

RESEARCH PAPER

Contribution to the knowledge of Batrachideini (Orthoptera: Tetrigidae): description of two new flightless genera, *Naskreckiana* and *Procellator*, and revision of the status of *Eotetrix*

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Abstract. Two new genera of pygmy grasshoppers belonging to the subfamily Batrachideinae (Orthoptera: Tetrigidae) are described from Central America, each including a single new flightless species. *Naskreckiana kosemeni* Kasalo, Buzzetti & Skejo gen. & sp. nov. is described from Costa Rica, *Procellator kai* Kasalo, Skejo & Cambra gen. & sp. nov. is described from Panama. Facts suggesting that †*Eotetrix* Gorochoy, 2012, stat. restit., is not a synonym of *Tettigidea* Scudder, 1862 are discussed. The dichotomous key to Batrachideini by SILVA et al. (2021) is updated with the inclusion of these two new genera. Currently, the tribe Batrachideini includes 14 extant genera and 61 extant species.

Resumen. Se describen dos géneros nuevos de saltamontes pigmeos (Orthoptera: Tetrigidae: Batrachideini: Batrachideinae) de América Central. Cada género nuevo contiene una especie nueva sin alas. *Naskreckiana kosemeni* Kasalo, Buzzetti & Skejo gen. & sp. nov. es descrito de Costa Rica, mientras que *Procellator kai* Kasalo, Skejo & Cambra gen. & sp. nov. es descrita de Panamá. Discutimos y sugerimos que †*Eotetrix* Gorochoy, 2012, stat. restit., no es un sinónimo de *Tettigidea* Scudder, 1862. Una clave dicotómica para la identificación de géneros de Batrachideini por SILVA et al. (2021) es actualizada con la inclusión de dos géneros nuevos. En la actualidad, la tribu Batrachideini incluye 14 géneros y 61 especies no extintas.

Key words. Orthoptera, Caelifera, Batrachideinae, fossil, new genera, new species, iNaturalist, Central America, Neotropical Region

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Introduction

Central America is a nature's treasure where, despite the centuries-long research tradition in zoology and botany, new species of vertebrates (RAY et al. 2023), insects (ENGEL 2022), plants (LOIS et al. 2023), and fungi (MANZ et al. 2021) are still being discovered and described. The information on the pygmy grasshoppers (Orthoptera: Tetrigidae) of Central America remained brief and scattered until a literature review and checklist were produced (KASALO et al. 2023). Although this publication represents a major step forward, it is now abundantly clear that the

work in question is just a starting point for the research of pygmy grasshoppers in the region.

Online social media provide a constant flow of data that can be used in scientific research (MESAGLIO et al. 2021). It is not a rarity for new species to be discovered online, especially when insects are concerned (JAISWARA et al. 2022). The undescribed diversity of pygmy grasshoppers, especially in the tropics, remains enormous (ITRAC-BRUNEAU & DOUCET 2022) and will certainly not cease to entertain researchers any time soon. iNaturalist and Facebook provide good platforms where photographs of



specimens can be posted, their identifications discussed, and collaborations forged. The local (citizen) scientists can collect specimens, deposit them in a museum and thus allow the taxa they discover in the field to get proper names. This study, focused on Central American Batrachideini, represents a collaborative effort between professional orthopterists, museum curators, and citizen scientists in describing peculiar new taxa.

Batrachideinae is a diverse subfamily within Tetrigidae (CIGLIANO et al. 2023). The subfamily is divided into 3 tribes. Bufonidini Hancock, 1907 are distributed in Australia, New Guinea, New Caledonia, and the Solomon Islands (STOROZHENKO 2019, CIGLIANO et al. 2023). Cassittigini Yin, 1984 occur in Africa, Indochina and the islands of SE Asia, and New Guinea (STOROZHENKO 2019, CIGLIANO et al. 2023). Batrachideini Bolívar, 1887, the nominotypical tribe, is mostly confined to the Americas, with a single European fossil representative (STOROZHENKO 2019, THOMAS et al. 2019, CIGLIANO et al. 2023).

Until now, the tribe Batrachideini was composed of 12 extant genera and one monotypic genus with an extinct species, †*Danatettix hoffeinsorum* Thomas, Skejo & Heads, 2019, which is the only European representative of the tribe. The other monotypic genus with an extinct representative, †*Eotettix* Gorochoy, 2012 stat. restit., was synonymized with *Tettigidea* Scudder, 1862, with the species †*Eotettix unicornis* Gorochoy, 2012 being assigned to the *Tettigidea (armata)* species group (SILVA et al. 2021). This taxonomic act is reviewed in this study. There are known undescribed species of Batrachideini (KASALO et al. 2021, ITRAC-BRUNEAU & DOUCET in press), and the taxonomy of the tribe needs further work (KASALO et al. 2023), making the research of Batrachideini a lucrative effort.

The aim of this paper is to describe two monotypic genera, one from Costa Rica and the other from Panama, and to discuss the status of †*Eotettix* Gorochoy, 2012 stat. restit. An updated key to the extant Batrachideini genera is provided.

Materials and methods

Acquisition of specimens. *Procellator kai* gen. & sp. nov. was discovered by Kai Squires, who photographed and collected a specimen and posted it to iNaturalist (<https://www.inaturalist.org/observations/147731362>). The photograph was seen by the authors, who contacted Squires and asked him to collect more material for the study. Squires conducted several trips to the type locality with permission from the owner of the Cocobolo Nature Reserve, provided more data, and deposited the holotype at the Museo de Invertebrados G.B. Fairchild (MIUP), University of Panama. Kai Squires provided all of the photographs of this species. The specimens were photographed using a Panasonic FZ80 digital camera.

The specimen that was subsequently designated as the holotype of *Naskreckiana kosemeni* gen. & sp. nov. was found in Museo Civico di Rovereto, Italy (MCRI) by the last author. The genus was already known to exist (KASALO et al. 2023) but could not be described due to the lack of

physical specimens. The photographs of the holotype were taken by the second author using an ASKANIA MZM 1 optical microscope and a Samsung Galaxy A5 phone camera. Additional photographs were obtained from Roland Lupoli and Piotr Naskrecki.

Photographs of the digitalized specimens of †*Eotettix unicornis* Gorochoy, 2012 were examined through the website maintained by the Smithsonian Institution, National Museum of Natural History.

Taxonomy, morphological terminology and nomenclature. Taxonomy follows CIGLIANO et al. (2023). Morphological terminology follows TUMBRINCK (2014). Measurements follow TUMBRINCK (2014) and STOROZHENKO & PUSHKAR (2015). Specimens photographed next to a ruler were measured using the ImageJ 1.53t software. Nomenclature follows the International Code of Zoological Nomenclature (ICZN 1999). Illustrations were made using Microsoft PowerPoint.

Taxonomy

Family Tetrigidae Rambur, 1838 Subfamily Batrachideinae Bolívar, 1887 Tribe Batrachideini Bolívar, 1887

Composition and distribution. With the two new genera described in this paper and the revised status of †*Eotettix* stat. restit., the tribe Batrachideini includes 2 extinct genera, each with one species, and 14 extant genera, altogether with 61 described extant species: *Batrachidea* Serville, 1838 (5 species), *Cranotettix* Grant, 1955 (1 species), *Eutettigidea* Hancock, 1914 (1 species), *Halmatettix* Hancock, 1909 (5 species), *Lophoscirtus* Bruner, 1910 (1 species), *Paurotarsus* Hancock, 1900 (2 species), *Paxilla* Bolívar, 1887 (4 species), *Plectronotus* Morse, 1900 (2 species), *Puiggaria* Bolívar, 1887 (1 species), *Rehmidium* Grant, 1956 (4 species), *Scaria* Bolívar, 1887 (12 species + 1 undescribed), *Tettigidea* (21 species), *Naskreckiana* gen. nov. (1 species), *Procellator* gen. nov. (1 species) (SILVA et al. 2021, KASALO et al. 2021, CIGLIANO et al. 2023).

One extinct European genus and species, †*Danatettix hoffeinsorum*, is known from the Baltic amber, while another, North-American †*Eotettix unicornis*, is known from the sediments of the Green River Formation (GOROCHOV & LABANDEIRA 2012). Extant members of the tribe Batrachideini inhabit the Americas. The greatest number of Batrachideini genera is found in Central America, with 7 genera (*Cranotettix*, *Naskreckiana* gen. nov., *Paurotarsus*, *Plectronotus*, *Procellator* gen. nov., *Scaria*, *Tettigidea*) and Southern America, with 9 genera (*Batrachidea*, *Eutettigidea*, *Halmatettix*, *Lophoscirtus*, *Paurotarsus*, *Puiggaria*, *Rehmidium*, *Scaria*, *Tettigidea*). Six out of 14 Batrachideini genera with extant representatives, namely *Cranotettix*, *Lophoscirtus*, *Naskreckiana* gen. nov., *Procellator* gen. nov., *Eutettigidea*, and *Puiggaria*, are currently monotypic. North America (Canada, the United States of America, and Mexico) is inhabited by 8 species of *Tettigidea* and 4 species of *Paxilla*. The latter

genus is the only genus of Batrachideinae endemic to the Nearctic Region (SILVA et al. 2021, CIGLIANO et al. 2023).

Updated key to Batrachideini genera

The most recent key to Batrachideini genera (SILVA et al. 2021) is updated with the newly-described genera and in some cases with a focus on different diagnostic characters.

- 1 Eyes strongly elongated and tear-shaped in dorsal view, slanting inwards (Fig. 1A). 2
- Eyes round or slightly elongated in dorsal view, not significantly slanting inwards (Fig. 1A). 3
- 2 Brachypronotal; alae absent, tegmina present; pronotum arcuate in lateral view; anterior margin of pronotum smooth; pronotal apex reaching terminalia.
..... *Paxilla* Bolívar, 1887
- Macro- or brachypronotal; brachypronotal forms of variable shape, but never with combination of characters listed for *Paxilla*. .. *Tettigidea* Scudder, 1862
- 3 Vertex projecting upwards in front of eyes; body distinctly laterally compressed (humeral angles as wide as outer margins of eyes); anterior margin of vertex with elevated carinae. *Lophoscirtus* Bruner, 1910
- Vertex differently developed but never projecting upwards; body not laterally compressed; humeral angles wider than eyes; carinae of vertex differently elevated. 4
- 4 Median carina of pronotum elevated throughout most of its length (Fig. 1B). 5
- Median carina of pronotum not elevated throughout its length (Fig. 1B). 10
- 5 Anterior pronotal protrusion in form of thin spine. ..
..... *Puiggaria* Bolívar, 1887
- Anterior pronotal protrusion wide, and covering large part of vertex. 6
- 6 Median carina of pronotum not or only faintly undulated in lateral view (Fig. 1C). 7
- Median carina of pronotum moderately to strongly undulated in lateral view (Fig. 1C). 9
- 7 Anterior pronotal protrusion reaching far beyond vertex; median carina of pronotum weakly undulated in lateral view (Fig. 1C). *Cranotettix* Grant, 1955
- Anterior pronotal protrusion barely surpassing vertex or shorter; median carina of pronotum weakly or not at all undulated in lateral view (Fig. 1C). 8
- 8 Median carina of pronotum not undulated in lateral view, highest above prozona and slightly lowering towards apex of pronotum (Fig. 1C).
..... *Halmatettix* Hancock, 1909
- Median carina of pronotum weakly undulated in lateral view, highest above prozona and moderately lowering towards apex of pronotum (Fig. 1C).
... *Naskreckiana* Kasalo, Buzzetti & Skejo **gen. nov.**
- 9 Median carina of pronotum strongly undulated in lateral view, with large elevation above prozona (Fig. 1C).
... *Procellator* Kasalo, Skejo & Cambra **gen. nov.**

- Anterior third of median carina of pronotum moderately undulated in lateral view, with small elevation above prozona (Fig. 1C). *Plectronotus* Morse, 1900
- 10 Ventral sinus of paranota almost absent; anterior pronotal spine absent; third segment of hind tarsus shorter than first. *Paurotarsus* Hancock, 1900
- Ventral sinus of paranota distinct; anterior pronotal spine present; third segment of hind tarsus as long as first or longer. 11
- 11 Vertex surpassing level of eyes in dorsal view; vertex rectangular in dorsal view; wings longer than pronotum. *Eutettigidea* Hancock, 1914
- Vertex at level of eyes in dorsal view or shorter; vertex triangular in dorsal view; wings barely surpassing pronotum, as long as pronotum or reduced. 12
- 12 Vertex at level of eyes in dorsal view.
..... *Batrachidea* Serville, 1838
- Vertex not reaching level of eyes in dorsal view. 13
- 13 Macropronotal; presence of strong hooked spine in anterior part of pronotum; tegmina of most species with diverse markings ranging from large dots and stripes to small dots. *Scaria* Bolívar, 1887
- Usually micropronotal; tegmina (if present) with small dot. *Rehndidium* Grant, 1956

Note on the key. The key provided here is meant to serve as preliminary assistance to researchers and citizen scientists in identifying Batrachideini genera. Most of these genera are in need of a revision (see Discussion), thus it should not be expected that the key works for all the species of the genera concerned.

Naskreckiana Kasalo, Buzzetti & Skejo **gen. nov.**

(Figs 2–4)

Type species. *Naskreckiana kosemeni* Kasalo, Buzzetti & Skejo sp. nov., by original designation.

Diagnosis. Most similar to the Batrachideini genera with an elevated median carina of the pronotum: *Cranotettix*, *Halmatettix*, *Plectronotus*, and *Procellator*. The following set of characters allows this genus to be separated from all other Batrachideini members: (1) frontal costa bifurcation in the upper third of the eye height, (2) middle line of the antennal grooves at the bottom margin of the eyes, (3) anterior spine reaching approximately to the anterior level of eyes, (4) median carina of pronotum mostly smooth, elevated throughout its length, highest in the anterior third of its length.

Etymology. The genus is named after Piotr Naskrecki, who was the first to record this new genus in its natural habitat. The genus name is derived from his surname and is a feminine noun. Piotr Naskrecki is a famous zoologist, photographer, and fieldwork biologist, who made a huge contribution to orthopterology by describing 138 currently valid taxa (one tribe, 15 genera, 118 species, and 4 sub-species).

Composition and distribution. The genus includes a single species, *Naskreckiana kosemeni* Kasalo, Buzzetti & Skejo sp. nov., for now known only from Costa Rica.

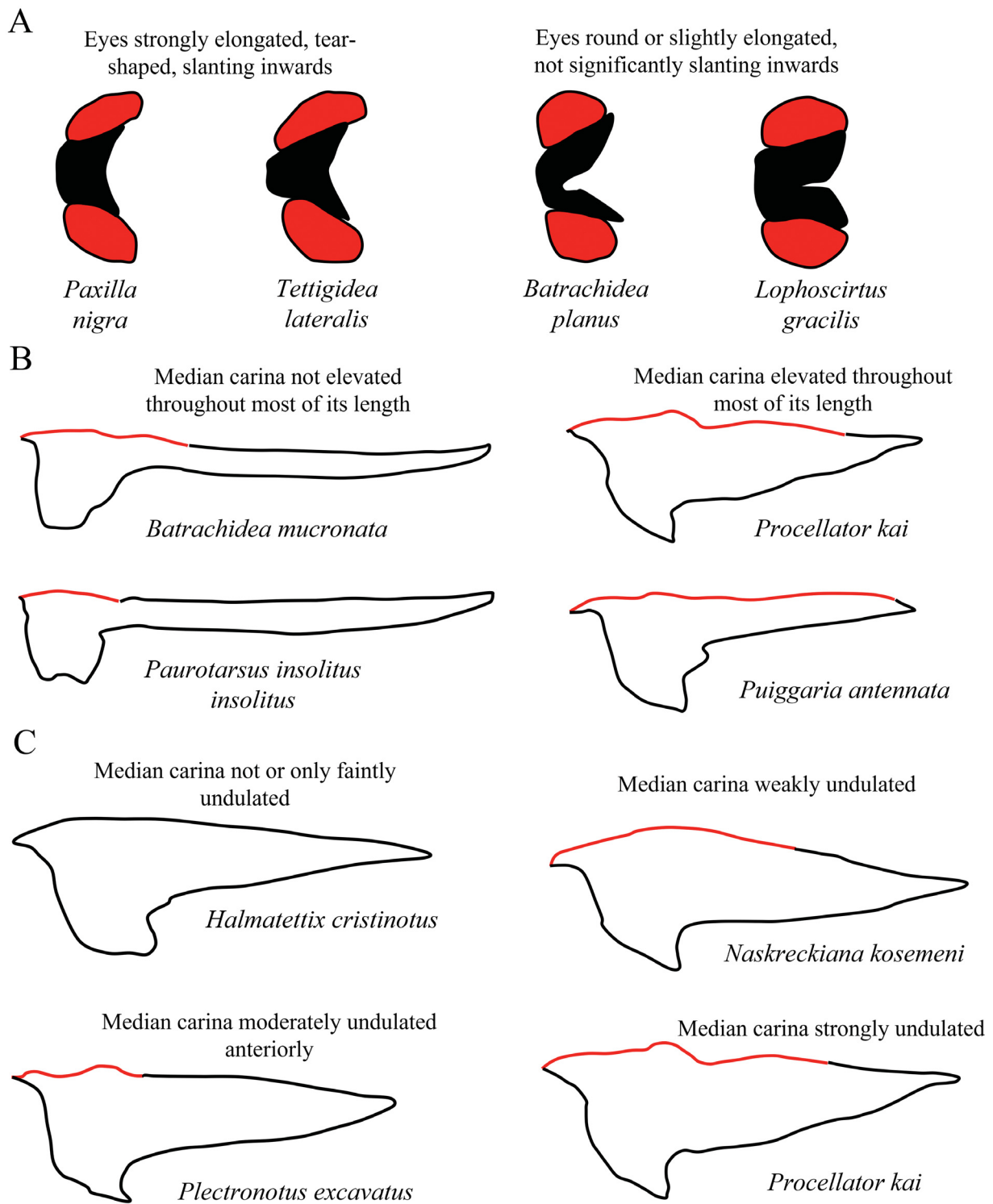


Fig. 1. Illustrations of some of the characters used in the key. A – shape of the eyes; B – elevation of the median carina of the pronotum; C – undulations of the median carina of the pronotum. The drawings were made after photographs taken by Josef Tumbrinck, Daniela Silva, Marcelo Pereira, Josip Skejo, Jadranka Škorput, Filippo Maria Buzzetti, and Holger Braun, available on the Orthoptera Species File website (CIGLIANO et al. 2023).

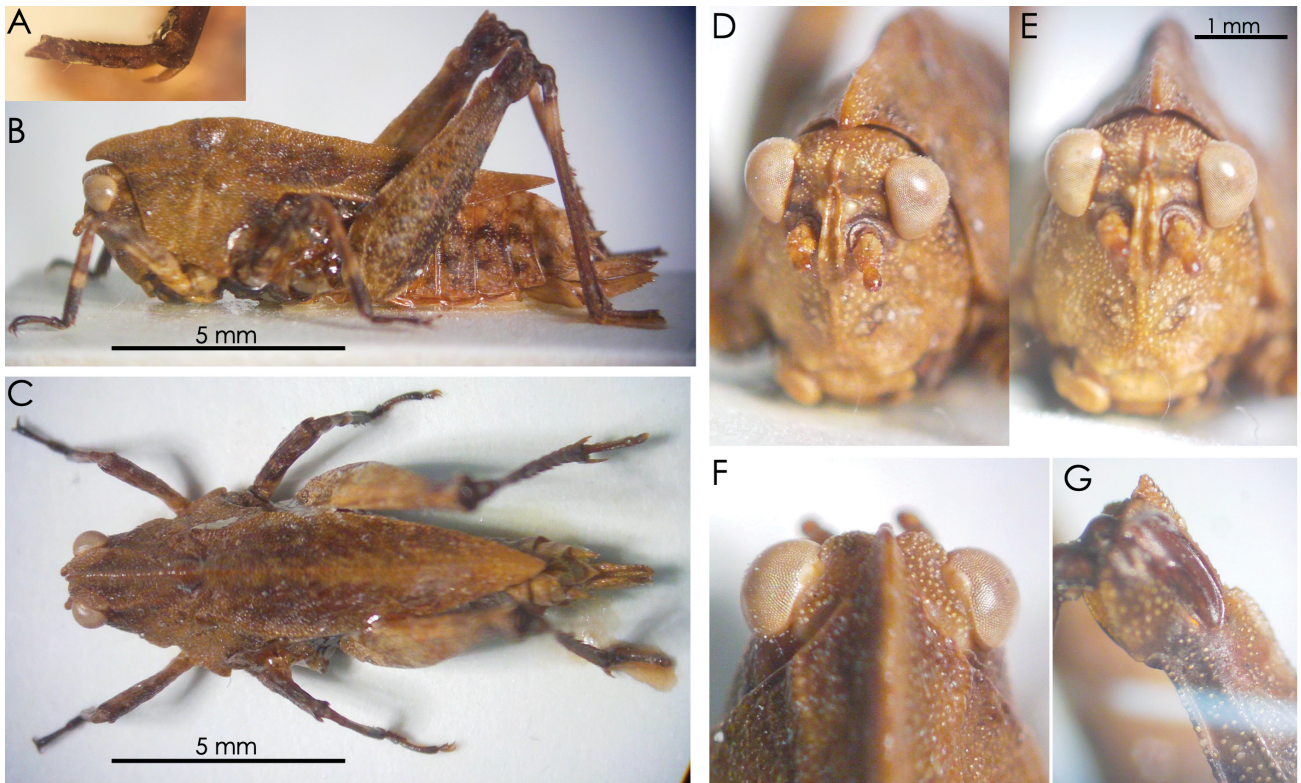


Fig. 2. The holotype of *Naskreckiana kosemeni* gen. & sp. nov. A – hind tarsus; B – body in lateral view; C – body in dorsal view; D–E – head in anterior view; F – head in dorsal view; G – knee of the hind leg, showing the antegenicular and the genicular teeth. Photographs by Filippo Maria Buzzetti, Josip Skejo and Jadranka Škorput.

COSTA RICA: Cartago Prov.,
Refugio Genesis II, nr. Cañón
(9.70758, -83.91219), 2369 m



Fig. 3. A living female individual of *Naskreckiana*, potentially representing an undescribed species of the genus. Photographed by Piotr Naskrecki.

Naskreckiana kosemeni
Kasalo, Buzzetti & Skejo sp. nov.

(Figs 2–4)

Type locality. Costa Rica, Province San José, Cordillera de Talamanca, Cerro de la Muerte, near Interamericana. In Páramo vegetation, around ponds with *Sphagnum* growth.

Type material. HOLOTYPE: ♀ (Fig. 2), labels: „CR: San Jose: Cordillera“ / de Talamanca: Cerro de la Muerte, Veg. Paramo, / around ponds in *Sphagnum*, / 10.iii.1991“ collected by M. Brojer, deposited at the Museo Civico di Rovereto, Italy (MCRI).

Diagnosis. Median carina of pronotum smoothly curved. Pronotal apex not reaching terminalia. Anterior spine not reaching past the vertex. 18 visible antennomeres.

Description of holotype. Head. Anterior view. Carinae of vertex U-shaped. Frontal costa bifurcation at around upper third of eye height. Facial carinae narrow and parallel, forming narrow scutellum. Paired ocelli just below bifurcation. Middle level of antennal grooves at level with bottom margin of eyes. **Dorsal view.** Vertex around 1.5 times wider than eye, progressively narrowing anteriorly. Medial carina present throughout length of vertex. Shallow fossulae present in anterior half. **Antennae.** Absent in holotype.

Pronotum. Lateral view. Median carina elevated throughout its length, smoothly curved, tallest above level of lateral lobes, slightly lowering towards head, moderately lowering towards pronotal apex. Paranota rectangular. Lateral lobes triangular with rounded tip. Ventral sinus large and smooth. Infrascapular area moderately sized, triangular, reaching approximately middle of length between humeral angles and pronotal apex.

Dorsal view. Pronotum covers large part of vertex. Anterior spine long, protruding to level of eyes. Prozonal carinae short, converging caudally. Interhumeral carinae approximately as long as prozonal carinae, parallel. Pronotum interspersed with small tubercles. Lateral lobes very slightly projecting outwards. Humeral angles rounded and blunt. Behind humeral angles, pronotum gradually narrows. Pronotal apex rounded.

Wings and tegmina invisible, either absent or reduced and covered by pronotum.

Legs. Anterior and middle femora slim and straight, with very slightly bumpy dorsal and ventral margins. Anterior and middle tibiae quadratic in cross-section; smooth. Anterior tarsi with long first segment that bears three rounded pulvilli. Hind femora thin and smooth, around 3.5 times longer than wide. Antegenicular and genicular teeth small. Hind tibiae with teeth along their caudal margins. Third tarsal segment approximately equal in length to first. Pulvilli damaged, distal one as long as proximal two.

Coloration. Faded in holotype. Uniformly brownish with large blackish areas on pronotal disc that extend from level of base of middle leg nearly to pronotal apex and are medially interrupted by median carina. Median carina and prozonal carinae of pronotum vaguely yellow. Lateral carinae of pronotum strongly yellow. Vertex covered with yellow dots. Anterior and middle femora darker than pronotum, hind femur brownish in upper half, blackish in bottom half. Maxillary palpi white.

Measurements (all in millimeters). Body length 18.22; vertex width 1.88; eye width 1.2; scutellum width 0.34; pronotum length 20.16; pronotum lobe width 8.21; pronotum height 6.99; infrascapular area height 1.32; infrascapular area length 5.9; fore femur length 4.22; fore femur width 0.97; middle femur length 4.16; middle femur width 0.74; post femur length 14.04; post femur width 4.05; hind tibia length 10.69; first hind tarsal segment length 1.04; third hind tarsal segment length 1.2; ovipositor dorsal valve length 3.29; ovipositor ventral valve length 2.89.

Etymology. Named in honor of C. M. Kosemen, a Turkish artist and independent researcher who is known for his work on speculative evolution. The specific epithet is a noun of the second Latin declension in genitive case; derived from the surname “Kosemen”.

Potential undescribed species. The specimen photographed by Piotr Naskrecki in Tapantí National Park (Fig. 3) exhibits some apparent differences from the one photographed by Roland Lupoli in Braulio Carrillo National Park (Fig. 4). The latter is a clear example of a living *N. kosemeni* sp. nov. Naskrecki’s specimen has a differently shaped median carina (slightly wavy instead of smoothly curved), longer anterior spine (reaching past the vertex), longer pronotum (apex covering terminalia), and different color pattern (paranota and legs dark, brownish; pronotal disc bright, yellowish). This specimen also has a notch in the exterior part of the visible paranotum, but it likely appeared due to physical damage during the growth of the individual. It is thus entirely possible that at least two separate species of *Naskreckiana* gen. nov. live around San José, but more specimens should be examined to be certain whether the noted differences represent intraspecific variability.

Procellator Kasalo, Skejo & Cambra gen. nov.

(Figs 5–7)

Type species. *Procellator kai* Kasalo, Skejo & Cambra sp. nov., here designated.

Diagnosis. Most similar to the Batrachideini genera with an elevated median carina of the pronotum: *Cranotettix*, *Halमतettix*, *Plectronotus*, and *Naskreckiana*. The following set of characters allow this genus to be separated from all other Batrachideini: (1) frontal costa bifurcation at the upper third of the eye height, (2) mid-line of the antennal grooves at the bottom margin of eyes, (3) anterior spine reaching far beyond the anterior level of eyes, (4) median carina of pronotum elevated throughout its length, highest in the anterior quarter of its length, strongly undulated.

Etymology. The word is coined from the Latin word *procella*, meaning storm, fused with the Latin suffix *-tor* used to form a third declension masculine agent noun (e.g., like *gladiator*, from *gladius*, sword). It represents a metaphor of the upcoming storm in the form of a revision of Batrachideini. “*procellator*, -oris, m.” is thus a masculine gender noun.

Composition and distribution. The genus includes a single species, *Procellator kai* Kasalo, Skejo & Cambra sp. nov., for now known only from Panama.

***Procellator kai* Kasalo, Skejjo & Cambra sp. nov.**

(Figs 5–7)

Type material. HOLOTYPE: ♀ (Fig. 5) collected by Kai Squires, 30.i.2023, deposited at the Museo de Invertebrados G.B. Fairchild, University of Panama (MIUP).

Type locality. Panama, Cocobolo Nature Reserve, Ridge Trail, 9.314646, -79.205559.

Diagnosis. Inseparable from generic diagnosis until more species are discovered.

Description of holotype. Head. Vertex nearly two times wider than eye. Dorsal view obscured by pronotum, but vertex appears to progressively narrow towards front. Carinae of vertex form U- or V-shapes visible anteriorly. Frontal costa bifurcation at around upper third of eye height. Facial carinae narrow and parallel, forming narrow scutellum. Paired ocelli just below bifurcation. Middle level of antennal grooves at level of bottom margin of eyes.

Antennae. 21 visible antennomeres.

Pronotum. Lateral view. Paranota rectangular. Lateral lobes blunt triangular. Large and smooth ventral sinus. Infrascapular area large; widest between posterior and middle femora, progressively narrows up to level of mid-level of hind femora when extended parallel to infrascapular area. Median carina elevated, of complex shape; section above prozona is tallest, slightly sloping down anteriorly and ending in anterior spine; at level of lateral lobes is small hump, caudally of which median carina moderately drops 1 mm down and continues in weakly undulated shape towards apex of pronotum. Entire pronotum bulges at level of small hump (anterior to humeral angles) and at level of first undulation (posterior to humeral angles).

Dorsal view. Pronotum covers most of the vertex. Anterior spine long, protruding past eyes by one length of eye as seen in dorsal view. Prozonal carinae long and parallel. Interhumeral carinae approximately as long as prozonal carinae, connected by sulci to median carina and to humeroapical carinae, together of sigmoid shape. Pronotum slightly sulcate, covered in small yellow tubercles. Lateral lobes flaring outwards. Humeral angles blunt. Behind humeral angles, pronotum narrows slightly, but a little more so at about mid-length of hind femora (when extended parallel to pronotum), giving apical region of pronotum shape of wide spine. Pronotal apex pointed. Internal lateral carinae visible from mid-level of infrascapular area; moderately converging towards median carina, forming large lateral area.

Wings and tegmina invisible, either absent or reduced and covered by pronotum.

Legs. Anterior and middle femora slim and straight, with slightly bulging dorsal margins each carrying deep furrow. Anterior and middle femora carry spine at distal end of dorsal margin; especially prominent on middle femora. Anterior and middle tibiae quadratic in cross-section; smooth with only a few small teeth distally. Anterior tarsi with very long first segment that bears three rounded pulvilli. Hind femora smooth, around 2.5 times longer than wide. Antegenicular tooth small, genicular tooth large. Hind tibiae with teeth along their caudal margins. Pulvilli

large and blunt, distal one almost double in size than the other two. Third tarsal segment longer than first.

Coloration. Antennae yellowish-brown. Maxillary palpi strikingly white. Rest of body vividly colored. All pronotal carinae with interchanging yellow and black stripes/spots. Base coloration of pronotum yellowish to brownish. Entire pronotum covered with tiny yellow dot-like elevations. In dorsal view, three chevron-shaped markings visible on pronotal disc; anterior one pale yellow, humeral (largest) one grayish-brown, then well-defined thin yellowish one. Posterior to them is rhomboid shape that is dark anteriorly and pale posteriorly, ending in yellow-colored apex of pronotum. Legs striped, interchanging yellow and black irregularly-shaped stripes. Base coloration of ventral side of body brownish-black. Sternites bearing two parallel yellow lines. A living specimens of this species displaying its colors in natural habitat can be seen in Fig. 6.

Measurements (all in millimeters). Body length 16.13; vertex width 1.22; eye width 0.70; scutellum width 0.20; pronotum length 18.50; pronotum lobe width 7.54; pronotum height 6.61; infrascapular area height 1.18; infrascapular area length 7.39; fore femur length 4.21; fore femur width 1.02; middle femur length 4.56; middle femur width 1.26; post femur length 11.51; post femur width 3.55; hind tibia length 9.00; first hind tarsal segment length 1.68; third hind tarsal segment length 2.17; ovipositor dorsal valve length 1.94; ovipositor ventral valve length 1.6; ovipositor valve width 0.74.

Description of nymph (Fig. 7). Pronotum not fully developed, but sharp elevation in prozona allows identification. Presence of strong genicular teeth. Coloration pattern not fully apparent, but yellow dots present.

Habitat (Fig. 8). Many specimens found alongside the forest trail, on or near the pictured palm belonging to the family Arecaceae.

Etymology. Named after Kai Squires who originally discovered this genus and species and uploaded the photos to iNaturalist where they were recognized as new to science. Kai took many photographs, collected the holotype, and responded promptly to our requests. We are more than honored to name this amazing species after him. The specific epithet, *kai*, is a masculine noun in apposition.

†*Eotetrix* Gorochoy, 2012, stat. restit.

Type species. †*Eotetrix unicornis* Gorochoy, 2012, comb. restit., original designation.

Composition and distribution. Composed of the type species only, extinct, known from Wyoming, USA; Green River Formation (Middle Eocene).

Justification of taxonomic acts. THOMAS et al. (2019) noted that the genus †*Eotetrix* is similar to *Scaria* and *Rehndium* and is likely related to them. In the same publication, *Tettigidea* and its relatives are noted as a genus group that is distinct from the *Scaria-Rehndium* group. SILVA et al. (2021) synonymized †*Eotetrix* with *Tettigidea*, claiming that the structure of the head and the pronotum fit more with the latter genus. They then assigned †*Eotetrix unicornis* comb. restit. to *Tettigidea (armata)* species group, noting that the species is not “affiliated” with the *Tettigidea (late-*



Fig. 4. Living male (top) and female (bottom) individuals of *Naskreckiana kosemeni* gen. & sp. nov. in their natural habitat. Photographed in Braulio Carrillo National Park in Costa Rica by Roland Lupoli.

ralis) species group. This reasoning is problematic, since the authors indicate †*Eotetrix* and *Tettigidea* as synonyms, but include the species from the synonymized genus in a group that is not morphologically close to the type species of *Tettigidea*, *T. lateralis* (Say, 1824), and which may be an entirely separate genus. The definitions of *Tettigidea* and its species groups are not sorted out (KASALO et al. 2023) and are only getting more complicated by taxonomic acts that handle neither type species nor generic diagnoses. †*Eotetrix unicornis* does appear similar to the species of *Tettigidea* (*armata*) complex, but it also appears similar to the species of *Batrachidea* in the shape of the pronotum, the anterior spine, and the head, and somewhat to the species of *Paurotarsus* in the shape of the head and the elongation of the pronotum. This example illustrates how synonymization can be arbitrarily conducted in the absence of well-defined taxa, especially when one of the included type specimens is a fossil that is not particularly well preserved. SILVA et al. (2021) correctly note that †*Eotetrix unicornis* was found much further North than today's distribution ranges of *Scaria* and *Rehndium*, which warrants an examination of potential relatedness with the North American taxa. It cannot be excluded that there are extant close relatives of this species in North America. They may even be currently classified under *Tettigidea*, but that by itself does not mean anything if *Tettigidea* comprises many morphologies that significantly differ from its type species. Thus, the status of †*Eotetrix* stat. restit. is rever-

ted to its original state, as a monotypic genus in the tribe Batrachideini. Only when the entire tribe is revised, it may be possible to correctly determine potential evolutionary relationships between the genera. The features discussed here are all difficult to see in the fossilized remains so the complete identity of the species may remain unresolved, which is another reason not to assign it to extant taxa; it is much clearer to group the extinct and the extant genera in higher taxonomic categories, such as genera groups.

Discussion

In recent years, some research was conducted on Batrachideini, focusing mostly on the specious genera *Tettigidea* and *Scaria* (CADENA-CASTANEDA et al. 2019, SILVA et al. 2021, ITRAC-BRUNEAU & DOUCET 2022). Although the recent revisions (CADENA-CASTANEDA et al. 2019, SILVA et al. 2021) represent valuable steps toward the understanding of Batrachideini taxonomy, a lot of questions still persist, especially regarding *Tettigidea* (KASALO et al. 2023). One such question was the status of †*Eotetrix* stat. restit., which was synonymized with *Tettigidea* based on the reasoning that circumvented dealing with the type species of *Tettigidea* (SILVA et al. 2021), which is essential for such an act. The papers that dealt with this issue (THOMAS et al. 2019, SILVA et al. 2021) did so only briefly, without an exhaustive examination of all relevant material. Here, we take a conservative stance on the issue and resurrect †*Eotetrix* stat. restit. as a separate monotypic genus and leave the

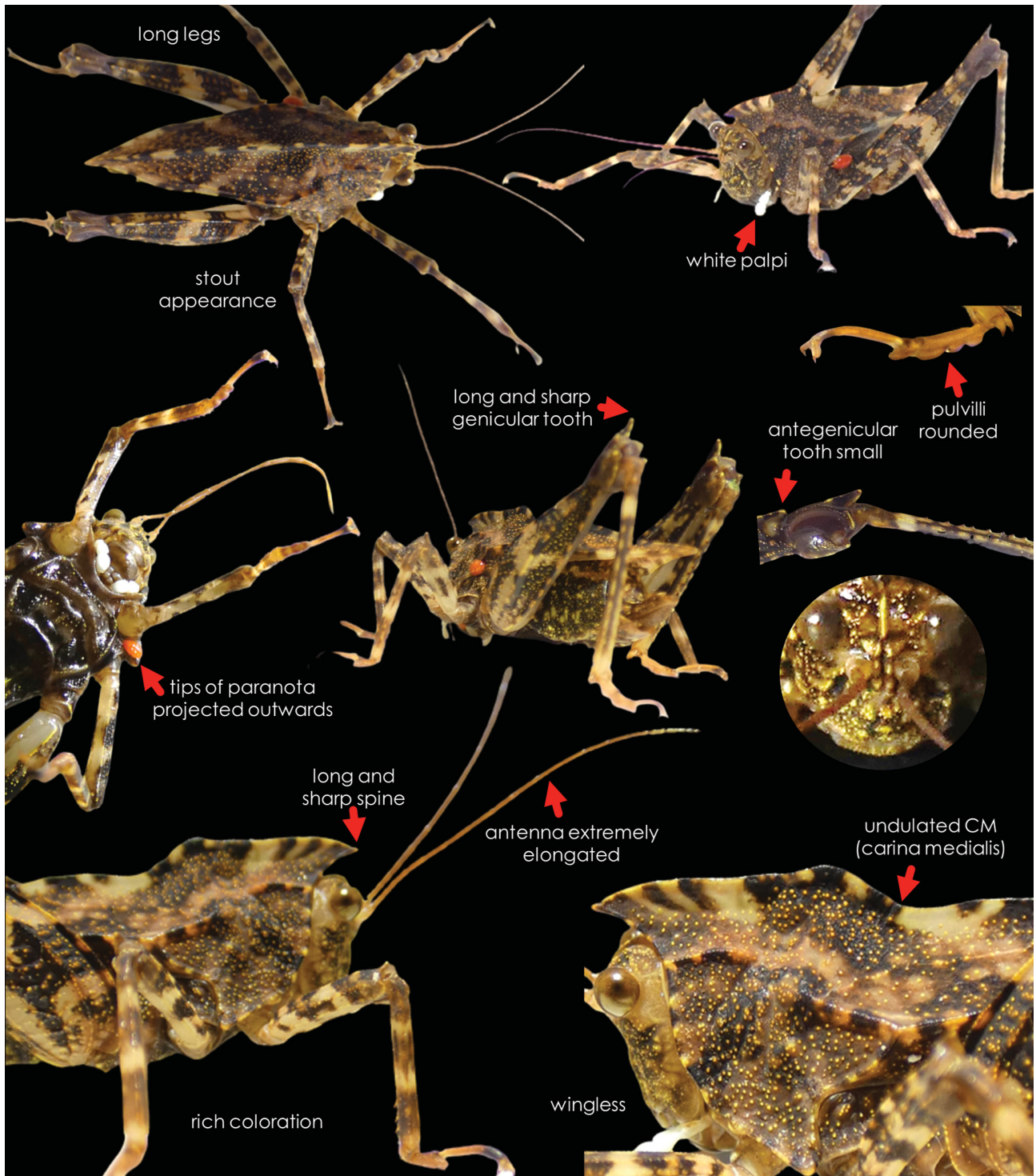


Fig. 5. The holotype of *Procillator kai* gen. & sp. nov. with key diagnostic characters marked. Photographed by Kai Squires.

discussion on its placement within the systematics of Batrachideini for the future. Batrachideini, and Batrachideinae as a whole, need revision (STOROZHENKO 2019, KASALO et al. 2023), and this is apparent from the key provided in this paper - many genera have no clear diagnostic characters and most have not been reviewed since they were first described (CIGLIANO et al. 2023).

In stark contrast to the *Scaria* species that was discovered but could not be described due to the lack of physical type specimens (KASALO et al. 2021), with *Procillator*

kai gen. & sp. nov. we managed to immediately get in contact with the person who observed it and consequently obtained physical specimens. This is an example of how regular monitoring of citizen science portals, iNaturalist in this case, can allow quick and effective cooperation across the world (MESAGLIO et al. 2021). The benefits of using social media go beyond mere discovery of new species; they allow scientists to track species across a wide area and gather a wealth of data about various aspects of their biologies (CONNORS et al. 2022, Mo & Mo 2022). Of



Fig. 6. An adult female of *Procellator kai* gen. & sp. nov. photographed in its natural habitat by Kai Squires.



Fig. 7. A nymph of *Procellator kai* gen. & sp. nov. photographed in its natural habitat by Kai Squires.



Fig. 8. The natural habitat of *Procellator kai* gen. & sp. nov. Photographed by Kai Squires.

course, the data from social media cannot be taken at face value, it should be evaluated by experts first, but social media are nonetheless a powerful tool for modern research (HOCHMAIR et al. 2020).

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