objective delimitation of the species and definition of relationships. Third, from the distribution and relationships of species, we suggested three radiation centres for the lineage: (1) Northwest Anatolia + Eastern Balkans, (2) Northeast Anatolia + Caucasus and (3) Crimea. Fourth, after evaluating morphological and song phenotypes we considered 21 species in *P. bosphoricus* group constituting three subgroups: (1) *P. sureyanus* and *P. kocaki* (+ *P. athos*),

(2) *P. turcicus* + *P. turciae* and (3) *P. bidens*, *P. bischoffi*, *P. bosphoricus*, *P. cervus*, *P. demirsoyi*, *P. geoktschajcus*, *P. heinrichi*, *P. istanbul*, *P. miramae*, *P. pliginskii*, *P. proximus*, *P. roseoviridis* sp. n., *P. scythicus*, *P. similis* and *P. tauricus* (+ *P. djakonovi*). The following nomenclatural actions were made: (1) *P. roseoviridis* Chobanov & Kaya **sp. n.** described, (2) *P. similis proximus* Ünal, 2010 raised to species level as *P. proximus* **stat. n.**, (3) *P. naskrecki* Ünal, 2001 **syn.n.** synonymised with *P. demirsoyi* Sevgili, 2001 (4) *P. diversus* Ünal, 2010 **syn.n.** and *P. anatolicus* Ramme 1933 **syn.n.** put in synonymy with *P. sureyanus* Uvarov, 1930, (5) *P. oligacanthus* Miram, 1938 **syn.n.** and *P. tereckensis* Stshelkanovtzev, 1910 **stat.rev.** resynonymised with *P. similis* Retowski, 1889, (6) *P. beybienkoi* Tarbinsky, 1932 **syn.n.** and *P. kusnezovi* Miram, 1929 **syn.n.** synonymised with *P. tauricus* Retowski, 1888, and (7) *P. boldyrevi* Miram, 1938 **syn.n.** synonymised with *P. pliginskii* Miram, 1929.

Introduction

Poecilimon Fischer is one of the most speciose genera of Phaneropterinae (Tettigoniidae, Orthoptera) including around 150 species (Bei-Bienko 1954; Eades *et al.* 2011). It is distributed in Eurasia, but the core areas of its range are Anatolia and Southeast Europe. For example more than 55 of the Anatolian species are endemic (Çıplak *et al.* 1999). The high rate of endemism is possibly due to the radiation history of the genus. It is suggested that *Poecilimon* radiated from some ancestral stocks in the Old Aegeid plate in Tertiary, but main radiation has occurred during glacial periods (La Greca 1999; Çıplak 2004). Such a radiation may cause a confusing taxonomy due to the following reasons. First, a recent radiation indicates young species that may be poorly differentiated from each other. Second, there may be several slightly diverged, but reproductively not yet isolated populations, some of which were erroneously described as distinct species. Third, range changes during climatic cycles might have caused isolation of some populations in one period, their secondary contact in the following period, and so finally their hybridization. All these possible events may cause a confusing classification and prevent advanced phylogenetic and phylogeographic studies.

Ramme (1933) was the first who revised *Poecilimon* listing 68 species. After this date many new species have been described and this number has doubled (Bei-Bienko 1954; Heller *et al.* 1998; Çıplak *et al.* 1999; Ünal 2003, 2004, 2005, 2010; Eades *et al.* OSF—2011). However, in previous studies on *Poecilimon*, especially for the Anatolian species, mostly the morphology has been considered in a traditional approach, and modern methods or approaches are rarely used. Only recently some species groups were studied (Chobanov & Heller 2010; Heller & Sevgili 2005; Heller *et al.* 2006, 2008; Zhantiev & Korsunovskaya 2005; Ullrich *et al.* 2010) using new techniques.

Ramme (1933) included 15 species in his Group VIII and later (Ramme 1951) transferred them to the genus *Eupoecilimon* Tarbinsky 1932, adding some species described thereafter. However, this classification has not been followed in subsequent publications and all these species were retransferred to *Poecilimon* (Bei-Bienko 1954; Harz 1969). These species share several similarities, especially those belonging to the index vertex/scapus, shape of pronotum and male cerci (Fig. 1). The monophyly of this group is also supported by a molecular phylogenetic analysis (Ullrich *et al.* 2010). However, some of the characters used in species diagnoses are variable and the species cannot be easily distinguished from each other. For example, both elevation and width of metazona significantly vary within species and have been used in doubtful delimitation of species (e.g. compare Ramme 1951 for *P. similis* and *P. richteri*). Thus, it is necessary to reconsider the accuracy of characters used in species diagnoses.

The species united by Ramme (1951) in genus *Eupoecilimon*, which was later synonymised (see above), represent by our opinion a natural group of related taxa and following Ramme (1951) the group have to be named *P. anatolicus* group. However, according to the newly collected data (present paper), *P. anatolicus* has to be synonymised with *P. sureyanus*. Ünal (2010) has already used the name *P. sureyanus* group, though he listed here only few of the species formerly united in genus *Eupoecilimon*. He (l.c.) splits this natural grouping into few groups, including here only the species found in Turkey. He also refers only to morphology (including variable characters—see below) and thus, the latter grouping cannot reflect the natural relationships. Taking into account the published information (including molecular data—Ullrich 2010) and new information (see below) we outline the group and use the oldest published name for the group—*P. bosphoricus*.

The species *P. flavescens* (Herrich-Schäffer, 1838), type species of *Eupoecilimon* Tarbinsky, is certainly a member of the *bosphoricus* group. However, since the type (one female), which was figured and described by Fischer (1853), seems to be lost and the locality information is quite imprecise (“Südrußland” *fide* Ramme 1951 = southern Russia), it has to be treated as *species incerta*, following Ramme (1933). Ünal (2010) proposes again to use the name *Eupoecilimon* as subgenus name for the *bosphoricus* group, but for such an action the relationship to