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Two new species of *Agaporomorphus* Zimmermann (Coleoptera: Dytiscidae) from Peru

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Abstract

Two new species in the genus *Agaporomorphus* Zimmermann are described from Madre de Dios, Peru, *A. tambopatensis* Miller, **n. sp**. and *A. silvaticus* Miller, **n. sp**. A key to males of all the species in the genus is provided. A cladistic analysis is presented including the new species. *Agaporomorphus* is arranged into three species groups; the *A. dolichodactylus*-group (*A. dolichodactylus* Miller, *A. mecolobus* Miller and *A. grandisinuatus* Miller); the *A. knischi*-group (*A. knischi* Zimmermann, *A. tambopatensis* and *A. silvaticus*); and the *A. pereirai*-group with a single species, *A. pereirai* Guignot. Taxonomically and phylogenetically important characters are discussed and illustrated.

Key words: Neotropical, diving beetle, phylogeny, rain forest

Introduction

The genus *Agaporomorphus* Zimmermann is a small genus of small diving beetles found only in the Neotropical region and distributed from eastern Peru north to Suriname and south to southeastern Brazil. Little is known about their biology since most specimens and species have been collected only at lights.

For most of its taxonomic history, *Agaporomorphus* included species currently placed in *Hydrodytes* Miller (subfamily Hydrodytinae Miller) until the classification was revised by Miller (2001b). *Agaporomorophus* is apparently the sister group to the rest of the Copelatinae (Miller 2001b), an extremely speciose radiation within Dytiscidae. The genus is diagnosed by the following combination of characters: 1) small size (<3.65mm), 2) scutellum visible, 3) metacoxal lines very closely approximated, 4) metacoxae without oblique, fine striae, 5) bursa copulatrix absent, and 6) dorsal surfaces of elytra and pronotum with very fine, short striae evenly distributed over surface.

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The genus was revised by Miller (2001a) and was found to include five species, three of them new at that time. A recent collecting trip to Peru yielded two additional new species described here.

Materials and Methods

Measurements were obtained using an ocular scale on a Wild M3C dissecting microscope. Only intact specimens were measured. The total length (TL) and greatest width (GW) of specimens are provided. The ratio TL/GW is also provided to give an indication of shape.

This project is based mainly on specimens collected in Tambopata, Madre de Dios, Peru. Holotypes and paratypes are deposited in the United States National Museum, Smithsonian Institution, Washington, DC, USA (curator T. Erwin). Paratypes are also deposited at the Museo de Historia Natural, Universidad Mayor de San Marcos, Lima, Peru and in the authorís collection.

At the present time, females of several species are indistinguishable. For this reason, the included key allows only males to be identified.

The two new species described here, *A. tambopatensis* and *A. silvaticus*, were included in the matrix analyzed by Miller (2001a). No other changes to the taxon content of the analysis were made. The data matrix (Miller 2001a) was updated to accommodate two new species and four characters (07–10, Table 1) and manipulated and trees were examined using the program Winclada (Nixon 2002). Shortest trees were found using NONA (Goloboff 1995) and the commands "wh" and "mswap+." The following new characters were included in the cladistic analysis (numbered beginning from the characters in Miller (2001a)). Character states for taxa are presented in Table 1.

TABLE 1. Data matrix of assigned states of characters for seven species of *Agaporomorphus* and generalized outgroup. Characters 1–6 are the same as those from Miller (2001a).

	000000 0001
	123456 7890
Outgroup	000000 0000
A. knischi	000001 1111
A. pereirai	000001 0000
A. grandisinuatus	101000 0000
A. mecolobus	211110 0000
A. dolichodactylus	211110 0000
A. tambopatensis	000000 1111
A. silvaticus	000000 1000

7. *Small series of elongate setae on each side of midline on dorsal surface of male median lobe*; (0) absent, (1) present (Figs. 9, 13, 17). Specimens of *A. knischi*, *A. tambopatensis* and *A. silvaticus* each have a small series of prominent setae along each side of the dorsal surface of the male median lobe.
8. *Male with triangular spinous process medially along posterior margin of visible abdominal sternite V*; (0) absent, (1) present (Miller 2001a: fig. 32). Specimens of *A. knischi* and *A. tambopatensis* each have a triangular process medially on the posterior margin of abdominal sternite V. This structure is carinate in *A. knischi* and may correspond to the prominent peg-like setae present along the posteroventral margin of the metatibia forming a stridulatory device. The process in *A. tambopatensis* is not carinate, however, and there do not appear to be corresponding peg-like setae on the metatibia calling into question its function as a stridulatory device.
9. *Male with series of parallel oblique strigae on each side of middle of abdominal ventrite III*; (0) absent; (1) present (Miller 2001a: fig. 32). Male members of *A. knischi* and *A. tambopatensis* have a series of strigae on the surface of each side of ventrite III. I previously interpreted these as corresponding to the peg-like setae on the posteroventral margin of the metatibia in males of *A. knischi* (Miller 2001a: fig. 31) forming a stridulatory device (Miller 2001a). However, these pegs do not seem to easily interface with this region of the sternite suggesting that some other structure may work together with these strigae in some fashion if they are a part of a stridulatory device. No obvious corresponding structures were found.
10. *Male antennomere V*; (0) not modified; (1) with prominent posteroventral emargination. Members of *A. tambopatensis* and *A. knischi* have antennomere VI modified.

Key to the Species of *Agaporomorphus* (males)

1. Male with antennomere VI conspicuously modified, expanded with distinct posteroventral emargination (Figs. 1, 2)..... 2
- Male with antennomere VI not conspicuously modified (Fig. 3)..... 3

2(1). Male with antennomere V broadly triangular and flattened, antennomere VI very broad, deeply and broadly emarginate along posteroventral margin (Fig. 1); male with very prominent, carinate process medially along posterior margin of abdominal ventrite V, with corresponding peglike setae along anteroventral margin of metatibia forming apparent stridulatory device.....*A. knischi* Zimmermann
- Male with antennomere V moderately broad, but not triangular and flattened, antennomere VI moderately broad, with prominent emargination along posteroventral margin (Fig. 2); male with relatively small triangular process medially along posterior margin of visible abdominal ventrite V, without corresponding peglike setae along anteroventral margin of metatibia.....*A. tambopatensis*, n. sp.

3(1). Pro- and mesotarsal claws of male very long, subequal in length to mesotarsomere V (Miller 2001a: figs. 23, 24); apex of mesotarsomere V with distinct lobe (Miller 2001a: figs. 23–24); median lobe with very long basodorsal process (Miller 2001a: figs. 10, 14) 4

- Pro- and mesotarsal claws 1/2 to 3/4 length of mesotarsomere V (Miller 2001a: figs. 20–22); apex of mesotarsomere V without lobe (Miller 2001a: figs. 20–22); median lobe without long process or with process short (Miller 2001a: figs. 1, 5, 7) 5

4(3). Median lobe in lateral aspect very robust apically (Miller 2001a: fig. 10); apical lobe on mesotarsomere V less than ¼ length of mesotarsomere V (Miller 2001a: fig. 23) .....*A. mecolobus* Miller

- Median lobe in lateral aspect more slender apically (Miller 2001a: fig. 14); apical lobe on mesotarsomere V greater than ¼ length of mesotarsomere V (Miller 2001a: fig. 24)..... *A. dolichodactylus* Miller

5(3). Posterior claw of male mesotarsus slightly sinuate in dorsal aspect (Miller 2001a: fig. 27); median lobe in lateral aspect with two large dorsal convexities, a larger one medially and a smaller lobe more basally, ventrally without series of setae (Miller 2001a: fig. 7)..... *A. grandisinuatus* Miller

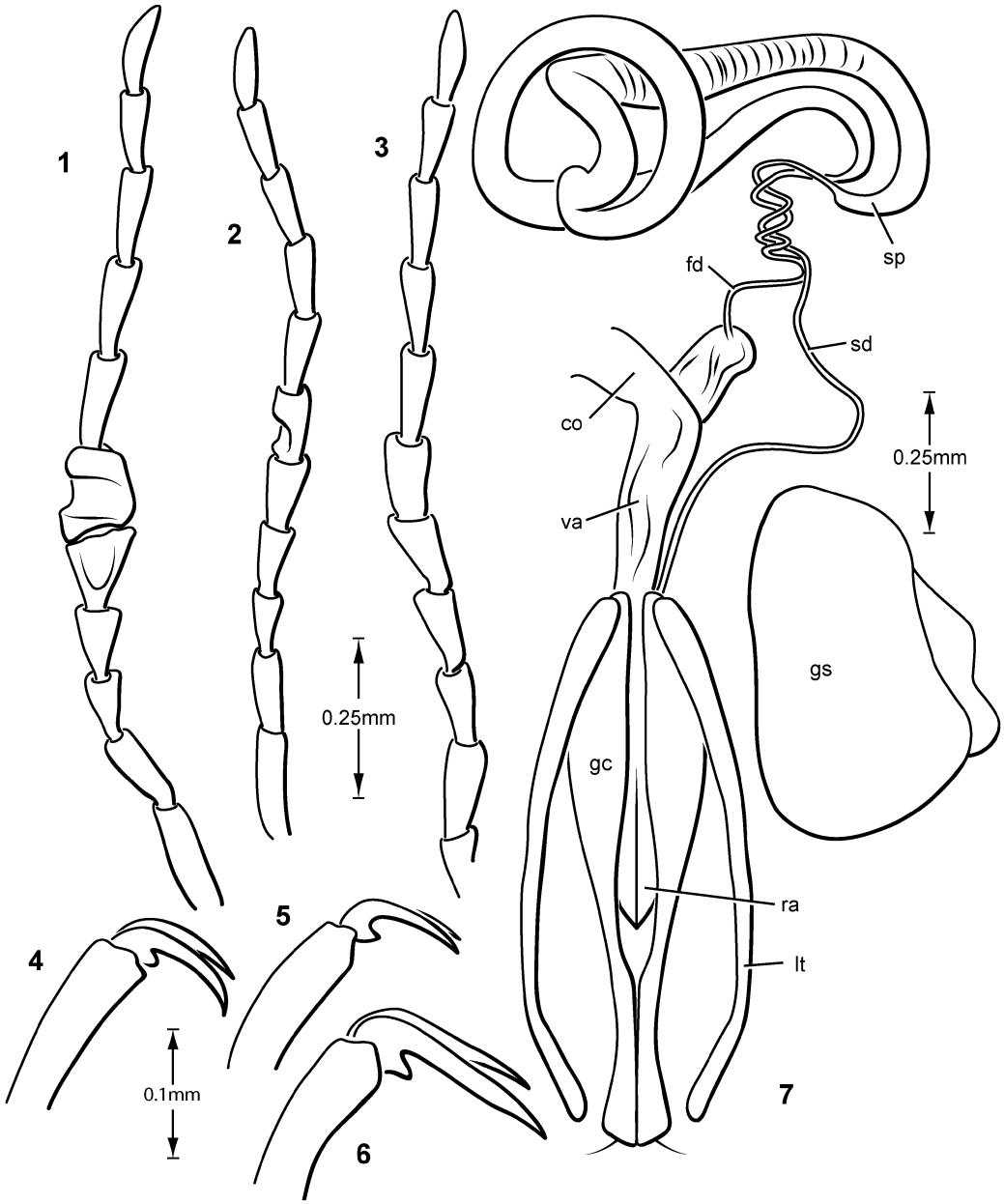
- Posterior claw of male mesotarsus not sinuate in dorsal aspect; median lobe in lateral aspect without convexities 6

6(5). Male median lobe elongate, slender, in lateral aspect with prominent, acutely pointed flanges, broad ventral lobe bearing region of ventrally-directed setae (Miller 2001a: fig. 5).....*A. pereirai* Guignot

- Male median lobe robust, strongly curved, in lateral aspect without pointed flanges, with small series of dorsally directed setae medially on each side of midline (Fig. 17) .....*A. silvaticus* n. sp.

***Agaporomorphus tambopatensis* Miller, new species**
(Figs. 2, 5, 7, 12–15)

Diagnosis. This species can be distinguished from all other known *Agaporomorphus* except *A. knischi* by the presence of a modification of antennomere VI in the male. This antennomere is broader than in other taxa and has a distinct emargination on the posteroventral surface (Fig. 2). The antennae in male *A. knischi* are modified as well, but antennomere V in that species is broadly triangular and antennomere VI is broader and more broadly emarginate. In *A. tambopatensis* the male protarsal claws are relatively unmodified, evenly curved and slender (Fig. 5). The male mesotarsal claws are not especially long and are not sinuate. In males there is a small, triangular process extending from the middle of the posterior margin of visible abdominal sternite V and a series of oblique, parallel strigae on each side of abdominal ventrite III. The male median lobe is very broad and has a small series of setae on each side of the dorsal surface (Fig. 13). In ventral aspect the median lobe is convoluted with lobes and folds (Fig. 14).



FIGURES 1–7. *Agaporomorphus* spp., morphological details. 1, 4—*A. knischi*; 2, 5, 7—*A. tambopatensis*; 3, 6—*A. silvaticus*. 1–3—left antenna, male, ventral aspect; 4–6—right protarsus, male, posterior aspect; 7—genitalia, female, ventral aspect. co—common oviduct; fd—fertilization duct; gc—gonocoxa; gs—gonocoxosternite; lt—laterotergite; ra—rami; sd—spermathecal duct; sp—spermatheca; va—vagina.

Description. *Measurements*. TL = 2.91–3.08 mm, GW = 1.48–1.58 mm, TL/GW = 1.95–1.97. *Coloration*. Red-brown on all dorsal surfaces, broadly light yellow along anterior margin of elytron. All ventral surfaces and appendages yellow except abdominal sternites red-yellow. *Sculpture and structure*. Pronotum with microsculpture consisting of

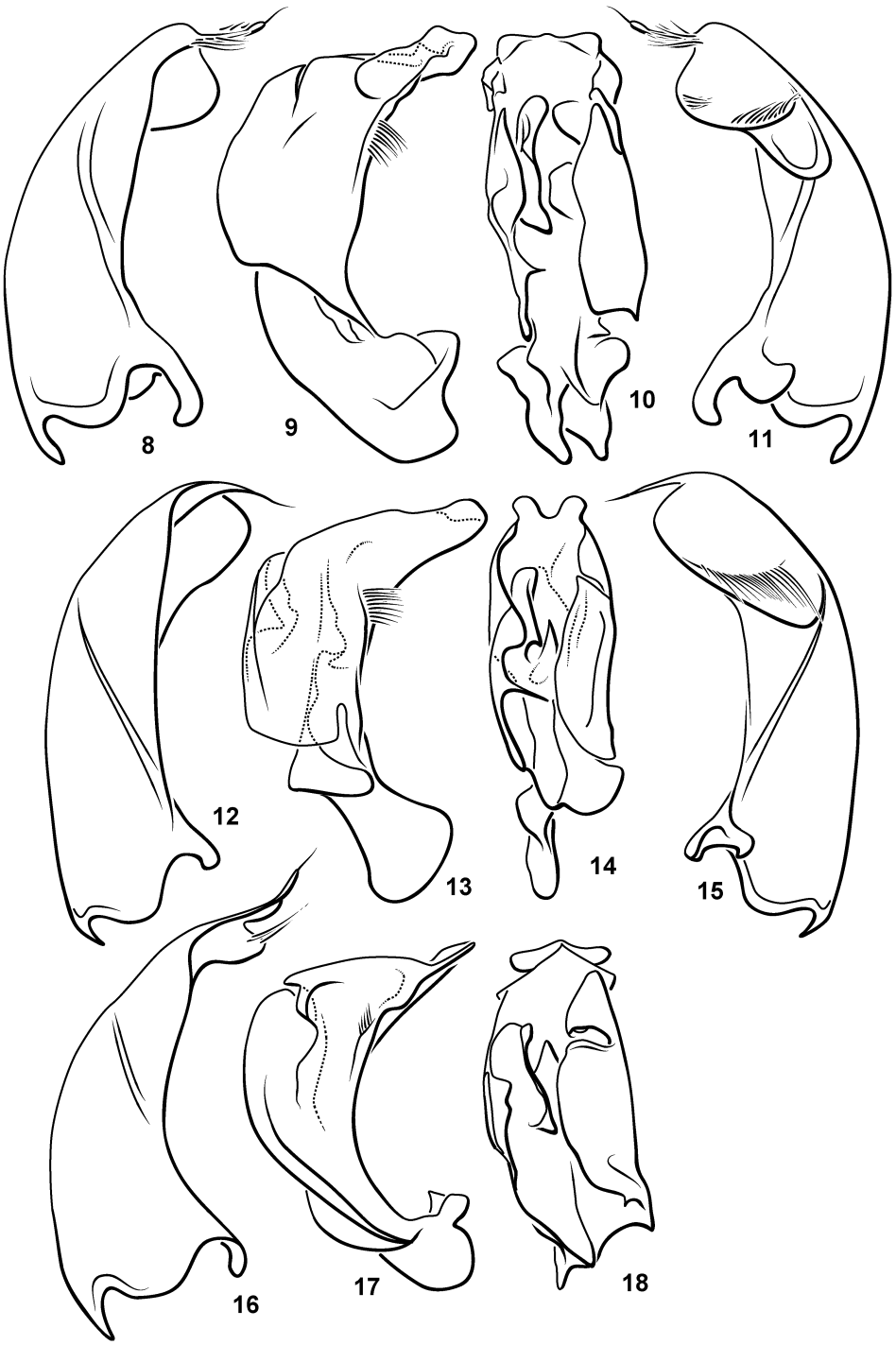
fine, slightly longitudinally lengthened cells, with very fine and short longitudinal striae dispersed irregularly and moderately densely; lateral pronotal bead obscured in anterior one-fourth. Prosternum medially strongly and sharply carinate, carina extending onto prosternal process; prosternal process medially with a distinct longitudinal carina extending to apex, laterally with strongly beaded margins, apex pointed. Elytron covered with extremely fine, evenly spaced, short striae, striae more punctiform laterally and apically. Metafemur moderately broad, length about 3.2 times greatest width. *Male genitalia.* Median lobe in lateral aspect robust, with broad expansion dorsad, apex with hyaline apicoventral lobe (Fig. 13); in ventral aspect very robust, broad, with complicated folding and structures (Fig. 14). Lateral lobe broad basally, strongly narrowed medially, apical half very slender, apicomedially with large membranous lobes bearing series of long setae (Figs. 12, 15). *Female genitalia* (Fig. 7). Spermatheca very long, coiled, slender, tapered to spermathecal duct; spermathecal duct relatively short; fertilization duct very long, coiled; gonocoxa slender, lateral margin broadly convex, apex expanded; laterotergite very slender, elongate. *Sexual dimorphism*. Male protarsal claws unmodified (Fig. 5); pro- and mesotarsal claws about half length of mesotarsomere V; without apical lobe on mesotarsomere V; protarsomeres I and II broadened, protarsomere I with two large adhesive setae, protarsomere II without adhesive setae; mesotarsomeres I and II slightly broadened, mesotarsomere 1 with one large, medial adhesive seta and two large, apical adhesive setae, mesotarsomere II with two smaller, apical adhesive setae; female pro- and mesotarsomeres unmodified. Male with distinct triangular, posteriorly-directed prominence medially along posterior margin of visible abdominal sternite V; female without spine. Male antennomeres V and VI modified, V broadly triangular, VI broad with large posterior emargination (Fig. 2); female antennomeres unmodified. *Variation*. Coloration variable from relatively light brown with pale pronotum and elytral bases to darker brown and more concolorous.

Etymology. The specific epithet is a Latinized adjective *tambopatensis* derived from the name of the type locality of this species.

Phylogenetic relationships. *Agaporomorphus tambopatensis* is the sister to *A. knischi* (Fig. 19) based on the common presence in males of a triangular spinous process medially along the posterior margin of visible abdominal sternite V (Char. 8, Miller 2001a: fig. 32), a series of parallel oblique strigae on each side of the medial surface of abdominal ventrite III (Char. 9, Miller 2001a: fig. 32) and modifications of antennomere VI (Char. 10, Figs. 1–2).

Distribution. Known only from Madre de Dios, Peru.

Material examined. HOLOTYPE: ♂ labeled, "PERU: Madre de Dios, Rio Tambopata, Posadas Amazonas, 13 December 2003, K.B. Miller/ HOLOTYPE: *Agaporomorphus tambopatensis* Miller, 2005 [red label with double black line border]." PARATYPES, 20 total, labeled same as holotype except "…/ PARATYPE: *Agaporomorphus tambopatensis* Miller, 2005 [blue label with black line border]."



FIGURES 8–18. *Agaporomorphus* spp., male genitalia. 8–11—*A. knischi*; 8—right lateral lobe, right lateral aspect; 9—median lobe, right lateral aspect; 10—median lobe, ventral aspect; 11—right lateral lobe, left lateral aspect. 12–15—*A. tambopatensis*; 12—right lateral lobe, right lateral aspect; 13—median lobe, right lateral aspect; 14—median lobe, ventral aspect; 15—right lateral lobe, left lateral aspect. 16–18—*A. silvaticus*; 16—right lateral lobe, right lateral aspect; 17—median lobe, right lateral aspect; 18—median lobe, ventral aspect.

***Agaporomorphus silvaticus* Miller, new species**
(Figs. 3, 6, 16–18)

Diagnosis. This species lacks conspicuous modifications to the antennae (Fig. 3). The protarsal claws are long and robust with the ventral margins slightly sinuate and the bases strongly curved (Fig. 6). The mesotarsal claws are not long or sinuate. Males lack a triangular process along the posterior margin of abdominal sternite VI and lack a series of oblique rugae on each side of abdominal ventrite III. The male median lobe is very robust and strongly curved in lateral aspect (Fig. 17). It is convoluted with folds and lobes in ventral aspect (Fig. 18).

Description. *Measurements*. TL = 3.48 mm, GW = 1.70 mm, TL/GW = 2.04. *Coloration*. Red-brown on all dorsal surfaces, broadly light yellow along anterior margin of elytron. All ventral surfaces and appendages yellow except abdominal sternites, medial portion of prosternum and prosternal process red-yellow. *Sculpture and structure*. Pronotum with microsculpture consisting of fine, slightly longitudinally lengthened cells, with very fine and short longitudinal striae dispersed randomly and moderately densely; lateral pronotal bead obscured in anterior one-fourth. Prosternum medially strongly and sharply carinate, carina extending onto prosternal process; prosternal process medially with a distinct longitudinal carina extending to apex, laterally with strongly beaded margins, apex pointed. Elytron covered with extremely fine, evenly spaced, short striae, striae more punctiform laterally and apically. Metafemur moderately broad, length about 3.2 times greatest width. *Male genitalia*. Median lobe in lateral aspect very robust, broadly expanded dorsad, strongly curved, apex narrowed with small hyaline apicoventral lobe (Figs. 17); in ventral aspect very robust, broad, with complicated folding and structures (Fig. 18). Lateral lobe broad basally, narrowed medially, apical portion slender, apicomedially with large membranous lobes bearing series of few long setae (Fig. 16) also with setae apicomedially. *Female*. Unknown. *Sexual dimorphism*. Female unknown, but male protarsal claws modified, long, basally strongly curved, slightly sinuate (Fig. 6); pro- and mesotarsal claws a little less than half length of mesotarsomere V; without apical lobe on mesotarsomere V; protarsomeres I and II broadened, protarsomere I with two large adhesive setae, protarsomere II without adhesive setae; mesotarsomeres I and II slightly broadened, mesotarsomere I with one large, medial adhesive seta and two large, apical adhesive setae, mesotarsomere II with two smaller, apical adhesive setae. Male antennomeres V and VI slightly broader and flatter than other antennomeres (Fig. 3).

Etymology. The specific epithet is a Latin adjective *silvaticus, -a, -um,* meaning of or belonging to a wood or to trees, referring to the dense, virgin forest in which this species was found.

Phylogenetic relationships. *Agaporomorphus silvaticus* is the sister to a clade containing *A. tambopatensis* and *A. knischi* based on the common presence in these species of a small series of setae on each side of the dorsal surface of the male median lobe (Char. 7, Figs. 9, 13, 17).

Distribution. Known only from Madre de Dios, Peru.

Material examined. HOLOTYPE: ♂ labeled, "PERU: Madre de Dios, Rio Tambopata, Posadas Amazonas, 13 December 2003, K.B. Miller/ HOLOTYPE: *Agaporomorphus silvaticus* Miller, 2005 [red label with double black line border]." This species is known only from the holotype.

Results of parsimony analysis

A single most parsimonious cladogram was found (length = 12, CI = 91, RI = 92, Fig. 19). A single character (Char. 6) is homoplasious. Three species groups are indicated with relationships among them unresolved (Fig. 19). One species group includes *A. pereirai*, one includes *A. dolichodactylus*, *A. mecolobus* and *A. grandisinuatus* and one includes *A. knischi*, *A. tambopatensis* and *A. silvaticus* (Fig. 19).

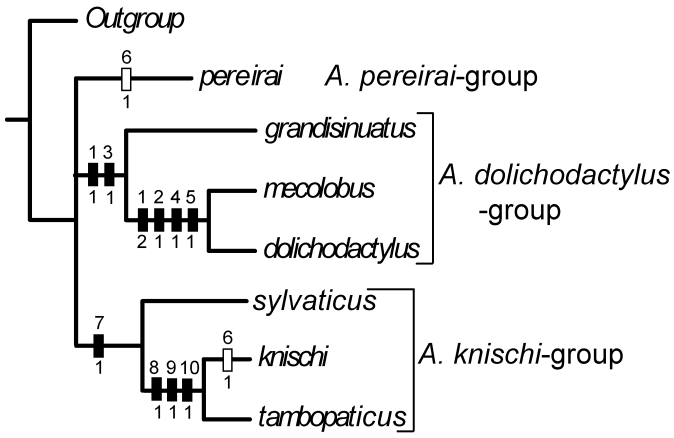


FIGURE 19. Single most parsimonious cladogram of *Agaporomorphus* species (length = 12, CI = 91, RI = 92). Numbers above hatch marks refer to characters numbers. Numbers below hatch marks refer to character state transformations.

Discussion

There are three species groups indicated by the cladistic analysis (Fig. 19). The *A. pereirai*-group contains the single species, *A. pereirai*, characterized by several apomorphies unique to the species (see Miller 2001a). The *A. dolichodactylus*-group is characterized by the presence of a dorsal prominence on the male median lobe (relatively small in *A. grandisinuatus*) (Miller 2001a: figs. 7, 10, 14) and the male posterior mesotarsal claw distinctly sinuate (Miller 2001a: figs. 27–29). The *A. knischi*-group is characterized by similar, complex, male genitalia including several discrete characters

such as the presence of a small series of setae along the sides of the dorsal surface of the median lobe (Figs. 9, 13, 17). Two of these species, *A. knischi* and *A. tambopatensis* also share modified fifth and sixth antennomeres in males (Figs. 1, 2), whereas *A. silvaticus* has these antennomeres slightly expanded, but not strongly modified (Fig. 3). Previously (Miller 2001a), I interpreted a series of oblique grooves on each side of the third visible abdominal sternite (Miller 2001a: fig. 32) as the file of a stridulatory device in *A. knischi*. The corresponding comb was interpreted as the robust, peg-like setae on the posteroventral margin of the metatibia (Miller 2001a: fig. 31). It seems more likely, however, that these pegs correspond with the carinate, triangular process extending posteriorly from the middle of the posterior margin of visible abdominal sternite V (Miller 2001a: fig. 32). The oblique grooves, however, are present only in males. They are also present in males of *A. tambopatensis*. If this is a stridulatory device, the corresponding structure does not appear to be pegs, but instead may be the angulate posterior margins of the metatrochanter or metafemur.

Three species of *Agaporomorphus* were collected together in the Tambopata area, *A. knischi*, *A. tambopatensis*, and *A. silvaticus*. Several specimens of *A. knischi* and *A. tambopatensis* and only a single specimen of *A. silvaticus* were collected. Most of these, including the single specimen of *A. silvaticus*, were collected at a mercury vapor lamp at a canopy platform at about 30 meters, well above the tops of most of the trees in the area. *Agaporomorphus knischi* was also collected, in low numbers, from a leaf-choked swamp in dense tropical forest. The only habitat information known for another *Agaporomorphus* is for *A. dolichodactylus* which was collected from shallow, weedy marshes in subtropical lowlands of Bolivia (Miller 2001a).

There is a surprisingly diverse *Agaporomorphus* fauna at Tambopata, Peru, the type locality for the two new species described here. *Agaporomorphus grandisinuatus*, *A. knischi*, *A. tambopatensis* and *A. silvaticus* each occur at the site, and the last three of these are clearly closely related. Members of *Agaporomorphus* are apparently cryptic in habitat and are rarely collected. However, when they are found in numbers, often there are several species involved. It seems likely from this that numerous new species will eventually be found. Continued emphasis on canopy mercury vapor lamping may prove to be a fruitful means for investigating this diversity.

Acknowledgments

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References

Goloboff, P. (1999) NONA. Ver. 2.0. Published by the author, Tucumán, Argentina.

Miller, K.B. (2001a) Revision of the Genus *Agaporomorphus* Zimmermann (Coleoptera: Dytiscidae: Copelatinae). *Annals of the Entomological Society of America*, 94, 520–529.

Miller, K.B. (2001b) On the phylogeny of the Dytiscidae (Coleoptera) with emphasis on the morphology of the female reproductive tract. *Insect Systematics and Evolution*, 32, 45–92.

Nixon, K. C. (2002) WinClada ver. 1.00.08. Published by the author, Ithaca, NY.

