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***Aquarius philippinensis* sp.n., a large endemic water strider (Insecta: Heteroptera: Gerridae) from ancient crater lakes in South Luzon, Philippines**

H. Zettel* & R. B. Ruiz**

Abstract

Aquarius philippinensis sp.n. from Lake Buhi and Lake Baao, Camarines Sur, South Luzon, Philippines, is described, illustrated, and compared with closely related species. *Aquarius philippinensis* sp.n. belongs to the *A. paludum* species group (sensu ANDERSEN 1990) and is probably part of a phylogenetic clade containing *A. adelaidis* (DOHRN, 1860) and *A. lili* POLHEMUS & POLHEMUS, 1994.

Key words: Heteroptera, Gerridae, Gerrinae, *Aquarius*, *Aquarius paludum* group, new species, Philippines, Luzon, Lake Buhi, Lake Baao, endemism

Zusammenfassung

Aquarius philippinensis sp.n. von den beiden Seen Buhi und Baao in Camarines Sur, Süd-Luzon, Philippinen, wird beschrieben, abgebildet und mit den nächstverwandten Arten verglichen. *Aquarius philippinensis* sp.n. gehört in die *A. paludum*-Artengruppe (sensu ANDERSEN 1990), wo er Teil jenes phylogenetischen Astes ist, der auch *A. adelaidis* (DOHRN, 1860) und *A. lili* POLHEMUS & POLHEMUS, 1994 enthält.

Introduction

Water striders of the genera *Gerris* FABRICIUS, 1794, *Limnopus* STÅL, 1868, and *Aquarius* SCHELLENBERG, 1800 are important organisms for studies of biogeography, evolutionary trends and ecological adaptations, and certainly the best-studied Gerromorpha regarding these aspects. *Aquarius* has been phylogenetically and taxonomically revised by ANDERSEN (1990) and DAMGAARD & al. (2000). ANDERSEN (1995) lists sixteen species and one subspecies world-wide. ANDERSEN (1990) divides *Aquarius* into four monophyletic species groups and gives information on distribution, ecology, and wing length dimorphism; his *Aquarius paludum* group consists of the following species: the trans-Palaearctic species *A. paludum* (FABRICIUS, 1794), which reaches the most northern parts of India and Indochina at the southern border of its distribution, with the distinct subspecies *A. paludum amamiensis* (MIYAMOTO, 1958) from Amami-Oshima and the Ryu-Kyu Islands, Japan (ANDERSEN 1990); the Oriental species *A. adelaidis* (DOHRN, 1860) from the south and southeast Asian mainland, Sri Lanka, Sumatra, Borneo and Luzon of the Philippine Islands (ANDERSEN 1990, POLHEMUS & POLHEMUS 1994); the northwestern Australian species *A. fabricii* ANDERSEN, 1990; the eastern Australian

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species *A. antigone* (KIRKALDY, 1899); the Afrotropical species *A. distanti* (HORVÁTH, 1899); and the Timorese species *A. lili* POLHEMUS & POLHEMUS, 1994. A seventh species of this group has recently been discovered by the junior author in two ancient crater lakes in southern Luzon, Philippines, and is described here. Its possible phylogenetic relationships and its probably very local endemism are briefly discussed.

From the Philippine Islands, the only published record of *Aquarius* is a single male of *A. adelaidis*, which has been collected in an abandoned fish pond near the former Clark Air Base in Pampanga Province, Luzon (POLHEMUS & REISEN 1976).

Repositories of specimens:

CSSAC Camarines Sur State Agricultural College, Pili, Camarines Sur, Philippines

CZW Coll. H. & S.V. Zettel, Vienna, Austria

NHMW Naturhistorisches Museum in Wien, Vienna, Austria

UPLB Museum of Natural History, University of the Philippines, Los Baños, Laguna, Philippines

Material and methods

All specimens examined were collected in 70 % isopropyl alcohol. Later-on, part of specimens was dry-mounted, pinned or glued on card labels. Examination of external structures was carried out by use of a LEICA Wild M10 stereo-microscope (max. 108 x magnification). Drawings were made by using a camera lucida. Measurements of specific body parts were done using a micrometer caliper.

Terminology follows ANDERSEN (1990) and previous publications of the senior author (e.g., ZETTEL & CHEN 2000). Measurements of brachypterous specimens stated under "Size" refer to 20 examined specimens of each sex; other measurements refer to the holotype or to the allotype, respectively.

Aquarius philippinensis sp.n. (Figs. 1 - 14)

Holotype (brachypterous male): Philippines, Camarines Sur, Buhi, Santa Cruz, Lake Buhi, December 21, 2001, leg. Ryan B. Ruiz (UPLB); **paratypes**: 22 ♂♂, 21 ♀♀ (including allotype; all brachypterous), same locality data (CSSAC, CZW, NHMW, UPLB); 1 ♂ (brachypterous), und 1 ♀ (macropterous) from Camarines Sur, Baao, San Francisco, Lake Baao, December 21, 2002, leg. Ryan B. Ruiz (CSSAC, CZW).

Description:

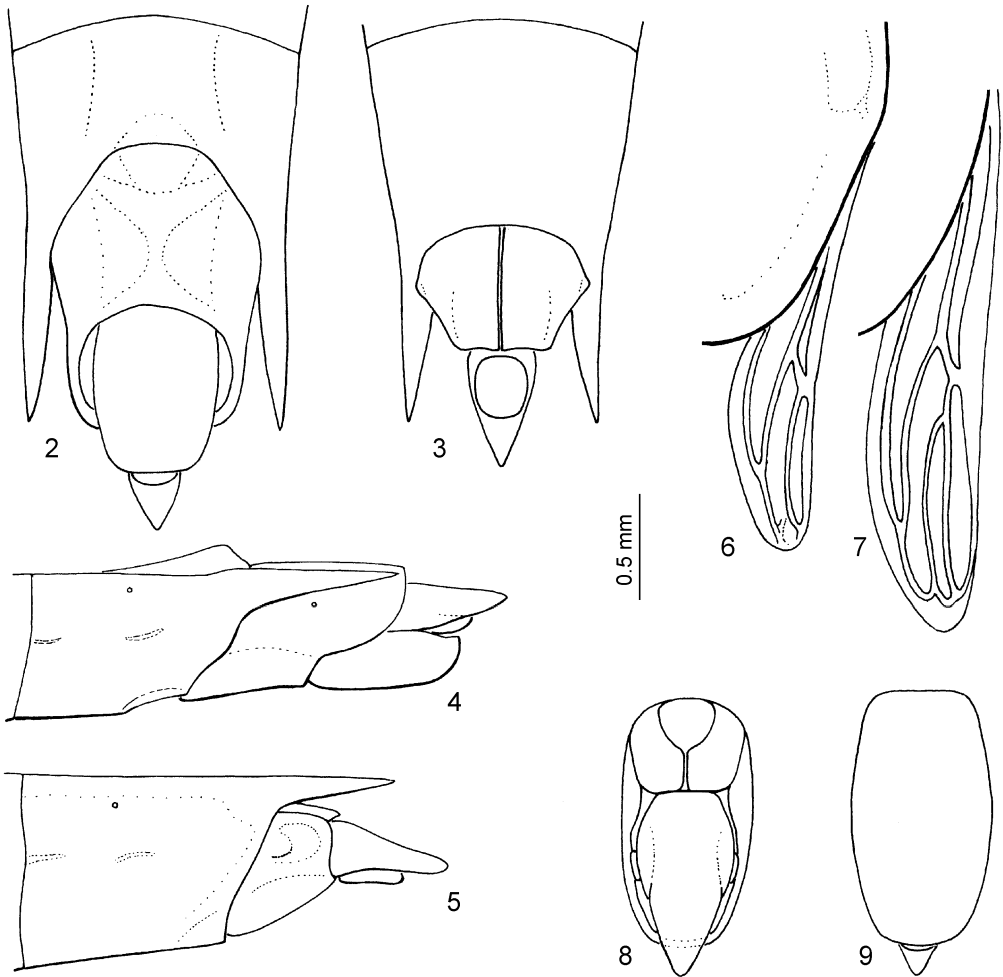
Brachypterous male: Size: body length 10.8 - 12.6 mm ($\bar{\varnothing}$ = 12.0; holotype: 11.8 mm); maximum width across mesacetabula 2.4 - 2.8 mm ($\bar{\varnothing}$ = 2.63 mm; holotype: 2.61 mm); head width 1.7 - 2.0 mm ($\bar{\varnothing}$ = 1.85 mm; holotype: 1.80 mm); length of second antennomere 1.1 - 1.3 mm ($\bar{\varnothing}$ = 1.23 mm; holotype: 1.21 mm); mesofemur length 10.1 - 11.4 mm ($\bar{\varnothing}$ = 10.66 mm; holotype: 1.21 mm).

Colour: Mainly black, covered with short silverish pubescence, head dorsally with transverse yellow mark at base; basal two rostral segments brownish yellow; antennomeres black; anterior lobe of pronotum black with fairly distinct, narrow, pale median line; pronotal lobe mainly black, lateral margin beyond humeri yellow, in some specimens yellow stripe reaching more or less anteriad, hind margin usually black, in some



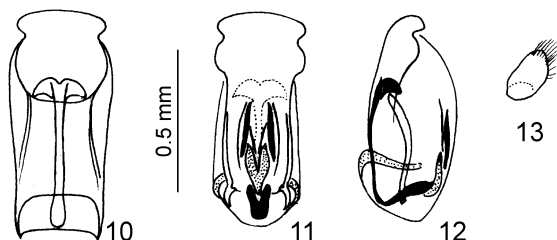
Fig. 1: *Aquarius philippinensis* sp.n., habitus of brachypterous male, legs partly omitted.

specimens indistinctly, narrowly blackish brown (especially in specimen from Lake Baao); forewing blackish brown (medium brown in specimen from Lake Baao), veins black (light brown in specimen from Lake Baao); legs mainly blackish, procoxa and trochanters ventrally yellowish; femora at extreme base yellowish brown; tergites black; connexival margin black, in some specimens narrowly yellowish brown in posterior part; connexival spines black; lower pleural and ventral surfaces of body black with silverish pubescence; prosternum and lower part of all acetabula yellowish; area in front of metasternal scent orifice with golden pubescence; segment 8 distally yellowish; pygophore apically yellowish brown.



Figs. 2 - 9: *Aquarius philippinensis* sp.n. (2, 4, 6 - 9: male; 3, 5: female): (2, 3) terminalia of abdomen, ventral view; (4, 5) same, lateral view; (6, 7) forewings of two brachypterous specimens; (8) pygophore and proctiger, dorsal view; (9) same, ventral view.

Structural characteristics: body elongate (Fig. 1), total length 4.4 times maximum width of body; relative lengths of antennomeres 1 - 4 as 2.3 : 1 : 0.6 : 0.9; antennomere 1 much longer than antennomeres 2 and 3 together; rostrum stout and short, barely reaching hind margin of prosternum; length of segment 3 and 4 together 1.36 mm; pronotum long and narrow, only slightly widened across humeri; anterior part strongly elevated, behind eyes with sharp tubercles, on disc shallowly depressed; pronotal lobe sharply delimited from anterior pronotum by deep transverse depressions, with faint median carina in anterior third and in front of hind margin; humeral elevations distinct, shiny; hind margin of lobe distinctly produced; lengths of leg segments (in relation to length of mesofemur = 100): profemur 34, protibia 30, protarsus 5+6, mesofemur 100, mesotibia 75, mesotarsus 22+7, metafemur 103, metatibia 62, metatarsus 14+6; profemur incrassate, almost



Figs. 10 - 13: (10) endosoma, not exerted, dorsal view; (11) endosoma, exerted, ventral view; (12) same, lateral view; (13) left paramere, lateral view.

straight, subapically slightly constricted; protibia nearly straight, flattened; mesofemur ventrally and posteriorly with numerous short spines, without long pilosity; claws of all tarsi small, but distinct; forewings variable in length (Figs. 6, 7), reaching base of second to middle of fourth abdominal tergite; venation reduced; mesosternum with medial groove all over its length, more distinct anteriorly, 2.5 times metasternum length; metasternum not depressed; slit-shaped scent orifice situated on low tubercle; abdomen slender, sides subparallel, hardly tapering posteriorly; tergites 2 - 6 subequal in length, tergite 7 distinctly longer; laterotergites narrow, obliquely raised; connexival spines slender, but short, reaching distal third to apex of segment 8 (Figs. 2, 4); sternites 2 - 7 subequal in length, medianly carinate; hind margin of sternite 7 broadly concave, medially without or with small and very shallow triangular impression (Fig. 2); segment 8 large, subcylindrical, ventrally with basal and two lateral impressions, leaving triangular elevated area, which appearing keel-like posteriorly (Fig. 2); pygophore large, subovate, weakly truncate posteriorly (Figs. 8, 9); parameres very small, leaf-shaped, setose (Fig. 13); proctiger strongly tapering, with slender and pointed apex (Figs. 8, 9); endosoma sclerites as illustrated in Figs. 10 - 12: dorsal plate posteriorly prolonged beyond apex of dorsal sclerite, sclerotized, widened, with regularly curved hind margin, with distinct incisions of distal lateral margins; basal plate straight, weakly sclerotized; dorsal sclerite slender, distally bifurcate, with short, broad, recurved hooks, with basal furcation robust, curved anteriorly; apical sclerites absent; lateral sclerites slender, with subparallel sides; ventral sclerite V-shaped; two pairs of long, slender, sclerotized, accessory ventral sclerites present.

Brachypterous female: Size: body length 13.0 - 14.3 mm ($\bar{\varnothing}$ = 13.7 mm; allotype: 13.0 mm); maximum width across mesacetabula 2.8 - 3.1 mm ($\bar{\varnothing}$ = 2.91 mm; allotype: 2.81 mm); head width 1.6 - 2.0 mm ($\bar{\varnothing}$ = 1.80 mm; allotype: 1.78 mm); length of second antennomere 1.0 - 1.3 mm ($\bar{\varnothing}$ = 1.12 mm; allotype: 1.12 mm); mesofemur length 10.8 - 12.1 mm ($\bar{\varnothing}$ = 11.31 mm; allotype: 11.0 mm). Colour as in brachypterous male, except connexiva with narrow yellowish margin from apex of second segment to connexival spine, hind margin of sternite 7 and tergite 8 yellowish, gonocoxa yellow, and metasternum without golden pilosity.

Structural characteristics mostly as in male; total length 4.5 times maximum body width; relative lengths of antennomeres 1 - 4 as 2.5 : 1 : 0.65 : 0.95; lengths of leg segments (in relation to length of mesofemur = 100): profemur 35, protibia 29, protarsus 5+6, mesofemur 100, mesotibia 79, mesotarsus 23+6, metafemur 112, metatibia 62, metatarsus 15+6; profemur slender, tapering towards apex, without subapical constriction; forewings variable in length, reaching base of tergite 2 to middle of tergite 3; mesosternum posteriorly hardly grooved; abdomen slender, with sides anteriorly subparallel, posteriorly slightly tapering; tergite 1 very short, tergites 2 - 5 subequal in

length, tergites 6 and 7 slightly longer; laterotergites relatively broad, suberect; connexival spines slender, subparallel, reaching middle to apical fourth of proctiger (Figs. 3, 5); sternites 2 - 5 subequal in length, sternites 6 and 7 slightly longer; sternites medianly at most indistinctly carinate; hind margin of sternite 7 broadly concave (Fig. 3); gonocoxae 1 elongate, with ventrolateral subparallel impressions and deep dorsal impressions behind dorsal tubercle (Fig. 5); proctiger long and slender, with pointed apex (Figs. 3, 5).

Macropterous female: Size: body length 14.0 mm; maximum width across mesacetabula 2.96 mm; head width 1.82 mm; length of second antennomere 1.20 mm; mesofemur length 11.3 mm ($n = 1$). Colour and most structural characteristics as in brachypterous morph; total length 4.7 times maximum width; pronotum anteriorly more elevated, with prominent humeral angles; posterior part of pronotal lobe slightly more protruding; forewing venation with second bifurcation of M+Cu widely removed from anterior cross-vein of forewing; connexival spines reaching apical third of proctiger.

Macropterous male: unknown.

Comparative notes: *Aquarius philippinensis* sp.n. belongs to the *A. paludum* species group as defined by ANDERSEN (1990). The user of the identification key by ANDERSEN (1990) is confronted with the same difficulties in couplet 3 (and subsequently in couplets 4 or 12) as stated for *A. lili* by POLHEMUS & POLHEMUS (1994). Both, *A. lili* and *A. philippinensis* sp.n., are dominantly brachypterous (no micropterous or apterous morph), but have relatively short connexival spines (couplet 3) (Figs. 2 - 5). However, *A. philippinensis* sp.n. differs from *A. lili* in the shape of the dorsal plate of the vesicula of the male (Fig. 11), which is very similar with that of *A. adelaidis*. From both, *A. lili* and *A. adelaidis*, the new species can be easily distinguished by the black or at most weakly brownish (not broadly yellowish) hind margin of the pronotal lobe and by the absent (or at most very weakly developed) triangular impression at the hind margin of sternite 7 of the male (Fig. 2). The latter characteristic also distinguishes *A. philippinensis* sp.n. from *A. paludum*, a species with black hind margin of the pronotal lobe. In females, the dorsal tubercle of the gonocoxa is less developed in *A. philippinensis* sp.n. (Fig. 5) than in *A. adelaidis*. It seems evident that *A. adelaidis*, *A. lili*, and *A. philippinensis* sp.n. form one phylogenetic clade.

The affinities within this clade are presently unresolved. Closest relationship between *A. philippinensis* sp.n. and *A. adelaidis* is supported by the characteristic dorsal plate of the aedeagus, but between *A. philippinensis* sp.n. and *A. lili* by the short connexival spines and the indistinct or absent impression of the sternite 7 of the male.

Relationships within the *A. paludum* group are currently being investigated (Damgaard & Zettel, in prep.). Preliminary results support specific status of *A. philippinensis* sp.n.

Habitat notes: Specimens have been observed skating on the water surface of the lakes, frequently in flotillas. Those areas are preferred, where decayed organic materials are floating, or where boulders are present. Nymphs are found swimming behind huge boulders, where waters are very still and currentless.

Distribution (Fig. 14): This species is presently known only from two large lakes in Bicol, southern Luzon, Philippines: Lake Buhi and Lake Baao. Lake Buhi is known as the main site of the sinarapan, *Mistichthys luzonensis* SMITH, 1902 (Gobiidae), the world's smallest commercial fish species, which is endemic in Camarines Sur. The number of water bug species, which are endemic in the Bicol Region, is considerably high and confirms the

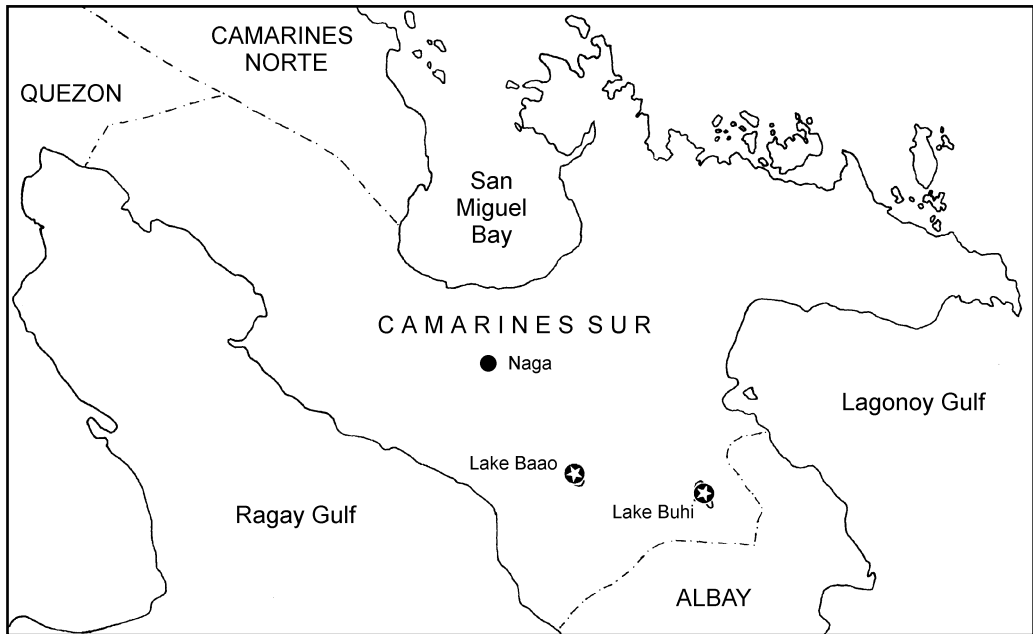


Fig. 14: Type localities (asterisks) of *Aquarius philippinensis* sp.n. in southern Luzon.

zoogeographical isolation from the Central Luzon areas. Although many water bug groups are not yet well studied, some examples of endemic Gerridae, Aphelocheiridae, Naucoridae, and Helotrephidae can be taken from recent publications presenting results of the "Philippine Water Bugs Inventory Project". The fact that such a large water strider like *Aquarius philippinensis* has not been collected elsewhere in the Philippines, indicates that this species is geographically confined to the Bicol Region and eventually even to suitable habitats in the old crater lakes. Other crater lakes in the Philippines provide similar habitats. The senior author has investigated Lake Bulusan (Sorsogon Province, southern Luzon) and Lake Danao (Leyte), without findings of *Aquarius*.

The ecology of the lakes in Camarines Sur has dramatically changed due to fishery management (GINDELBERG 1981), which may also effect the populations of *Aquarius philippinensis*. Observation of population development and – if necessary – conservation measures are recommended to protect this unique Philippine water strider from extinction.

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