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Phalacrichus semicaecus sp.nov., the first micropterous and microphthalmic forest-litter species of Limnichidae (Coleoptera)

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HERNANDO, C. & RIBERA, I. 2003. Phalacrichus semicaecus sp.nov., the first micropterous and microphthalmic forest-litter species of Limnichidae (Coleoptera). *Entomol. Probl.* 33(1–2): XX–YY. – A species of forest litter Limnichidae is described as new, *Phalacrichus semicaecus* sp.nov. from Brazil. It is microphthalmic, micropterous, depigmented, with reduced size, globular shape, and short and robust appendages. All these are typical morphological modifications of forest litter species in a number of unrelated families. Examples of highly modified forest litter species in groups with a diverse phylogenetic origin are reviewed.

Key words: Limnichidae, *Phalacrichus semicaecus* sp.nov., forest-litter, Brazil.

Introduction

The ecology of many of the members of family Limnichidae is still unknown, but most seem to be riparian or semiaquatic (HERNANDO & RIBERA in press). A few species within riparian genera are secondarily terrestrial, mostly inhabiting tropical forests (RIBERA & HERNANDO 1999; HERNANDO & RIBERA 2001 and in press), with only one genus (with two species) known to be entirely terrestrial, *Limnichomorphus* PIC (SATÔ 1966). However, none of these species show special morphological modifications that could be interpreted as adaptations to a secondarily terrestrial life.

Here we report the discovery of the first Limnichidae with such modifications, a new species belonging to the genus *Phalacrichus* collected in forest litter in Brazil by R. Didham as part of a long-term project on forest diversity (see e.g. DIDHAM *et al*. 1998). The genus *Phalacrichus* was described by SHARP (1902) from central America. WOOLDRIDGE (1982) transferred to this genus two species described by PIC (1923, 1938) as *Byrrhinus* MOTSCHULSKY and *Eulimnichus* CASEY respectively, and described eight new species, all of them from the New World. Subsequently, WOOLDRIDGE (1993) described an additional species from Cerro de la Neblina, in Venezuela, and RIBERA & HERNANDO (2001) another one from Peru.

The ecology of many of these species is unknown (many of them were collected at light in sites close to water bodies (both running and stagnant, WOOLDRIDGE 1982, 1993), but they do not show any particular morphological modification linked to specialised habitats. All previously known species had well developed eyes and membranous wings (being good fliers), and have well pigmented bodies (dark brown or black).

The new species described below has, on the contrary, a number of features common in forest-litter species and assumed to be highly specialised: it is microphthalmic, micropterous, depigmented, with reduced size, globular shape, and short and robust appendages. This is the first species of the family to show such morphological modifications. We provide some examples of similar cases of isolated modified forest-litter species in independent lineages, in what is a remarkable case of morphological convergence with a likely adaptive value.

Material and methods

Scanning electron photographs were made with a ISI ABT-55 in the Natural History Museum, London, without coating the specimens. See below and DIDHAM *et al*. (1998) for the sampling methodology of *P. semicaecus* sp.nov.

Abbreviations used in the text:

BDFFP	Biological Dynamics of Forest Fragments Project
INPA	Instituto Nacional de Pesquisas da Amazonia
NHM	Natural History Museum, London

Phalacrichus semicaecus sp.nov.

(Figs 2–7)

Type locality. Manaus, Brazil, 2º 25' S, 59º 50' W.

Type material. Holotype female (INPA): "351 26", "Leaf litter, / Winkler method. / Terra firmé fst.", "BRAZIL: Manaus, AM. / INPA / Smithsonian / Res. 2º 25' S, 59º 50' W / R. Didham. iii.1994". Paratypes (INPA, NHM): three females, same data as holotype except reference Nos.: "351 9", "377 6" and "352 11".

Diagnosis. 1.4–1.5 mm long (holotype 1.52 mm),

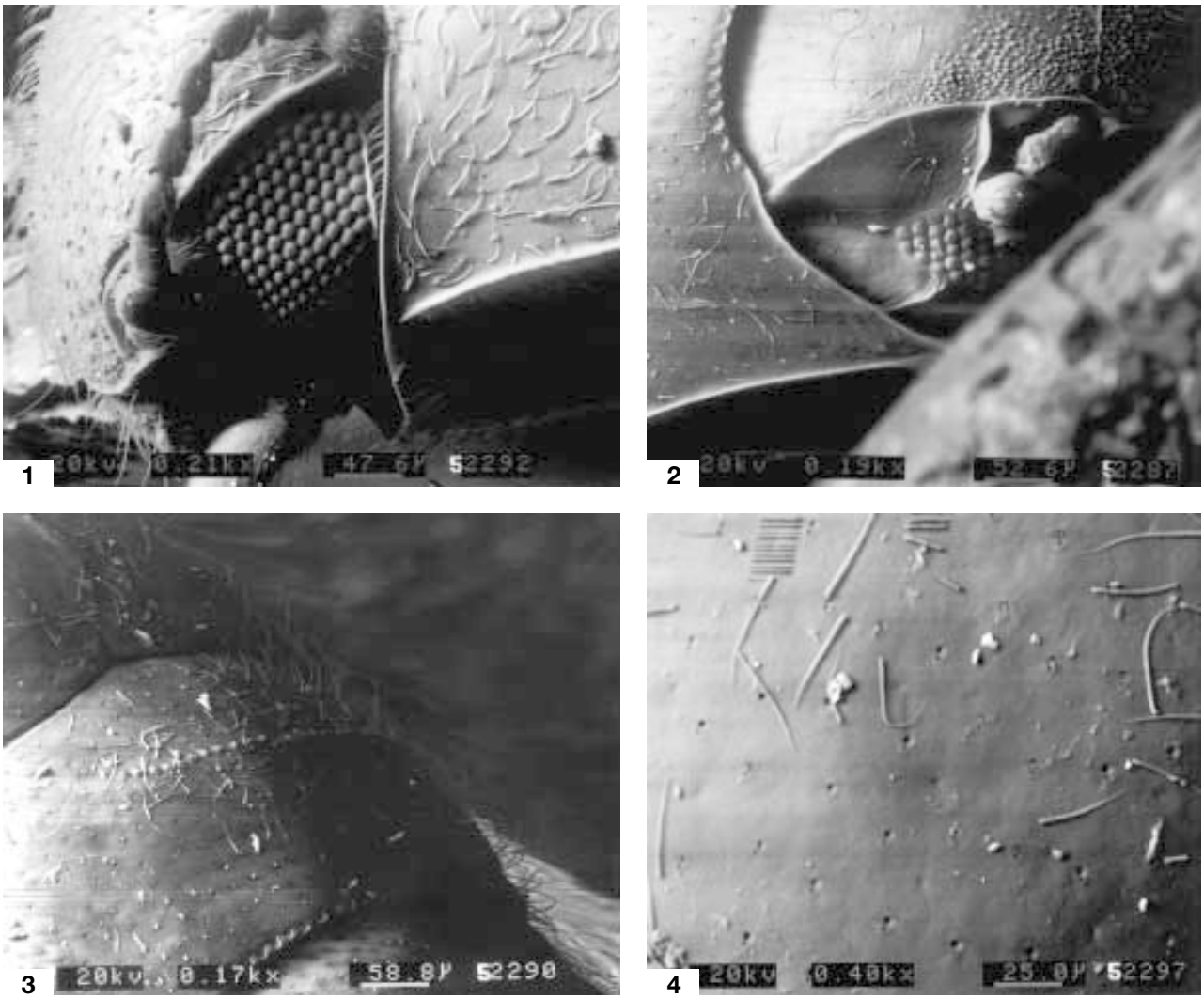
0.9–1.0 mm wide (holotype 0.95 mm). This is the only known microphthalmic, micropterous and depigmented species of the genus (and family).

Description. (Females). Body very convex, almost spherical. Pale brown, legs and head appendages paler, terminal segments of antenna almost colourless. Head with two lateral subparallel carinae, running up to insertion of antenna. Anterior margin of clypeus straight. Surface of head smooth and shiny, excluding three areas with strong microreticulation: surroundings of insertion of antennae, and anterior bead of clypeus (Fig. 2). Head covered by short, golden, erect pubescence. Eyes very reduced, with ca. 30 ommatidia, occupying the posterior ventral edge of a lateral depression with similar dimensions to the eye of other species of the genus, apparently with a less sclerotised cuticle (Figs 1, 2). Two first segments of antennae globular, robust, subequal; distal external margin of first segment with a small denticle; segments 3rd and 4th cylindrical; 5th to 11th moniliform, asymmetrical.

Pronotum transverse, trapezoidal; lateral and posterior margins finely bordered; anterior margin with a series of digitiform expansions regularly aligned, each with a seta (Fig. 3). Anterior angles acute, posterior angles smooth. Posterior margin bisinuate. Surface smooth and shiny, with a transverse series of small tubercles regularly aligned, forming a crescent reaching just behind the middle (Fig. 3). Marginal pubescence short and erect; central longer and more erect.

Elytra very convex; lateral margin strongly bordered; surface shiny, with no striae other than setigerous punctures, which are unordered and stronger than in pronotum. Punctures arranged in pairs, one larger, setigerous; another smaller and situated distally (Fig. 4). Pubescence erect, longer than in pronotum and head. Scutellum triangular, finely bordered. Micropterous, metathoracic wings strongly reduced to small scale-like membranes, without defined venation (Figs 5, 6).

Ventral surface covered with a short recumbent pubescence. Hypomera tranverse. Prosternal apophyses with a deep longitudinal sulcus, not reaching anterior margin of prosternum. Surface of prosternum strongly punctuated;



Figs 1–4 *Phalacrichus* spp.: (1) eye of *P. elongatus* (Pic); (2) eye of *P. semicaecus* sp.nov.; (3) pronotum of *P. semicaecus* sp.nov. (note the row of tubercles, and the digitiform expansions of the anterior margin); (4) elytral puncturation of *P. semicaecus* sp.nov.

punctures contiguous, given the impression of a reticle. Metasternum reduced in length. Last abdominal sternite with a small indentation.

Legs pubescent, short and robust. Tibiae sulcate for reception of femora.

Males unknown. Female genitalia as in Fig. 7.

Etymology. Meaning "half blind" (Latin), in reference to the small size of the eyes.

Ecology. The specimens were collected in the experimental study sites of the BDFFP, 80 km north of Manaus, an uniform upland dry forest ("terra firmé") on yellow lactosol soils of high clay content. All samples (ref. Nos. 351, 352 and 377) were collected at the same site, the western edge of a continuous forest reserve (BDFFP ref. No. 1401), 210 metres from the edge of the forest. Mean canopy height at this site was 26.63 m and the average midday temperature measured at 1.8 m above ground level in July/August was 27.16 °C. Each sample was a 1 metre square leaf litter, and the three samples in which the beetles were found were no more than 20 metres apart. Dry weight litter biomass of the samples ranged over 449.12–513.12 g/m^2, litter moisture content over 71.56–75.27%; and mean

Figs 5–7. *Phalacrichus* spp. (traced from photographs): (5) metathoracic wing of *P. semicaecus* sp.nov.; (6) metathoracic wing of *P. max* Hernando & Ribera (wing of *P. semicaecus* sp.nov. included at the same scale for comparison) (scale bar 0.5 mm); (7) ovopositor of *P. semicaecus* sp.nov., ventral view (scale bar 0.2 mm).

litter depth between 14–25 mm. The nearest stream or standing water was at least 300 m away (R. Didham, personal communication, 2000) (see DIDHAM *et al*. 1998 and references therein for more details of the general ecological characteristics of the BDFFP sites and their soil beetle fauna). It is interesting to note the regular occurrence of single specimens of *P. semicaecus* sp.nov. in samples of a very restricted area (despite intense sampling in surrounding forest patches), indicating at least a very patchy distribution within the study site. The general distribution of the species is however totally unknown.

Discussion

According to the key provided in WOOLDRIDGE (1982) *P. semicaecus* sp.nov. would be close to *P. rudis* WOOLDRIDGE from Venezuela and Surinam and *P. latus* WOOLDRIDGE from Venezuela and Brazil. However, it has a number of unique morphological modifications which are unique among the species of this genus, but which are common in species of a number of groups living in forest litter: small size, globular shape, light pigmentation, strong reduction (or loss) of metathoracic wings, and microphthalmy.

Among limnichids, there was no previously known micropththalmic species, and the only apterous ones are those of the genus *Hyphalus* BRITTON, which are intertidal (BRITTON 1971; HERNANDO & RIBERA 2000). Similar examples of small, microphthalmic, apterous (or micropterous) soil litter species in families which have in general aquatic or riparian habits can be found in the Dryopidae (e.g. *Geoparnus* BESUCHET, *Sosteamorphus* HINTON, *Oreoparnus* DELÈVE, *Spalacosostea* KODADA, *Pedestrodryops* KODADA, in which in some cases only the females show these characteristics, KODADA 1996, 2001) and Dytiscidae (*Geodessus* BRANCUCCI, *Terradessus* WATTS and *Typlodessus* BRANCUCCI; BALKE & HENDRICH 1996; BRANCUCCI 1979, 1985; WATTS 1982).

There are numerous examples of isolated taxa living in forest litter showing these morphological characteristics in a number of unrelated terrestrial families or genera with a different general ecology. Without being exhaustive, these include the Byrrhidae, with the genus *Curimopsis* GANGLBAUER, which has some apterous, depigmented and microphthalmic species, such as e.g. *C. jordai* (REITTER), a Balearic endemic living in the soil (JORDÀ 1922). In Clambidae, *Clambus semicaecus* ENDRÖDY-YOUNGA, from Peru, is the only microphthalmic and apterous species of the genus in South America (ENDRÖDY-YOUNGA 1998). *Anemadus smetanai* RUZICKA (Leiodidae) from China is also the only microphthalmic and apterous species of the genus (RUZICKA 1999); and in the same family, some species of the genus *Ptomaphagus* from the U.S. also show these adaptations (RUZICKA 1999) (see PECK 1978 for more examples in family Leiodidae).

Other examples include species in families Anthicidae (genus *Elgonidium* BASILEWSKY from Kenya, BASILEWSKY 1954); family Tenebrionidae (genus *Caecochares* KOCH from Madagascar, BREMER 2000); family Jacobsoniidae (*Derolathrus anophthalmus* (FRANZ) from the Canary Islands, FRANZ 1969, LÖBL & BURCKHARDT 1988); and family Eucinetidae (*Proezkus coecus* VIT from Thailand, VIT 2000). And finally, in a family which *a priori* could be thought of being most unlikely to have some species with these characteristics, the genus *Vinsonella* ARROW is an anomalous small blind lucanid living in the forest litter on Mauritius (ARROW 1940).

The presence of common derived morphological characteristics in a high number of unrelated species and genera, always associated with the habit of living in forest soil litter, is a remarkable example of evolutionary convergence. Some of these morphological features are similar to that present in subterranean environments, either in deep soil (endogeous), in caves or in coarse interstitial habitats (see e.g. JUBERTHIE & DECU 1998). However, the shape of the body and appendages are different: globular and with small robust appendages in soil litter; also with short robust appendages but with body less globular in endogeous environments; and with body more elongated and with long slender appendages in caves. These similarities suggest the possibility of relatively easy transitions among the tree environments, but at the same time pose interesting questions about the significance of the morphological differences and the mechanisms by which this morphological plasticity is achieved.

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