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Two new species of *Horatosphaga* Schaum 1853 from the highlands of East Africa (Tettigoniidae: Phaneropterinae)

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Abstract

New species of *Horatosphaga* Schaum 1853 are described from the East African highlands. *Horatosphaga sabuk* n. sp. occurs in montane forest clearings of the Kenyan highlands, while *Horatosphaga nou* n. sp. is found in montane forest clearings of the Manyara District of Tanzania. Notes on habitat and co-occurring Saltatoria species are given.

Key words

katydid, Horatosphaga, Kenya, Tanzania, montane forest, new species

Introduction

The Acrometopae are a group of katydids characterized (Ragge 1960) by the lack of a fore coxal spine, and by the presence of biconchate fore tibiae, a sloping fastigium verticis and stridulatory modification of the male fore wings beyond that of the stridulatory organ itself. The most obvious feature of the group is their high degree of sexual dimorphism. A revision of African Acrometopae was made by Ragge (1960). Additional species from East Africa were described subsequently by Ragge (1961) and Hemp (2002). A listing of African Acrometopae and their distributions (Table 1) indicates *Horatosphaga* as the most diverse genus with 27 species and with its center of diversity in eastern Africa.

Materials and Methods

Identification.— Acridoidea spp. were identified to genus, using mainly the keys of Dirsh (1965), and to species by keys of e.g., Beier, (1965), Ragge (1960, 1964), Jago (1968), Descamps (1977), Grunshaw (1991) or Green (1998). The material was checked again against the entomological collections of the National Museums of Kenya, Nairobi, at the Natural History Museum, London, and the Naturkunde Museum, Berlin.

Collection plots.— Permanent plots were laid on Mt. Sabuk, Kenya, and within the Nou forest reserve of Tanzania: a modified method of Braun-Blanquet (1964) covered montane forest, bushland and open-land communities. Following this method, Saltatoria coenoses are obtained — by netting, by song recording and by visual detection. Vegetation releves, also using the Braun-Blanquet approach, were made in parallel on the same plots (A. Hemp, unpub.).

Measurements.— Total body length refers to the midline length of the insect, disregarding its tegmina. In females the ovipositor is included in body length.

Song.—Field recordings of the songs were made with a Canon 3CCD Digital Video Camcorder XM1 Pal (16 Bit, 48 kHz). With this system ultrasonic frequencies are not included. Fast Fourier transforms were obtained using DADiSP (DSP Development Corp) and displayed using Corel Draw X3. Song duration was measured from the beginning of the first clearly visible echeme to the end of the last. The terminology used in describing the oscillograms is taken from Ragge & Reynolds (1984). Background noise on the original recording of the song of *H. sabuk* was removed using the noise-reduction function of Cool Edit Pro (version 2). The song recording of one male of *H. nou* was made in natural habitat in Nou forest at night, at a distance of about 1.5 m and temperature of 18 °C; the song of one male of *H. sabuk* was recorded in the late afternoon at a distance of about 1 m and a temperature of approximately 20 °C.

Depositories.— MNB: Museum für Naturkunde, Zentralinstitut der Humboldt-Universität zu Berlin; NHML: Natural History Museum London, UK; EDNMK: Entomological Department National Museums of Kenya, Nairobi. All other material remains in the collection of the author.

Results and Discussion

Horatosphaga sabuk sp. n. Figs 1-10

Holotype Male: Kenya, Mt. Sabuk, summit Mt. Sabuk, on herbaceous vegetation in bushland, 2155 m, March 2005, C. Hemp coll., depository NMB.

Paratypes: all Kenya. 1 female, same collection data as holotype, depository NMB. 1 male, same collection data as holotype, depository NHML. 1 male, same collection data as holotype, depository EDNMK.

Additional material examined, all Kenya, all C. Hemp coll.: 4 males, same data as holotype. 2 males May 2005, Mt. Sabuk, 1900 m on herbaceous vegetation along forest path. 1 female, May 2006, 2100 m, Mt. Machakos, forest edge of *Eucalyptus* plantation.

Description.— Male: Color: green to yellowish green; stridulatory area of right tegmen with brownish markings along stridulatory veins (Figs 1, 9). Head and antennae: antennae reddish from base to about two thirds of length, last third whitish; length of antennae about 2.5 times as long as length of insect; cuticle of head smooth,



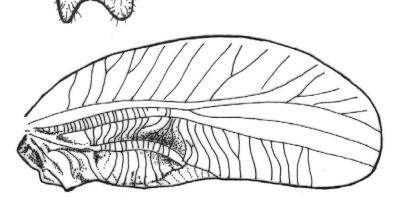
Fig. 1. Dorsal view of male *H. sabuk* stridulatory area.



Fig. 2. Dorsal view of head of male *H. sabuk* showing fastigium of the vertex.



Fig. 3. Lateral view of pronotum and stridulatory area of male *H. sabuk*.



apex of H. sabuk.

Fig. 4. Dorsal view of male abdominal

Fig. 6. Right forewing of male *H. sabuk*.

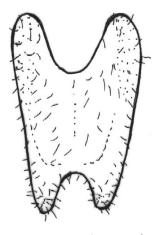


Fig. 5. Ventral view of male subgenital plate of *H. sabuk*.

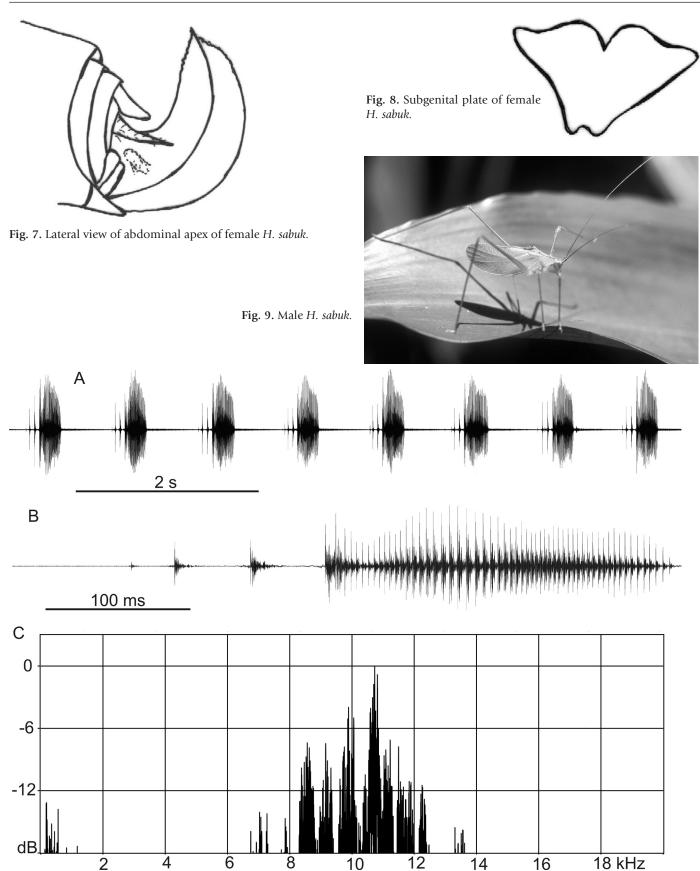


Fig. 10. *Horatosphaga sabuk.* A. Eight echemes from the continuing song. B. One of these echemes at higher time resolution. C. Spectrum; FFT calculated on time sample in B. Y axis expresses dB relative to the most intense frequency.

fastigium of vertex shallow sulcate between eyes, forming a conus in front of eyes (Fig. 2); eyes small, circular. Thorax: pronotum without lateral carinae, but in this area a pair of thin brownish fasciae; irregular grooves on lateral lobes of pronotum (Fig. 3). Tegmina and wings: tegmina well surpassing body, ratio length to width about 2.5; venation of right fore wings as in Fig. 6; alae reduced, hidden under fore wings, about 3.5 to 4.0 mm long. Legs: tympanic auricles conchate, area slightly inflated; fore, middle and hind femora with two to eight minute black spines ventrally in two rows; tibiae with minute black spinules in four rows, in hind tibiae these spinules occuring more densely; tarsi yellowish (Fig. 9). Genitalia: subgenital plate incised posteriorly into two lobes (Figs 4, 5); tenth abdominal tergite unmodified, cerci slender and crossing each other (Fig. 4).

Measurements.— Males (n = 9). Total length of body: 13 to 16 mm (mean 14.3). Median length of pronotum: 3.7 to 4.2 mm (mean 3.9). Length of hind femur: 18 to 22 mm (mean 20). Length of tegmina: 15 to 18 mm (mean 17).

Female: General facies: color green to yellowish green. Thorax: pronotum dorsally broader than in male. Tegmina: broader along whole length compared to male and rounded at apex, venation faint; hind wing 3.5 mm. Legs: as in male. Genitalia: subgenital plate as in Fig. 8; ovipositor short, stout, up-curved, serrate at apex; cerci slender and straight (Fig. 7).

Measurements.— Female (n=1). Total length of body: 22 mm. Median length of pronotum: 4.5 mm. Length of hind femur: 17 mm. Length of tegmina: 20 mm. Length of ovipositor: 6 mm.

Diagnosis.— *Horatosphaga sabuk* is another *Horatosphaga* species with reduced hind wings in both sexes. At present in this genus five species with reduced or absent hind wings are known. In two of them, *H. meruensis* (Sjöstedt, 1909) and *H. nuda* Ragge 1960, the tegmina are about four times longer than their maximum width. In *H. sabuk* the tegmina are broader (ratio length to width about 2.5).

Horatosphaga species with reduced hind wings and broad fore wings are *H. montivaga* (Sjöstedt 1909), *H. nou* n.sp. and *H. nomina* (Karsch, 1896). These three species appear to be closely related within the genus. The genitalia of all three species are very similar, e.g., an emarginate tenth abdominal tergite and a large supra-anal plate. *H. montivaga* and *H. nou* share a verrucose pronotal disc and spotted fore wings, characters not known for any other *Horatosphaga* species including *H. sabuk*.

Habitat.— H. sabuk inhabits herbaceous vegetation along montane forest edges and within clearings on Mt. Sabuk and Mt. Machakos in the Kenyan highlands. It was taken from the lower forest border at the top of Mt. Sabuk, at about 1850 to 2155 m, and at the edge of a forest remnant at 2100 m altitude on Mt. Machakos.

In a small clearing within Cassipourea forest near the road at 1900 m, H. sabuk was found syntopic with Amytta abbreviata Beier 1967, Gymnobothroides keniensis Johnston 1937, Heteracris brevipennis (I. Bolivar 1914), Heteropternis couloniana (Saussure 1884), Tylopsis fissa Ragge 1967, Lophothericles sp., Odontomelus pallidus Sjöstedt 1912, Parepistaurus deses nairobii Green 1998, Phlesirtes sp., Taphronota calliparea dimidiata Bolivar 1904, and Peronura clavigera Karsch 1888. At this altitude the forests are in part heavily degraded due to fires and grazing and as soon as the structure of the forest is lost, H. sabuk is no longer found. By contrast, on top of Mt. Sabuk at 2155 m, H. sabuk was abundant in 1 to 2 m-high degraded bushland: here

it lives syntopic with Heteracris brevipennis, Odontomelus pallidus, Gymnobothroides keniensis, Phlesirtes sp. and Amytta abbreviata.

Song.— Males of *H. sabuk* start their clearly audible calling songs in the late afternoon (Fig. 10), sitting motionless and well camouflaged in dense herbaceous vegetation along forest edges or at the edge of degraded bushland on top of Mt. Sabuk. The song is performed continuously. Fig 10 A shows eight echeme repetitions, excerpted from the song. Each echeme begins with a few impulse sounds, rapidly decaying pulses relatively well separated in time, followed by a long train of such pulses regularly given and overlapping closely in their decay. These latter pulses recur at a high rate and with a characteristic overall amplitude envelope. The form of this echeme is shown at higher resolution in Fig. 10 B. The spectrum (Fig. 10 C) is that of the time-domain sample of Fig 10 B. Carrier frequencies are distributed between 8 and 12 kHz, with their greatest intensity near 13 kHz.

Horatosphaga nou sp. n. Figs 11-22

Holotype Male: Tanzania, Manyara District, Nou Forest Reserve, herbaceous vegetation at forest edge and in forest clearings, 2100 m, Feb 2005, C. Hemp coll., depository NMB.

Paratypes: All Tanzania. 1 female, same collection data as holotype, depository NMB. 1 male, same collection data as holotype, depository NHML. 1 female, same collection data as holotype, depository NHML. 1 male, same collection data as holotype, depository EDNMK. 1 female, same collection data as holotype, depository EDNMK.

Additional material examined, all Tanzania, all C. Hemp coll. 5 males, 2 females, 5 nymphs, same data as holotype.

Description. - Male: Color: dark green, stridulatory area of right tegmen, margins of tegmina, and anterior margin of pronotum bordered yellow (Fig. 19). In preserved insects colors fading to dull green or near tawny; lateral cream-colored lines behind eyes. Head and antennae: antennae dark with white markings at each segment, this color fading in dried insects; length of antennae about three times as long as body length; cuticle of head smooth, fastigium of vertex sulcate between eyes, forming a conus in front of eyes (Fig. 11); eyes small, circular. Thorax: pronotum without lateral carinae; verrucose pronotal disc, sometimes with darker dorsal markings (Fig. 15). Tegmina and wings: tegmina surpassing body by about one third, ratio length to width about 2.7; venation of right forewings as in Fig. 14; irregular black spots present all over tegmina; alae much reduced, hidden under tegmina, about 3.0 to 3.5 mm long. Legs: tympanic auricles conchate; fore femora unarmed, mid and hind femora with five to 12 spines ventrally, anterior row shiny black while posterior rows (of spinules) of same green color as legs; fore and mid tibiae with eight to 12 minute spinules, in two rows ventrally, hind tibiae with numerous small spinules in four rows. Genitalia: subgenital plate incised posteriorly into two small lobes (Figs 12, 13); tenth abdominal tergite unmodified; cerci slender, with incurved tips (Fig. 12).

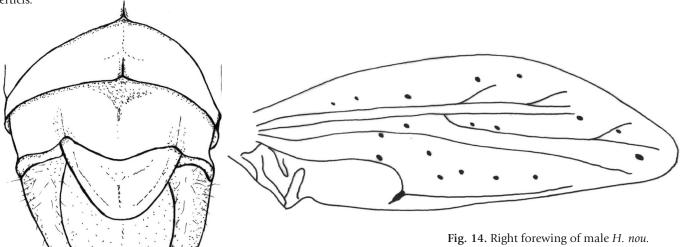
Measurements.— Males (n = 9). Total length of body: 16 to 20 mm (mean 18.6). Median length of pronotum: 5.2 to 5.7 mm (mean 5.4). Length of hind femur: 22-27 mm (mean 24.4). Length of tegmina: 17 to 20 mm (mean 18.7).

Female: (Fig 21) General facies: color dark green, yellow lines



Fig. 13. Ventral view of male subgenital plates of *H. nou* (left) and

Fig. 11. Dorsal view of head of male of *H. nou* showing fastigium verticis.



H. montivaga (right).

Fig. 12. Dorsal view of male abdominal apex of *Horatosphaga*



Fig. 15. Lateral view of pronotum of male H. nou.

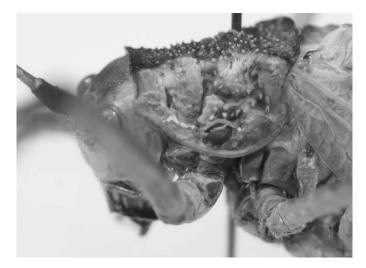


Fig. 16. Lateral view of pronotum of male H. montivaga.

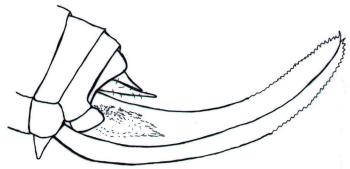


Fig. 17. Lateral view of abdominal apex of female H. nou.



Fig. 19. Male Horatosphaga nou.



Fig. 21. Female Horatosphaga nou.

not as apparent as in males (Fig. 20). Thorax: pronotum dorsally broader than in male. Tegmina: tegmina broader along whole length compared to male and rounded at apex, venation faint. Legs: as in male. Genitalia: subgenital plate broadly heart shaped (Fig. 18, left). Ovipositor slender, up-curved, serrated at apex. Cerci slender and straight (Fig. 17).

Measurements.— Females (n = 5). Total length of body: 29-38 mm (mean 33.6). Median length of pronotum: 5.5-6.7 mm (mean 6.1). Length of hind femur: 22-25 mm (mean 23.8). Length of tegmina: 17-23 mm (mean 20.8). Length of ovipositor: 12-15 mm (mean 13.6).

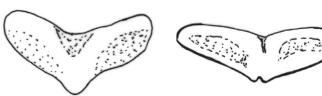


Fig. 18. Female subgenital plates. Left, H. nou; Right, H. montivaga.



Fig. 20. Male *H. montivaga*. Note dark pronotal fascia and verrucose pronotal disk. Clearly visible also are the black spots of the fore wings, typical for both *H. montivaga* and *nou*.

Diagnosis.— Horatosphaga nou is very closely related to H. montivaga (Sjöstedt 1909), this latter species being endemic to the areas of Tanzania defined by Mts Kilimanjaro and Meru. As does H. montivaga, H. nou has a verrucose pronotal disc, formerly regarded as a unique character for H. montivaga within the genus Horatosphaga (Ragge 1960). However, in H. nou the pronotal disc is not as strongly verrucose as in H. montivaga (compare Figs 15, 16). Both species also share spotted forewings, a character unknown for any other Horatosphaga species. The genitalia of both species are very similar, except for differences in the subgenital plates of both sexes (Figs 13, 18).

Ragge (1960) noted that the closest relative to *H. montivaga* is *H. nomina* (Karsch, 1896) from the Mpwapwa plateau of Tanzania, and writes that *H. montivaga* resembles *H. nomina* in every feature of taxonomic importance except the verrucose pronotal disc and spotted forewings. Since *H. nou* also shares with *H. montivaga* — in addition to an almost identical habitus and similar genitalic morphology — the verrucose pronotal disc and spotted forewings, a new link is established between *H. nomina*, occurring on the more southern-situated highlands around Mpwapwa in central Tanzania, and the Meru-Kilimanjaro area of northern Tanzania; this link may be found to reflect former migration events and speciation processes in the montane areas of Tanzania.

Two more species with an unmodified tenth abdominal tergite having reduced hind wings are *H. meruensis* (Sjöstedt, 1909) and *H. nuda* (Ragge 1960). Both species have narrow forewings and thus a different habitus in comparison to *H. nou.* Furthermore they are confined to small areas within East Africa. *H. meruensis* is

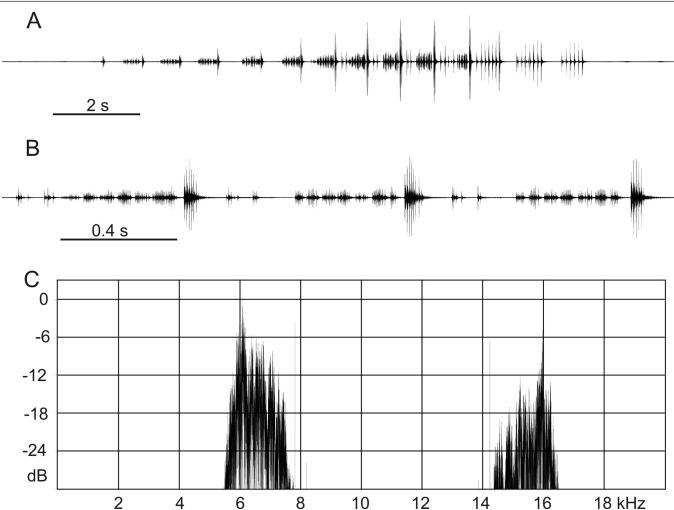


Fig. 22. *Horatosphaga nou.* A. One song of 14 echemes. B. Three of the highest intensity echemes at higher time resolution. C. Spectrum; FFT calculated on time sample in B. Y axis expresses dB relative to the most intense frequency.

only known from the Mt. Kilimanjaro-Mt. Meru area of northern Tanzania, and this species also inhabits a completely different habitat from *H. nou*. While *H. nou* is restricted to forest edges and forest clearings on mountains, *H. meruensis* inhabits colline and submontane grasslands around Mt. Meru and Mt. Kilimanjaro. *H. nuda* is known only from the Imatong Mts in southern Sudan. It also seems to be a species adapted to high altitudes [2700-2900 m, Ragge (1960)] but no further data are given on its habitat by this author where this species was collected.

Song.— Males of H. nou perform their calling songs after sunset. The song (Fig. 22A) lasts 7 to 10 s, and is comprised of ~14 echemes. It starts very faintly, rising in loudness and fading again. A stereotyped pulse structure is repeated within each echeme (Fig. 22B). There are two well-distinguished peaks within the spectrum, a lower peak near 6kHz (5.6-7.5 kHz wide 18dB down) and a higher near 16kHz (14.8-16.3 kHz wide 18dB down). The peaks are not harmonically related.

The insects sang irregularly and had gaps of silence of variable length between each single song. During these gaps most of the insects changed perch in the vegetation.

Habitat.—*H. nou* inhabits herbaceous vegetation along montane forest edges and in clearings of the Manyara Escarpment of Tanzania.

It was found from the lower forest border at 1800 m to 2100 m.

In herbaceous vegetation along a forest path through Nou forest at 2100 m, H. nou lives syntopic with Phaeocatantops sp., Phlesirtes sp., Chromothericles sp., Gymnobothroides sp., Parepistaurus deses manyara (Green 1998), Amytta sp., Monticolaria sp. and Heteropternis couloniana (Saussure 1884).

Remarks.—The discovery of *H. nou* suggests a former close relationship between the Meru-Kilimanjaro area and the Manyara Escarpment. This is further supported by other Saltatoria also found in the Nou forest reserve, such as a new *Monticolaria* species. The genus *Monticolaria* was previously known only from the Kilimanjaro-Meru area where two species have been described by Sjöstedt (1909). Nou forest also harbors new species of *Chromothericles*, *Amytta* and *Aerotegmina*, and these are also typical genera in the forests of Kilimanjaro and Meru.

Acknowledgements

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Table 1. African Acrometopae species.

Species	Distribution
Horatosphaga concava Ragge, 1960	Sudan, Kenya
Horatosphaga crosskeyi Ragge, 1960	Nigeria
Horatosphaga diminuta (Chopard, 1954)	Kenya
Horatosphaga elgonis (Chopard, 1938)	Kenya and Uganda, Aberdares and Mt. Elgon
Horatosphaga elongata (Rehn, 1914)	Zaire, Rwanda, Burundi
Horatosphaga gracilis (Sjöstedt, 1912)	Kenya, Mt. Kenya
Horatosphaga heteromorpha (Karsch, 1888)	East Africa
Horatosphaga inclusa (Karsch, 1893)	Ghana, Togo
Horatosphaga leggei (Kirby, 1909)	montane areas of East Africa and Zaire
Horatosphaga linearis (Rehn, 1914)	montane areas of Rwanda, Uganda, Tanzania
Horatosphaga longipes (Bolivar, 1922)	montane areas of Kenya
Horatosphaga magna Ragge, 1960	Ethiopia, Kenya
Horatosphaga media Ragge, 1960	Zimbabwe, Zambia, Tanzania, Zaire, Angola
Horatosphaga meruensis (Sjöstedt, 1909)	Tanzania, Mts Meru and Kilimanjaro
Horatosphaga montivaga (Sjöstedt, 1909)	Tanzania, Mts Meru and Kilimanjaro
Horatosphaga nomina (Karsch, 1896)	Tanzania
Horatosphaga nuda Ragge, 1960	Sudan, Uganda
Horatosphaga parensis Hemp, 2002	Tanzania, North and South Pare Mts.
Horatosphaga regularis (Bolivar, 1922)	Kenya
Horatosphaga ruspolii (Schulthess, 1898)	Ethiopia, Somalia, Uganda, Kenya
Horatosphaga serrifera Schaum, 1853	Tropical Africa south of the equator
Horatosphaga somali (Schulthess, 1898)	Somalia, Ethiopia
Horatosphaga stuhlmanni (Karsch, 1896)	Zaire
Horatosphaga stylifera (Karny, 1910)	Namibia, Angola
Horatosphaga vicina (Chopard, 1954)	Kenya
Horatosphaga nou n. sp	Tanzania, Manyara Escarpment
Horatosphaga sabuk n.sp.	montane areas of Kenya
Peronura clavigera Karsch, 1888	East Africa
Peronura uguenoensis Hemp, 2002	Tanzania, North Pare Mts.
Prosphaga calaharica (Karny, 1910)	Botswana
Prosphaga splendens Ragge, 1960	Ethiopia
Conchotopoda belcki Karsch, 1887	Namibia, South Africa
Conchotopoda crassicauda Ragge, 1960	South Africa
Conchotopoda grallatoria (Stål, 1856)	South Africa
Conchotopoda leptocerca (Stål, 1876)	Namibia
Conchotopoda parva Ragge, 1960	South Africa
Lamecosoma inermis Ragge, 1961	Kenya, Tanzania
Lamecosoma tenuis Ragge, 1960	Zambia