

A Comprehensive Key for Identification of the “Swarming Conehead” *Ruspolia Differens* Serville, 1838 (Orthoptera: Tettigoniidae) Occurring in the Afro-Tropical Region

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Abstract

This work reviewed the behavioural, morphological and molecular characteristics of the long-horned grasshopper *Ruspolia differens* Serville or “senene” in Swahili name (Orthoptera Tettigoniidae), as apparent in literature. On that basis, the work has generated a comprehensive key for identification of this species. As widely known, this insect native to Afro-tropical region where it is widely edible and it has a characteristic swarming behaviour that strikingly occurs during rainy season. Also, it has colour polymorphism with a total of six key sympatric colour forms, sex dimorphism with males possessing longer antennae and a unique pair of active tongue-like metathoracic flaps whereas the females have a corresponding pair of vestigial metathoracic nodules. Furthermore, the species has a pair of distinct subequal black markings on the mid and hind tibia near the knee joint and a white inter-ocular oval mark that appears like a simple eye. Its sister species which is *Ruspolia nitidula* Scopoli as verified by molecular phylogenetics is exclusively solitary, mostly greenish and Palearctic ranging in Asia, Europe and Northern Africa. Since swarming behaviour is a foremost diagnostic feature differentiating *R. differens* from other coneheads, it is worthwhile to demarcate the species with a common name “Swarming Conehead” adding to the existed names.

Keywords: *Ruspolia differens*; *R. lezoensis*; *R. nitidula*; Swarming Conehead

Introduction

The edible long-horned grasshopper, *Ruspolia differens* Serville, 1838, or “senene” in Swahili name is a well-studied insect species with well-known biology and biogeography. The species belongs to the subfamily Copiphorinae Burmeister in the family Tettigoniidae Krauss, (Syn. Conocephalidae Burmeister) of the order Orthoptera Latreille [1-3]. The name *R. differens* is accepted by the International Code of Zoological Nomenclature (ICZN) with nine synonyms namely *Conocephalus melanostictus* Karny, *C. mediotessellatus* Karny, *C. differens* Serville, *Homorocoryphus nitidulus* subsp. *vicinus*, *C. vicinus*, *C. exiguus*, *C. albidonervis*, *C. lemur*, and *C. longipennis* [4-7]. Formerly, *R. differens* was considered a subspecies (Syn. *Homorocoryphus nitidulus vicinus*) of the Palearctic species *Ruspolia nitidula* (Syn. *Homorocoryphus nitidulus nitidulus*) [1,2,8,9]. The wide understanding of this insect has overcome its taxonomic instability.

Ruspolia differens is a very widespread species throughout the Afro-tropical region, including also some islands of the Indian and Atlantic oceans [10-12]. Its geographical distribution is particularly linked with the need for a fairly even rainfall with seasonal peaks at regular intervals [5,7,10]. The species is widely consumed as a delicacy or crunchy snack in many areas of the world. In recent days, the species has also become a good source of income [12-15]. Furthermore, *R. differens* together with other *Ruspolia* spp. and their New World counterparts (the common coneheads, *Neoconocephalus* spp.) have been used as experimental animals by biologists investigating mechanisms of hearing, mechanisms of sound production and species specificity [1,9,10].

Species Identification

Behavioral Identification the Swarming Behaviour: *Ruspolia differens* can be identified by its striking swarming behaviour among tettigoniids [5,7,9,11]. The swarming phase which is mainly intended for breeding and migration of the species occurs in wet season when the environmental conditions are favourable [2,5,7,9]. On the other hand, the solitary phase occurs in dry season when breeding and migration events are hindered by the prevailing unfavourable environmental conditions. Studies have also revealed that the seasonal occurrence of swarms is genetically synchronized. In Tanzania, for example, swarms occur in the two rainy seasons per year,

that is, November and December (long rains) as well as April and May (short rains).

Morphological Identification

Colour Polymorphism: *Ruspolia differens* can also be identified by its unique colour polymorphism which apparently comprises at least six key sympatric forms (morphs) namely green, brown, purple-striped green, purple-suffused green, purple-suffused brown (Figure 1), and purple-striped brown that is very rare. Such pattern has never been reported in any other tettigoniid species. The relative occurrence frequency of these morphs changes with seasonal variation of weather for necessary camouflage of the species and, consequently, the greens dominate during rainy season when greenish vegetation dominates while the browns dominate during dry season when vegetation is largely brown due to dryness.

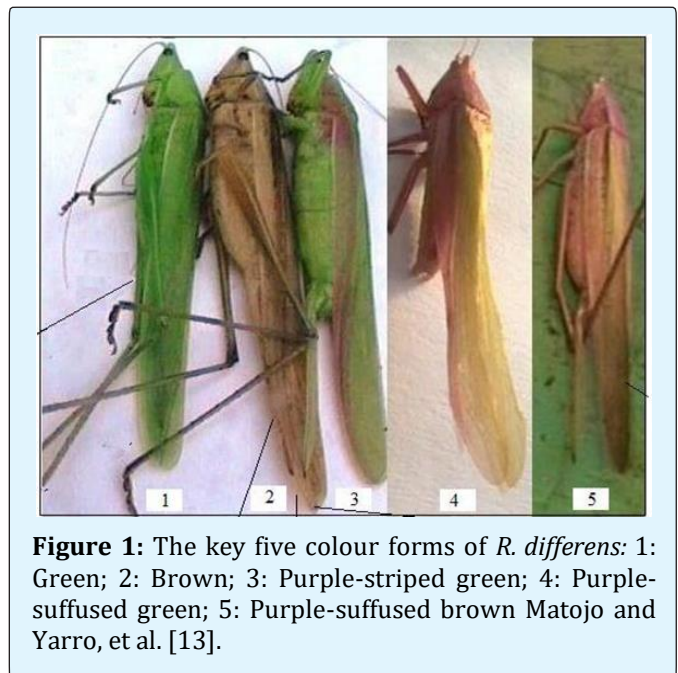


Figure 1: The key five colour forms of *R. differens*: 1: Green; 2: Brown; 3: Purple-striped green; 4: Purple-suffused green; 5: Purple-suffused brown Matojo and Yarro, et al. [13].

Paired Male Metathoracic Flaps: Also, *Ruspolia differens* has a unique sex dimorphism in which males have a smaller body size with longer antennae and a distinct pair of active tongue-like metathoracic flaps (Figure 2) whereas the females have a corresponding pair of vestigial metathoracic nodules.

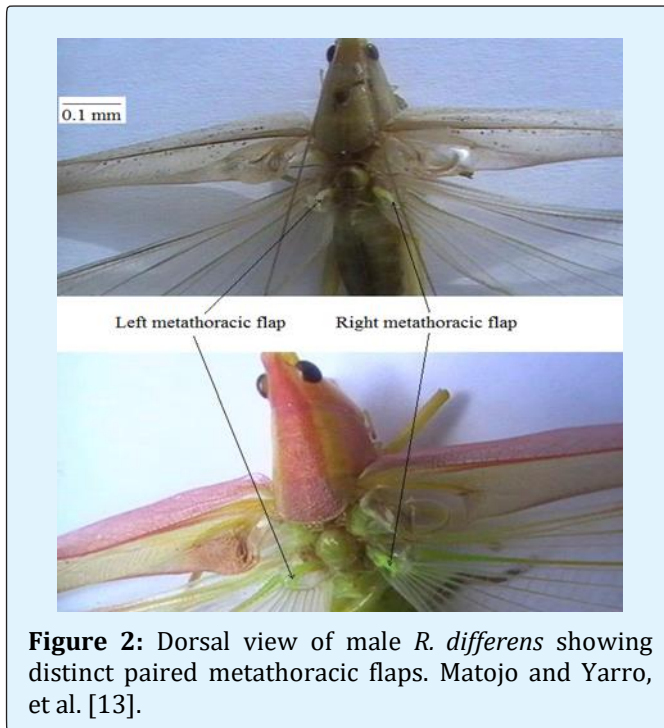


Figure 2: Dorsal view of male *R. differens* showing distinct paired metathoracic flaps. Matojo and Yarro, et al. [13].

Tibial Black Markings: *Ruspolia differens* can also be identified by its distinct pair of subequal black markings on the ventrolateral and dorsolateral positions of the mid and hind tibia near the knee joint (Figure 3). The ventrolateral marking is almost two times longer than the dorsolateral marking. Other tettigoniids have no comparable tibial markings.

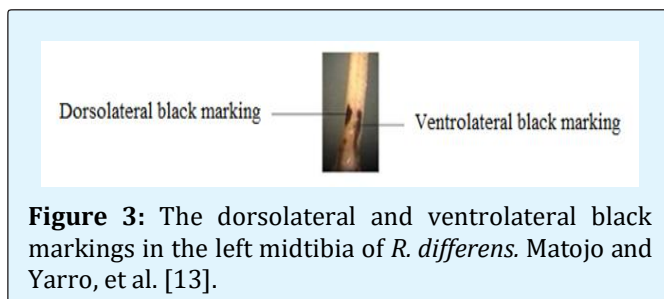


Figure 3: The dorsolateral and ventrolateral black markings in the left midtibia of *R. differens*. Matojo and Yarro, et al. [13].

A White Inter-Ocular Oval Mark: The fastigium of *R. differens* is separated from the frons by a white inter-ocular oval mark appearing like a median ocellus (i.e. simple eye) just posterior to the sulcus along the median carina (midway the two scapes) (Figure 4). The longitudinal and lateral diameters of this mark are almost one-third of those of the compound eye as described by Matojo, et al. [3].

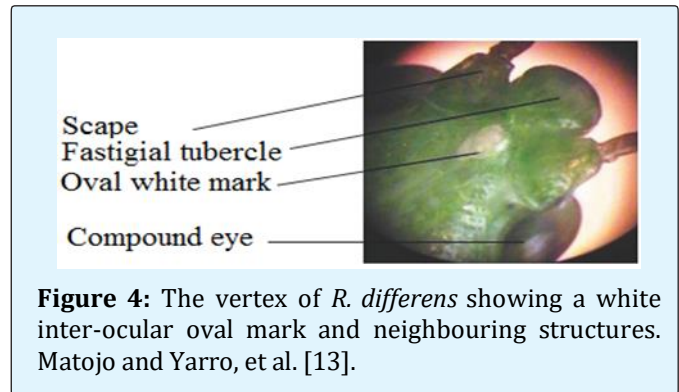


Figure 4: The vertex of *R. differens* showing a white inter-ocular oval mark and neighbouring structures. Matojo and Yarro, et al. [13].

Molecular Identification

Various molecular data of *R. differens* have been documented and registered with NCBI (National Centre of Biotechnology Information) global genebank for clear identification of the species using standard approaches. For example, Hemp, et al. documented 16S rRNA partial sequence of the species (Accession number FM882032). Likewise, Matojo, et al. [11] documented 18S rRNA partial sequence of the species (Accession Number KJ001187). Both works successfully verified that the sister species of *R. differens* is the Large Conehead, *Ruspolia nitidula* Scopoli, which is an exclusively solitary, mostly green and Palearctic species ranging in Asia, Europe and Northern Africa. Before molecular techniques, the two species were mainly considered conspecific due to their highly close morphological resemblance. Their other nearby relatives includes *R. dubia*, *R. lineosa* and *R. jezoensis*, all being native to Europe and Asia Appendix 1.

Conclusions

Based on the present review, the following conclusions are drawn in relation to *R. differens* identification:

- *Ruspolia differens* can be easily identified by its distinct five main characteristics as part of “A Comprehensive Key for identification of the Swarming Conehead, *Ruspolia differens* Serville, occurring in the Afro-tropical region” (see Appendix); the characteristics are swarming behaviour, colour polymorphism, male metathoracic flaps, paired subequal black markings on the mid and hind tibia, and a white inter-ocular oval mark that appears like a simple eye. The molecular relationship of *R. differens* agree well with its behavioural and morphological characteristics that the closest relative of this insect is the Large Conehead, *Ruspolia nitidula* which is a non-

swarming Palearctic species never reported in East Africa.

Recommendations

- Since swarming behaviour is a foremost diagnostic feature differentiating *R. differens* from other coneheads, it becomes worthwhile to demarcate the species with a common name "Swarming Conehead" adding to the existed names.
- Stakeholders are insisted to be well familiar with the distinguishing characteristics of *R. differens* for its proper handling, utilization and documentation.

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