



Potiguara troglobia gen. n., sp. n. – first record of a troglobitic Kinnaridae from Brazil (Hemiptera: Fulgoromorpha)

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Abstract

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A new obligately cavernicolous (troglobitic) species of the planthopper family Kinnaridae is described from Brazil. It could not be placed in any of the existing genera, thus a new genus is established. Information on its distribution and ecology is given. This is the first record of a troglobitic representative of this family from Brazil, and only the 5th cavernicolous kinnarid species worldwide.

Introduction

A recent survey of the limestone caves in Felipe Guerra municipality city, Rio Grande do Norte, Brazil, by a team of the Laboratório de Ecologia Subterrânea, Federal University of Lavras, Brazil, revealed the existence of a rich and diverse cavernicolous fauna (Ferreira et al. 2010). Among the terrestrial invertebrates is a new species of the planthopper family Kinnaridae (Figs 1–2).

The Kinnaridae is one of the smaller families within the Hemipteran group of Fulgoromorpha, currently comprising 104 species in 21 genera (Bourgoin 2013). Members of the family are known to exist in the Old and New World (Bourgoin 2013), with ca. 60 species documented to occur in the New World, predominantly in the Caribbean, North and Central America. Only one species is known from South America: *Oeclidius parallelus* Muir, 1934 from Brazil.

Although very little is known about the biology and ecology of Kinnaridae, the majority of species are epigeal and display well-developed compound eyes, vivid colouration of body and tegmina, and are capable of flight. A few species, however, have colonized caves.

Hitherto, the following kinnarid species have been reported from caves in Jamaica and Mexico:

Oeclidius antricola Fennah, 1980, and *Oeclidius minos* Fennah, 1980 (both troglobitic, Jamaica, occurring syntopic in Clarendon, Jackson Bay, Jackson Bay Cave), *Oeclidius persephone* Fennah, 1980 (hardly troglomorphic, except the red pigmentation of compound eyes, presumably troglomorphic, from Jamaica, Clarendon, Portland Ridge, Portland Cave), and *Oeclidius hades* Fennah, 1973 (troglomorphic, presumably troglobitic, from Mexico: San Luis Potosi, E. Valles, Cueva de Valdosa) (see Fennah 1973, 1980).

Following Fennah's subdivision of the Kinnaridae into the subfamilies Kinnarinae and Prosotropinae (Fennah 1945), the new species belongs to the subfamily Kinnarinae which is characterized by the presence of wax-bearing plates on the sixth, seventh and eighth female abdominal tergites. The Kinnarinae were further subdivided by Emeljanov (1984) into three tribes: the Kinnarini, the Propleromini and the Adolendini. Emeljanov (1984: 52) placed the American representatives of the subfamily Kinnarinae, the genera *Oeclidius* Van Duzee and *Southia* Kirkaldy, into the tribe Propleromini, limit-

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ing Kinnarini to the Old World taxa. Apart from Fennah's and Emeljanov's classification (see above), neither a phylogenetic analysis of the Kinnaridae has ever been attempted, nor have any synapomorphies been identified for any of the established genera or tribes.

Fennah (1980) provided a key to the New World genera, *Oeclidius* and *Southia*, and – in trying to accommodate the known epigean as well as the cavernicolous *Oeclidius* species, gave two alternatives leading to the genus. Applying this key to the recently discovered troglobitic Brazilian kinnarid, one of these alternatives (“Adults flightless; vertex at anterior margin more than twice as broad as long in middle; eyes absent; tegmina not surpassing abdomen; aedeagus bulbous, either entirely or basally”: Fennah 1980: 674) leads indeed to *Oeclidius*.

Nevertheless, the generic placement is problematic. Flightlessness, reduction of compound eyes and tegmina are troglomorphies, i.e., morphological alterations evolved in the course of adaptation to the cave environment, and are thus highly likely the result of parallel evolution. Moreover, in the characters of the male genitalia, the new species does not share any similarities with any of the known – epigean or cavernicolous – *Oeclidius* species which could be interpreted as synapomorphies. Thus, we opted for the establishment of a new genus to accommodate the new troglobitic species from Brazil. As it shares some, but not all of the characters given for the tribe Propleromini by Emeljanov (1984), we refrain from any tribal placement (see discussion).

Materials and methods

Collecting, preservation, permanent storage. The specimens were collected by hand, and transferred immediately in vials containing 96% ethanol. For permanent storage, after dissection and examination, genitalia and abdomen were transferred to polyethylene vials, and individually associated with the specimen vial.

Morphological examination techniques, visualization. Measurements and examinations of external body features were made from the specimen in ethanol, without further manipulation.

To prepare male genitalia for dissection, the genital capsule was removed from the specimen, macerated 24 h in 10% KOH at room temperature, washed in water, transferred to glycerine for storage, or to glycerine-jelly for drawings. Examinations and drawings were made using a Leitz stereomicroscope with *camera lucida* attachment.

Depository: ES: Laboratório de Ecologia Subterrânea/ISLA: Coleção de Invertebrados Subterrâneos da UFLA – Universidade Federal de Lavras, Brazil; MFN: Museum für Naturkunde, Berlin, Germany.

Taxonomy

Kinnaridae Muir

Kinnaridae Muir, 1925: 158

Kinnarinae: Fennah 1945: 449

Potiguara Hoch & Ferreira gen. n.

Type-species. *Potiguara troglobia* sp. n.. Type locality: Brazil, Rio Grande do Norte State, Gruta do Troglóbio.

Diagnosis. Small kinnarid (ca. 3 mm body length) with habitus strongly troglomorphic: compound eyes and ocelli absent, tegmina reduced, wings vestigial, bodily pigmentation reduced. *Potiguara* gen. n. can be distinguished from all other genera of the Kinnaridae by the unique combination of the following characters: male genitalia bilaterally symmetrical, genital segment in caudal aspect roundish, anal segment on each side with two prominent process, parameres proximally narrow and distally differentiated into three conspicuous, aedeagus bulbous at base, distally compressed, phallosome exposed dorsocaudally.

Description

Head. Vertex short, ca. $2.4 \times$ wider than medially long, broadly rectangular, with a faint median carina; anterior and posterior margin of vertex parallel, slightly concave towards frons. Frons about as long as maximally wide, and as long as post- and anteclypeus together. Frons widest at level of antennae. Frons medially and laterally smooth, post- and anteclypeus with a distinct median carina; lateral margins of frons strongly ridged; frontoclypeal suture medially slightly arched towards frons. Rostrum elongate, in repose well surpassing hind coxae. Compound eyes and ocelli absent. Antennae with scape short, subcylindrical, slightly expanding distally, pedicel cylindrical, ca. $2 \times$ as long as wide, with distinct sensory plaque organs; arista ca. $3 \times$ as long as pedicel.

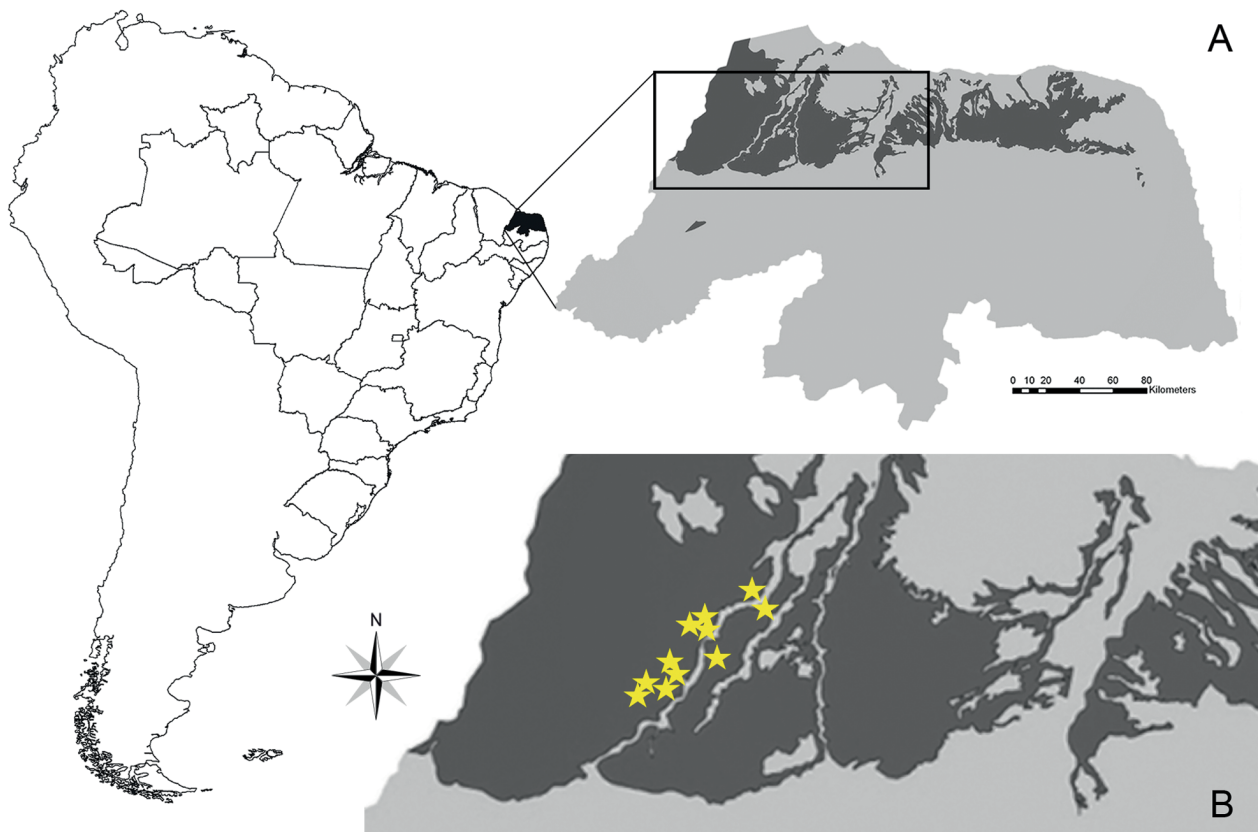
Thorax. Pronotum tricarinate, ca. $4.8 \times$ wider than vertex posteriorly, short, posterior margin medially shallowly concave. Mesonotum faintly tricarinate, ca. $1.5 \times$ wider than medially long. Tegulae present, vestigial. Hind tibiae laterally with a row of numerous rigid minute spines; hind tibiae distally with 6 teeth, arranged in two groups (3 + 3). First metatarsal joint distally with 6, 2nd metatarsal joint with 4 teeth. Pretarsal claws and arolia small, inconspicuous. Tegmina comparatively short, very shallowly tectiform, almost flat, in repose attaining tip of anal style in males, in females slightly surpassing tip of abdomen. Venation of tegmina in proximal portion as in epigean Kinnaridae with a large and wide subcostal cell; distally of nodal line distinctly reduced (Fig. 3), with 6 distal marginal cells. Hind wings vestigial, short, comparatively slightly longer in females, venation reduced.

Male genitalia (Figs 4–10). Genital segment bilaterally symmetrical, in lateral aspect short, in caudal aspect high-ovate.

Anal segment bilaterally symmetrical, proximally of anal style short, stout, distally of anal style with two



Figure 1. **A.** Map of South America with Rio Grande do Norte State; **B.** Lime stone area near Felipe Guerra municipality; yellow stars: distribution of *Potiguara troglobia*; **C.** Surface vegetation; **D.** *Potiguara troglobia* sp. n., adult female, on ceiling of cave; **E.** Cave interior. Photographs by R. L. Ferreira.



pairs of elongate processes. Parameres proximally narrow, distally differentiated into three elaborate processes. Aedeagus bilaterally symmetrical, in lateral aspect stout, bulbous, proximally rounded, ventrodistally of phallotreme bilaterally compressed. Proximal apodeme of aedeagus (= “tectiform structure”: term applied by Bourgoïn 1997 for Meenoplidae) elongate, narrow throughout.

Female (Fig. 11). Abdominal tergites 6–8 with wax-bearing plates distinctly present. Pregenital sternite narrow, ca. $3 \times$ as wide as medially long; lateral gonapophyses IX well developed, proximally narrow, distally expanding into a broadly rounded lobe extending laterodorsally; median gonapophyses IX arising from a wide base, distally tapering and apically produced into a slender process directed dorsomedially.

Etymology. The genus name refers to the native people of Rio Grande do Norte State, named *Potiguar*.

Potiguara troglobia Hoch & Ferreira sp. n.

Figures 1D–11

Diagnosis. Habitus. Strongly troglomorphic species, light body pigmentation, compound eyes and ocelli absent, dorsoventrally compressed body shape, tegmina short, in repose not surpassing tip of abdomen, wings vestigial.

Description.

Body length. Males. 2.4–2.8 mm ($n = 3$). Females. 3.2–3.3 mm ($n = 2$). Measurements refer to distance between anterior margin of head to tip of anal style in males, and to tip of ovipositor in females, respectively).

Colouration. Bodily colouration strongly reduced, uniformly creamy white to light yellowish. Tegmina translucent, veins whitish.

Configuration, shape and proportions of head and thorax as described for the genus.

Male genitalia. Genital segment on each side slightly ventrally of midlength with a shallowly concave pocket and slightly dorsally of midlength with an arm-like process which is distally tapering into a bilobate blunt tip and directed caudally. Anal segment distally of anal style with two pairs of processes: one arising caudally (long, narrow, \pm terete, in repose directed (dorso-)caudally), the other inserting ventrally (ca. $\frac{1}{4}$ the length of caudal processes, laterally compressed and directed laterally). Parameres distally with three processes differentiated as follows: ventral process long, sturdy, rod-like, caudal process in lateral aspect duck-head-shaped, with “bill” pointing dorsally, “head” medially concave, and dorsal process in lateral aspect bilobate, with one lobe rounded, the other \pm hook-shaped and curved basally. Aedeagus in lateral aspect stout, proximally rounded, distally, ventrally of phallotreme, bilaterally compressed and caudally tapering into a short, rounded lobe. Phallotreme in repose exposed dorsocaudally.

Female genitalia as described for the genus.



Figure 2. *Potiguara troglobia* sp. n. Habitus, male. Body length 2.8 mm. Photograph by J. Deckert, Berlin.

Distribution. Brazil, Rio Grande do Norte State. Although the first specimens were collected in the Troglóbio cave, some additional surveys in other caves revealed more specimens. Accordingly, the species is known from nine caves at the present moment.

Ecology. *Potiguara troglobia* sp. n. is highly troglomorphic and considered obligately cavernicolous (troglobitic). The largest population was found in Troglóbio cave, a small cavity (about 30 meters long), in which more than 25 specimens were observed. Individuals were seen under fallen rocks in the floor or freely walking in the moist sediment. Some specimens were observed feeding on roots that grow in the inner portion of the cave. However, the diverse surface vegetation in the area (Fig. 1C) did not allow us to clearly associate the roots to one or more plant species; thus at present there is no information for *Potiguara* on host specialization.

In almost all of the other caves only few specimens were observed (from 1 to 7 individuals) with an excep-

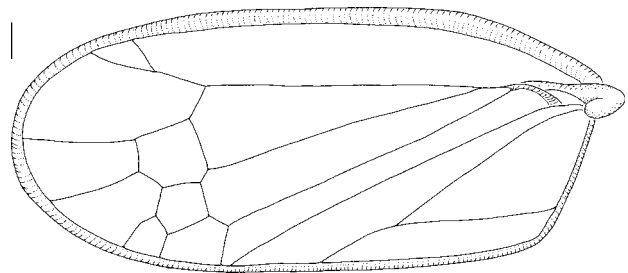


Figure 3. *Potiguara troglobia* sp. n. Left tegmen, male. Scale bar 0.1 mm.



Figure 4. *Potiguara troglobia* sp. n. Male genitalia, *in situ*, left lateral aspect. Holotype. Scale bar 0.1 mm.

tion for Boca de Peixe cave (Governador Dix-Sept Rosado municipality) in which 17 specimens were recorded. This cave is completely different from Troglóbio cave, so that the cave morphology or dimension seems not to be a relevant factor determining species preferences. Since the host specificity is unknown, it is impossible to determine whether such “large” populations are associated to any “patch” of a specific plant species growing outside these caves. In all caves, specimens were found only in very moist areas, always near root aggregations.

Most individuals were observed only in the dry season (a total of 8 caves were sampled in both seasons). In Boca de Peixe cave, from the total of 17 specimens observed, 16 were found in the dry season. During the rainy months in the area (from January to April) the caves substrates become very moist, and presumably individuals eventually migrate to other habitats, such as the mesocavernous rock system or MSS (*milieu souterrain superficiel*, as described by Juberthie et al. 1980), which are not directly accessible for us. The mesocavernous rock system may also facilitate subterranean dispersal and thus enable maintenance of gene-flow between troglobite populations (see “geographic variation”).

Potential predators includes spiders (Caponnidae – *Nops* sp., Gnaphosidae, Prodidomidae – *Lygromma* sp., Scytodidae – *Scytodes* sp. and Theridiidae – *Theridion* sp.), although those species were not frequently seen in the areas where *Potiguara* specimens were found. Unfortunately, no interactions were observed between *Potiguara* and any other species.

During visits paid to the caves in different months, the co-author and his team could find adults and nymphs in different stages, suggesting that reproduction occurs throughout the year. One of the females was found to have 19 mature eggs in the abdomen, each ca. 0.5 mm long and 0.3 mm wide.

Etymology. The species epithet refers to the strongly troglomorphic appearance and the obligately cavernicolous way of life of the species.

Material examined. Holotype ♂. BRAZIL: Rio Grande do Norte, Gruta do Troglóbio, Felipe Guerra, R.N., 29.08.2007, “LANG 2570”, in coll. Universidade Federal de Lavras, ISLA.

Paratypes. 4 ♂♂, 2 ♀♀, same data as holotype.

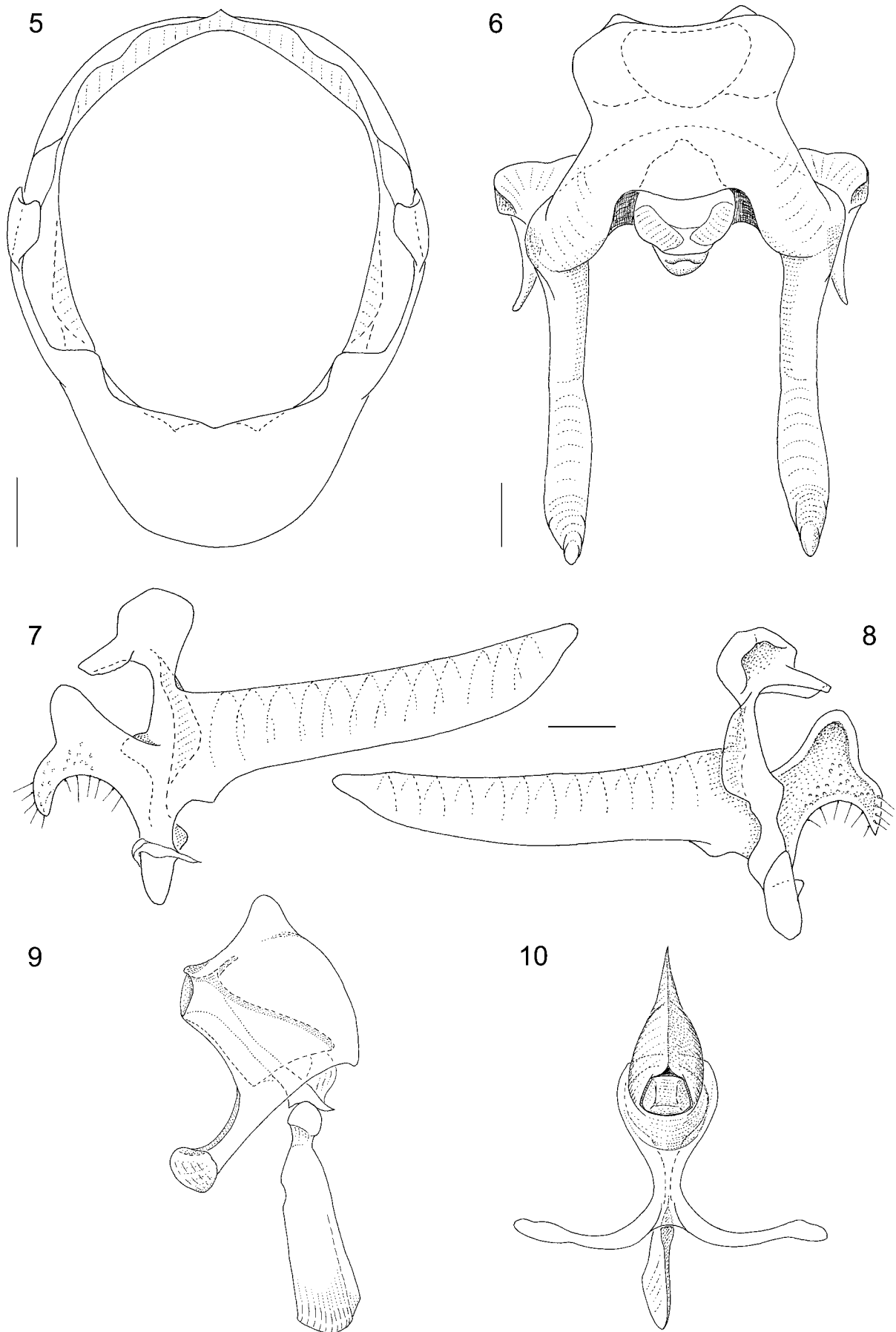
Additional material. 1 male, 11 nymphs, G. Sep 04.07., Lagedo do Rosário, F. Guerra, 28/07/09, ISLA; 3 males, 2 nymphs, Gruta da Bota, Arapuá, F. Guerra, 20/07/09, ISLA, MFN; 3 males, 1 nymph, G. Gusso, F. Guerra, 27/07/09, ISLA; 1 nymph, Gruta dos Fugitivos, Jandeira.RN, 22/02/09, ISLA.

Remarks. Slight variation among populations from different caves was observed in the shape of the dorsal process of the parameres (see below, “geographic variation”).

Conclusions

Tribal placement

Emeljanov (1984: 51) based his concept of the tribe Propleromini on the following combination of characters: (1) “penis without membranous formations”, (2) “phallosome located on tubular protuberance of phallosome”, (3) “connective fully developed”, (4) “pygotheca with rudimentary annular apodema on margin of anterior opening”, (5) “articulated apodemes of base of phallosome located laterally to it”, (6) “forewings not tapering to membranule, in quiescence folded like flat roof”, (7) “median simple or successively branching dichotomously: terminal branches numbering 1, 2, or 4”, (8) “posterior branch of radius (RP or RS) biapical”. *Potiguara troglobia* displays characters 1, 2, 5 and 6; however, characters 3 and 4 do not apply (there is no notable connective and no annular apodemes on the ce-



Figures 5–10. *Potiguara troglobia* sp. n. Male genitalia. **5.** Genital segment, caudal aspect; **6.** Anal segment, dorsal aspect; **7.** Left paramere, left lateral aspect; **8.** Same, median aspect; **9.** Aedeagus, left lateral aspect; **10.** Same, dorsal aspect. Holotype. Scale bars 0.1 mm.



Figure 11. *Potiguara troglobia* sp. n. External female genitalia, ventral aspect. Paratype. Scale bar 0.1 mm.

phal margin of the genital segment), and characters 7 and 8 are difficult to assess, due to the troglomorphic reduction of the tegmen. Due to the lack of any phylogenetic analysis of the Kinnaridae, it remains uncertain which of the above characters may be synapomorphies for the tribe, or whether and to which degree current tribal subdivision reflects cladogenesis. Even the Kinnaridae as a family has not yet been established as a monophyletic group (Asche 1988). O'Brien and Wilson (1985: 88) stated that "the Kinnaridae may ... be difficult to identify", and only Asche (1988: 51) mentioned the "comparatively broad costal field in the tegmen" to be not only of diagnostic, but of phylogenetic value.

Geographic variation

Potiguara troglobia is currently known from nine caves in Rio Grande do Norte State in Brazil. The caves vary considerably in size (see above) and are distributed over a larger area. *Potiguara* planthoppers may maintain gene-flow between populations from different caves by migration through the mesocavernous rock system. Interestingly, seven of the nine caves where *Potiguara troglobia* specimens were observed to occur, are located west of the main river of the region, the *Apodi*, while two are located east of it. The extend of the mesocavernous rock system is largely unknown, and local rainfall patterns may have an influence on habitat distribution. It is conceivable that in periods of extreme droughts when superficial microcaverns are prone to desiccation, planthoppers migrate into deeper and larger spaces where higher humidity prevails. The observation of higher numbers of *Potiguara troglobia* individuals in macrocaverns during dry seasons is consistent with this hypothesis.

Whether and how gene-flow is maintained between populations from different caves and even across the river remains speculative. Thus, the slight variation in male genital morphology which was observed between specimens from different caves may or may not be indicative of speciation. Further research is necessary to clarify the species status of the *Potiguara troglobia* populations.

Epigean relatives

No close epigean relatives could be identified for *Potiguara troglobia* in Brazil, or from elsewhere. The only other kinnarid species documented from Brazil is *Oecleidius parallelus* Muir, 1934, described after a single female from "Bahia; Iguassú" (Muir 1934: 581). This is apparently an epigean species, but there is no indication of a closer relationship between *O. parallelus* and *P. troglobia*. Thus, no assessment of any potential epigean ancestral species of *Potiguara troglobia* can be made at the present moment. As the epigean Kinnaridae fauna of Brazil must be considered virtually unknown, it is impossible to draw any conclusions about a potential relict status of the species.

Conservation status

At present the caves where *Potiguara troglobia* specimens were found are well preserved. Only few caves receive (a small number of) visitors, who do not enter deep inside the caves. However, expanding mining activities for limestone extraction and petroleum exploration represent potential threats for the cave environment and consequently, the highly specialized troglomorphic species. Accordingly, it would be of prime importance to establish a conservation unit to ensure the preservation of the caves in this area of Brazil, which is not only

home to *Potiguara troglobia*, but also to several other troglobitic invertebrates, some of which are presumed relicts (Ferreira, unpublished data).

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