



Karyotype of the South African katydid *Hetrodes pupus* (Linnaeus, 1758) (Orthoptera, Tettigoniidae) with special reference to relationships within the Hetrodinae subfamily

ELŻBIETA WARCHAŁOWSKA-ŚLIWA¹ & ALEXANDER G. BUGROV²

¹Institute of Systematics and Evolution of Animals, Polish Academy of Sciences, Stawkowska, 17, 31-016 Kraków, Poland

²Institute of Systematics and Ecology of Animals, Siberian Branch of Russian Academy of Sciences, 11 Frunze St., Novosibirsk 630091, Russia, and Novosibirsk State University, Pirogov St 2, Dep. Natural Sciences, Novosibirsk 630090, Russia

Abstract

The taxonomic position of *Hetrodes pupus* (Tettigoniidae, Hetrodinae) was clarified by a cytogenetic study of mitotic and meiotic chromosomes, including the localization of heterochromatin by C-banding. The karyotype of this species consists of 26 acrocentric autosomes and an acrocentric X chromosome, the largest element of the karyotype ($2n$ male=27, FN=27; sex determination system is X0 male/XX female). A cytogenetic comparative analysis of the Hetrodinae and other katydids revealed (1) the similarity of the karyotypic features of Hetrodinae and Microtettigoniinae, indicating monophyly; (2) that the morphology of the Hetrodinae karyotype is the result of parallel chromosome evolution via a decrease in the number of chromosome arms (FN).

Key words: *Hetrodes*, Hetrodinae, Orthoptera, Tettigoniidae, karyotype, C-bands

Introduction

The katydids of the subfamily Hetrodinae are distributed in Africa and southern Arabia. The subfamily comprises 14 genera and 73 species (Eades & Otte 2007). Traditionally, Hetrodinae has been included into Bradyporidae together with katydids of the subfamilies Bradyporinae, Deracanthinae (=Zichyinae), Ephippigerinae, and Pycnogastrinae (Kevan 1977, 1982, Rentz 1979, Irish 1992). Later the family status of this group was reduced to the subfamily Bradyporinae with tribes Bradyporini, Ephippigerini and Zichyini, whereas Hetrodinae were included into Tettigoniidae (Gorochov 1988, 1995, Eades & Otte 2007).

The position of the Hetrodinae in the phylogenetic tree of Tettigoniidae is still under discussion and is probably one of the most controversial aspects of Tettigoniidae phylogeny. Zeuner (1939) united the Bradyporinae, Ephippigerinae, Pycnogasterinae, Deracanthinae, Hetrodinae, and Acridoxeninae into the monophyletic Bradyporidae.

On the basis of the position of the antennae situated below the lower margin of the eyes and several other morphological characters, most authors consider Hetrodinae as the sister taxon of Bradyporinae (Zeuner 1939, Kevan 1977, 1982, Rentz 1979, Irish 1992, Storozhenko 1995). On the other hand, Gorochov (1988, 1995) placed Hetrodinae as the sister taxon to Glyphonotinae + Conocephalinae + Saginae (Fig. 1), according to a comparative analysis of fossil and traditional morphological features. Controversy is bound to result from Gorochov's aligning the Conocephalinae and Hetrodinae and the position of Microtettigoniinae, which probably are more related to the conocephaline branch than the Phasmodine-Meconematine branch (Bailey & Rentz 1990).

The phylogenetic hypothesis for all Ensifera proposed by Gwynne (1995) was based on morphological information and some behavioral characters connected with acoustical signaling and the production of