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A NEW SPECIES OF *POTAMONAUTES* MACLEAY, 1838, FROM
SOUTHWESTERN ETHIOPIA (DECAPODA, BRACHYURA,
POTAMONAUTIDAE)

BY

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ABSTRACT

Potamonautes holthuisi sp. nov. is described from southwestern Ethiopia (Gamo Gofa Province). This species is distinguished from congeners found in northeast Africa by characters of the gonopods 1 and 2, the anterior sternum, and the major cheliped. Illustrations of the species are provided, and differences discussed.

ZUSAMMENFASSUNG

Potamonautes holthuisi sp. nov. aus Süd-West Äthiopien (Gamo Gofa Provinz) wird beschrieben. Dieser Art wird von anderen Artverwandte aus Nord-Ost Afrika mit Merkmale den Gonopods 1 und 2, vorderes Sternums, und größter Schere unterschieden. Zeichnungen der Art werden ausgegeben und Unterschiede werden besprochen.

INTRODUCTION

The freshwater crab fauna of East and Northeast Africa is poorly known despite a number of recent contributions (Cumberlidge & Dobson, 2008; Cumberlidge, 2009a, b), and some countries in this region, such as Ethiopia, have been particularly overlooked when it comes to biological inventories. It is therefore likely that there are still a number of species of freshwater crabs in Ethiopia yet to be discovered, given its mountainous terrain and lack of systematic survey work over the years (Cumberlidge, 1999, 2009b).

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The freshwater crabs reported on in the present study were collected from Gamo Gofa and Sidamo Provinces in southwestern Ethiopia, in an arid region where the vegetation is predominantly dry savanna that includes fast-flowing mountain streams and rivers. This area lies within the Lake Turkana ecoregion in northwestern Kenya and southwestern Ethiopia that includes the basins of Lakes Turkana, Abaya, and Chamo, plus the Omo River basin (Thieme et al., 2005; Abell et al., 2008). The previously unidentified museum specimens reported on here were collected from the Ethiopian part of the Lake Turkana freshwater ecoregion between 40 and 90 years ago, and proved to belong to a new species of *Potamonautes* MacLeay, 1838 (here named *P. holthuisi* sp. nov.) in the exclusively African freshwater crab family Potamonautidae Bott, 1970. The new specimens from Ethiopia have a number of important characters that do not conform to the descriptions of any known African species (Bott, 1955; Williams, 1968, 1991; Cumberlidge, 1999). The new species is described from an adult male, and the taxonomically important characters of the gonopods, abdomen, mouthparts, carapace, sternum, and chelipeds are illustrated. The new species is compared with the four species of freshwater crabs that have been previously reported from Ethiopia — *Potamonautes niloticus* (H. Milne Edwards, 1837), *P. berardi*, (Audouin, 1826), *P. antheus* (Colosi, 1920), and *P. ignestii* (Parisi, 1923), and with superficially similar species found in neighboring Kenya (Bott, 1955; Williams et al., 1964; Williams, 1991; Cumberlidge, 1997, 1999).

METHODS

Carapace width (CW) is the distance across the carapace at the widest point; carapace length (CL) is measured along the median line, from the anterior to the posterior margin; carapace height (CH) is the maximum height of the cephalothorax; front width (FW) is measured along the anterior frontal margin between the orbits. These measurements were made with digital calipers. The following abbreviations are used: a, abdominal segment; a5/a6, sulci between adjacent abdominal segments; s, thoracic sternite; s1/s2, s2/s3, s4/s5, s5/s6, s6/s7, s7/s8, sternal sulci between adjacent thoracic sternites; e, thoracic episternite; s4/e4, s5/e5, s6/e6, s7/e7, episternal sulci between adjacent thoracic sternites and episternites; p1-p5, pereiopods 1-5; GO1, first gonopod; GO2, second gonopod; asl, above sea level. All measurements are given in millimeters. The terminology is adapted from Cumberlidge (1999). Line drawings were prepared using a Leica MZ 16 binocular microscope. The

habitus photograph was taken with a digital camera in combination with a Leiz MZ 95 adapter. Post processing was done using Adobe Photoshop 7.0.

TAXONOMY

Family POTAMONAUTIDAE Bott, 1970

Potamonautes holthuisi sp. nov.

(figs. 1-4)

Type locality. — Bodessa River, tributary of the Sagan (= Segan) River, 5°49'N 37°45'E, 1829 m asl, Gamo Gofa Province, southwestern Ethiopia.

Type material. — Holotype male: adult (CW 34.3, CL 25.4, CH 11.9, FW 8.2), Gamo Gofa Province, southwestern Ethiopia, Bodessa River, tributary of the Sagan (= Segan) River, 19.v.-3.vi.1912, 5°49'N 37°45'E, 1829 m asl, E.A. Means (USNM 82304 A). Paratypes: adult female (CW 35.1, CL 27.6, CH 12.4, FW 8.2), Gamo Gofa Province, southwestern Ethiopia, Bodessa River, tributary of the Sagan (= Segan) River, 19.v.-3.vi.1912, 5°49'N 37°45'E, 1829 m asl, coll. E.A. Means (USNM 82304 B); adult female (CW 33.9, CL 25.7, CH 11.8, FW 7.2), adult female (CW 31.5, CL 25.5, CH 12.0, FW 7.2), subadult female (CW 27.7, CL 20.4, CH 8.5, FW 6.7), Gamo Gofa Province, southwestern Ethiopia, Bodessa River, tributary of the Sagan (= Segan) River, 19.v.-3.vi.1912, 5°49'N 37°45'E, 1829 m asl, coll. E.A. Means (USNM 82304 C, D); adult male (CW 22.0, CL 16.5, CH 17.0, FW 5.6), adult female (CW 25.4, CL 19.4, CH 8.7, FW 6.2), subadult female (CW 23.7, CL 18.9, CH 9.0, FW 5.9), southwestern Ethiopia, Sidamo Province, Werka River and tributary, 10.xii.1983, 7°5'N 38°38'E, 1900 m asl, coll. Wenda Genet (NMU.TRW. 1984.01).

Etymology. — The species is named to honor Professor Lipke Bijdeley Holthuis (21 April 1921-7 March 2008) in recognition of his immense contributions to crustacean biology over the years that included insightful mentorship for his colleagues working on freshwater crabs in Africa and other parts of the world.

Diagnosis. — Postfrontal crest faint, comprising faint postorbital crests, strongest near anterolateral margins; epigastric crests faint, short (figs. 1A, B, 3A, B). Vertical groove on ischium of third maxilliped faint or absent (fig. 1I). Fixed finger of propodus of major (right) cheliped slender with 2 distinct molars in proximal region followed by a series of smaller teeth (fig. 1G); first carpal tooth distinct, pointed; second carpal tooth less than half size of first carpal tooth, pointed, followed by several small granules; distal meral tooth small, pointed (fig. 1C, D). Sternal sulcus s3/s4 U-shaped, deep at edges, faint in middle, almost meeting sternoabdominal cavity; episternal sulci s4/e4, s5/e5, s6/e6, s7/e7, faint, incomplete (fig. 1E). GO1 terminal article long, slim, curving outward at 60° angle to longitudinal axis of gonopod, tip slim,

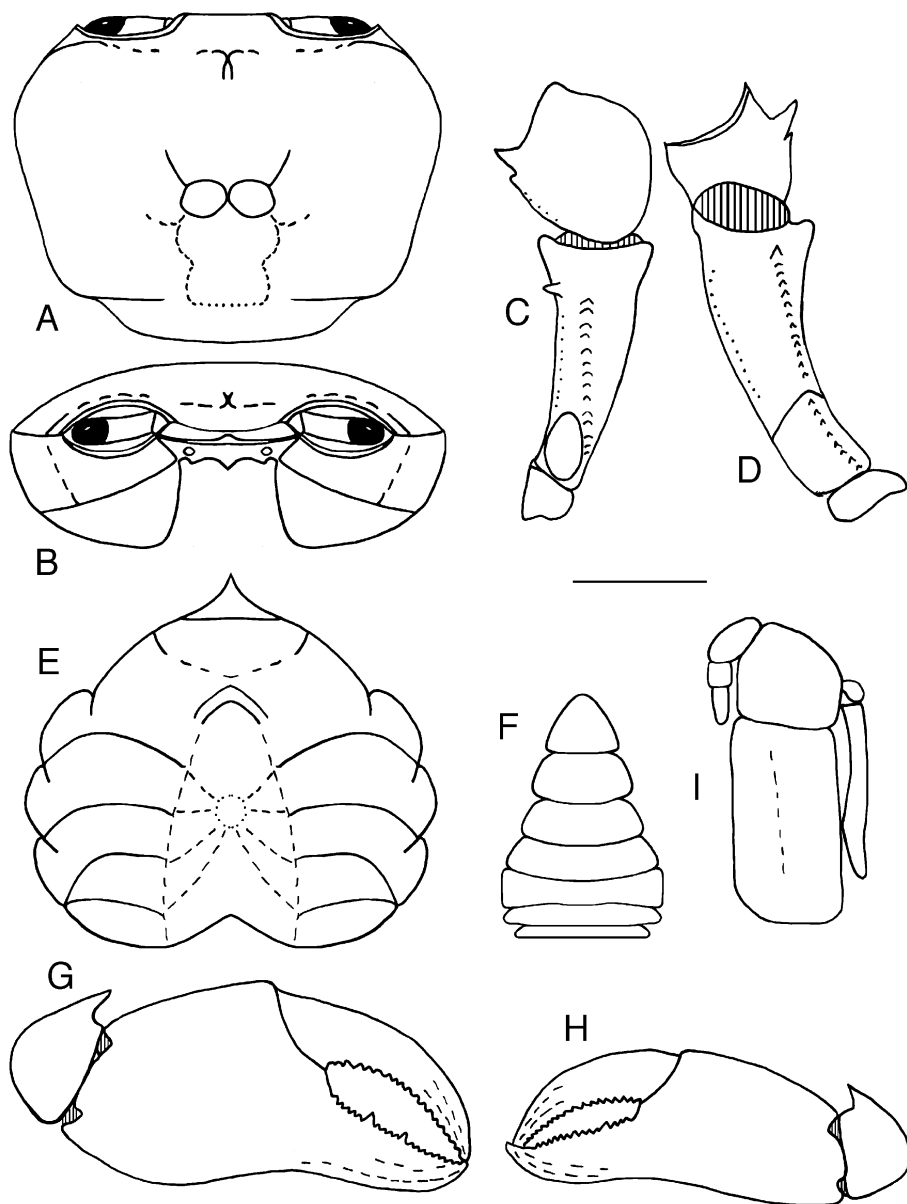


Fig. 1. *Potamonautes holthuisi* sp. nov., male holotype (CW 34.3 mm) from Gamo Gofa Province, southwestern Ethiopia (USNM 82304 A). A, carapace, dorsal view; B, carapace, frontal view; C, carpus and merus of right pereiopod 1 (major cheliped), dorsal view; D, carpus and merus of right pereiopod 1 (major cheliped), ventral view; E, male sternum; F, male abdomen; G, major (right) cheliped; H, minor (left) cheliped; I, left third maxilliped. Scale bar = 10 mm, A-H; 25 mm, I.

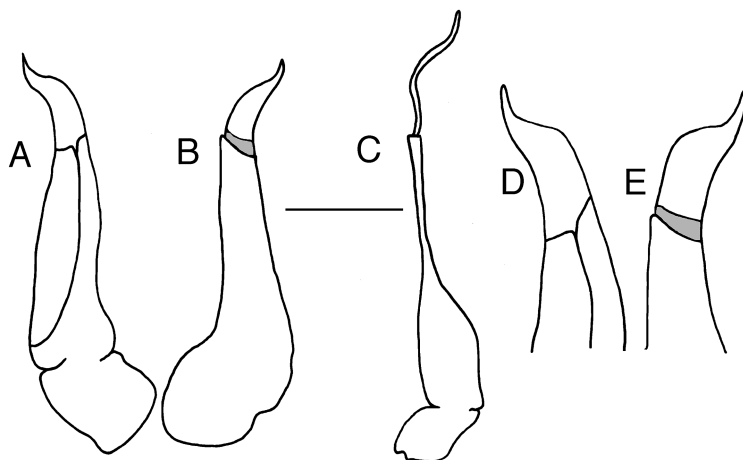


Fig. 2. *Potamonautes holthuisi* sp. nov., male holotype (CW 34.3 mm) from Gamo Gofa Province, southwestern Ethiopia (USNM 82304 A). A, right GO1, ventral view; B, right GO1, dorsal view; C, right GO2, ventral view; D, right GO1, details of tip, ventral view; E, right GO1, details of tip, dorsal view. Scale bar = 2.5 mm, A-C; 6.25 mm, D-E.

upturned (figs. 2A, B, D, E, 4A, B, D, E). GO2 terminal article flagellum-like, about half as long as subterminal segment, with slight curve at proximal end (figs. 2C, 4C).

Description. — Based on holotype, an adult male (CW 34.3 mm). Carapace oval, very wide (CW/FW 4.1), high (CH/FW 1.4); surface smooth; cardiac, urogastric grooves faint; cervical grooves short, faint; transverse branchial grooves absent (fig. 1A). Front narrow (FW/CW 0.24), deflexed (fig. 1B). Postfrontal crest faint, incomplete, strongest at anterolateral margins where it meets epibranchial tooth; postorbital, epigastric crests faint (fig. 1A). Anterolateral margin completely smooth, continuous with posterolateral margin; epibranchial tooth reduced to granule, continuous with anterolateral margin; exorbital tooth low, pointed; vertical sulcus on carapace sidewall faint and incomplete, not meeting anterolateral margin; suborbital, subhepatic, pterygostomial region of carapace sidewalls completely smooth (fig. 1B). Mandibular palp two-segmented, terminal article simple, setose; epistomial tooth triangular, deflexed, edges smooth. Third maxillipeds filling entire oral field, except for transversely oval respiratory openings at superior lateral corners; vertical sulcus on ischium of third maxilliped either very faint or smooth; exopod of third maxilliped reaching to lower half of merus, with long flagellum (fig. 1I).

Sternal sulcus s1/s2 absent; sulcus s2/s3 deep, running horizontally across sternum; sulcus s3/s4 U-shaped, deep at edges, faint in middle, almost meeting sternoabdominal cavity; anterior margin of sternoabdominal cavity thick,

distinctly raised; episternal sulci s4/e4, s5/e5, s6/e6, s7/e7, faint, incomplete (fig. 1E). Abdomen slim, outline triangular, tapered, widest at base, telson outline forming straight-sided triangle with broad base, rounded apex; s6/s7 meeting abdomen at a5/a6; s5/s6 meeting a6 one half of segment length from a6/a5 (fig. 1F).

GO1 terminal article long, slim, curving outward at 60° angle to longitudinal axis of gonopod, tip slim, upturned, lateral and medial folds of terminal article of GO1 uneven, medial fold slightly higher than lateral fold; j-shaped groove at junction between terminal article and subterminal segment of GO1 on ventral side; dorsal membrane narrow, subtriangular, widest laterally, narrowest medially (figs. 2A, B, D, E, 4A, B, D, E). GO2 terminal article flagellum-like, about half as long as subterminal segment, with slight curve at proximal end. Subterminal segments of GO1, GO2 equal in length (fig. 2C).

Dactylus of major cheliped slender, highly arched, closed fingers enclosing wide oval interspace; upper margin of dactylus of cheliped smooth; fixed finger of propodus of major (right) cheliped slender with 2 distinct, large teeth in proximal region followed by series of smaller teeth; lower margin of propodus slightly indented (fig. 1G, H); first carpal tooth distinct, pointed; second carpal tooth less than half size of first carpal tooth, pointed, followed by several small granules; distal meral tooth small, pointed; ventral margins of merus of cheliped lined by series of small, pointed teeth; superior surface of merus smooth, superior margin with carinae; outer face of merus smooth, lateral margin of inferior face of merus with very small teeth; inferior margin of ischium with small pointed teeth (fig. 1C, D). Walking legs (p2-p5) elongated, slender; inner margins of propodi p2-p5 smooth; dactyli of p2-p5 tapering to point, each bearing four rows of downward-pointing short, sharp spines (fig. 3B).

Size. — A medium-sized species; the largest known specimen is an adult female paratype, CW 35.1 mm.

Remarks. — *Potamonautes holthuisi* sp. nov. is easily distinguished from the other species of freshwater crabs found in Ethiopia: *P. niloticus*, *P. berardi*, *P. antheus*, and *P. ignestii* (table I). The upturned tip of the terminal article of GO1 is shared by *P. niloticus* and *P. holthuisi*, and both species have a third maxilliped with a faint or absent vertical sulcus. However, these two taxa can be easily distinguished by the following characters: the anterolateral margin of the carapace of *P. holthuisi* is smooth, whereas that of *P. niloticus* has several large pointed teeth; the postfrontal crest of *P. holthuisi* is weak and incomplete, whereas that of *P. niloticus* is strong and complete; the first carpal tooth of the

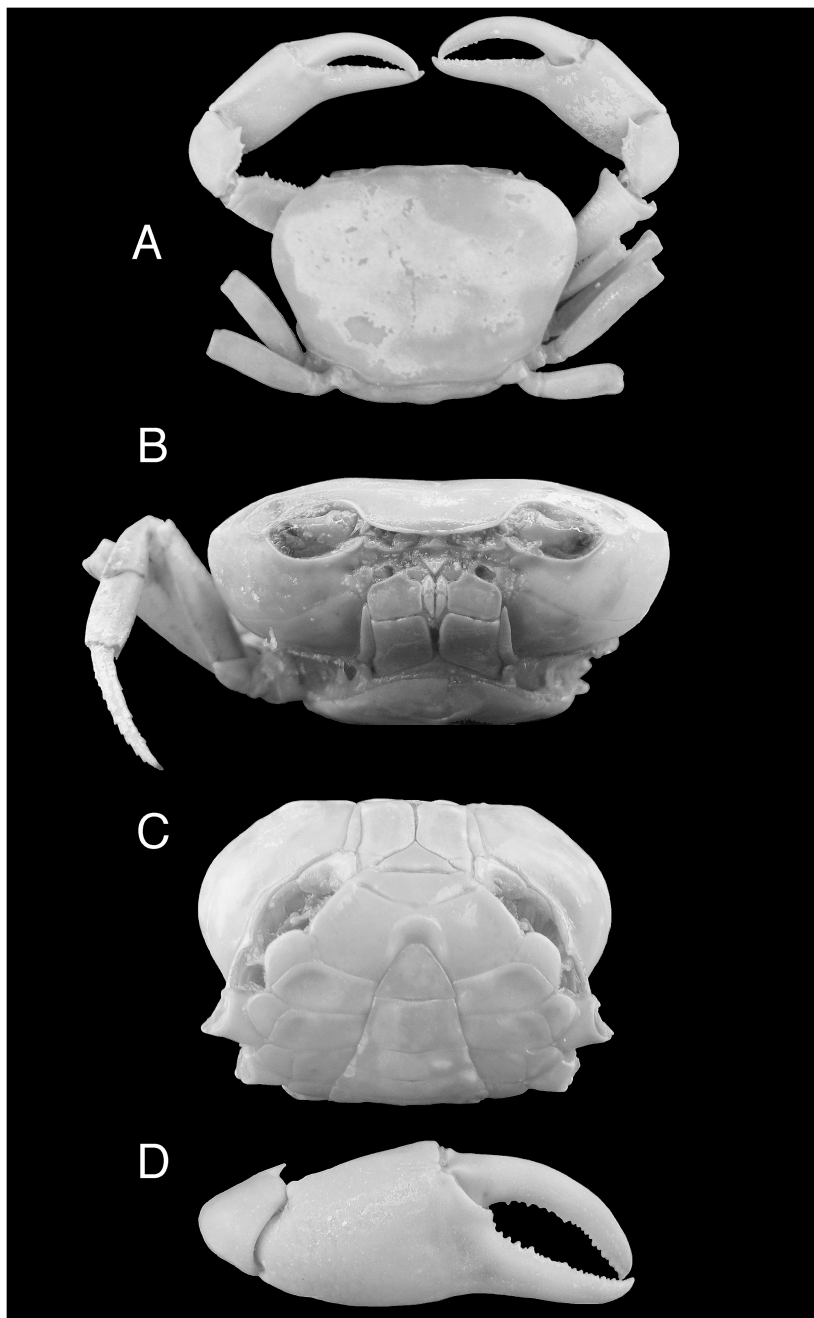


Fig. 3. *Potamonautes holthuisi* sp. nov., male holotype (CW 34.3 mm) from Gamo Gofa Province, southwestern Ethiopia (USNM 82304 A). A, dorsal view; B, frontal view; C, sternal view; D, major (right) cheliped.

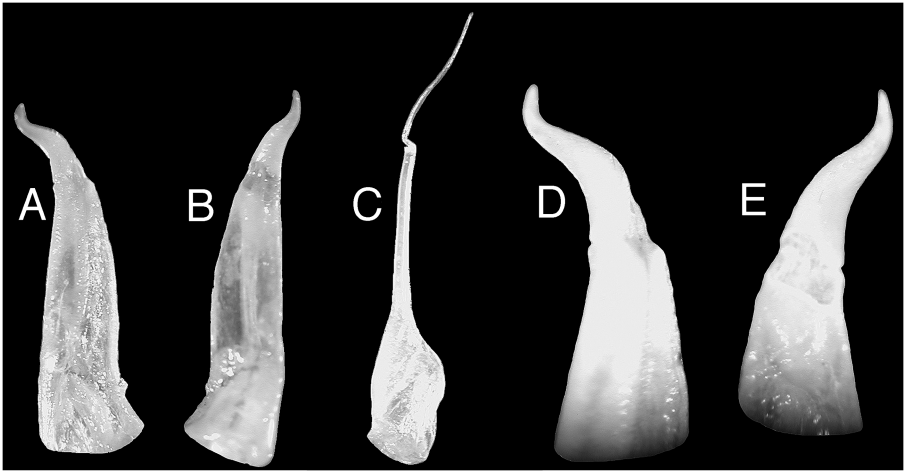


Fig. 4. *Potamonautes holthuisi* sp. nov., male holotype (CW 34.3 mm) from Gamo Gofa Province, southwestern Ethiopia (USNM 82304 A). A, right GO1, ventral view; B, right GO1, dorsal view; C, right GO2, ventral view; D, right GO1, detail of tip, ventral view; E, right GO1, detail of tip, dorsal view. Length of the terminal article measured along the mid-line of the dorsal face from tip to dorsal membrane = 1.6 mm.

TABLE I

Comparison of morphological characters of the freshwater crabs of Ethiopia. See text for taxonomic authorities

Character	Species				
	<i>P. holthuisi</i>	<i>P. niloticus</i>	<i>P. berardi</i>	<i>P. antheus</i>	<i>P. ignestii</i>
Anterolateral margin	smooth	several teeth	smooth	smooth	granular, raised
Vertical sulcus meets AL margin	yes	no	yes	no	yes
Postfrontal crest	weak	sharp, strong	weak/absent	weak/absent	strong
P1 carpus: 1 st carpal tooth	small, pointed	large, pointed	small, pointed	large, pointed	small, pointed
P1 merus: distal meral tooth	small, low	large, pointed	small, pointed	large	small, pointed
GO1 terminal article tip	upturned	upturned	straight	straight	straight
CW range for pubertal moult	35	55-65	22-24	65	35
Body size (adults)	medium	large	small	large	medium

carpus of the cheliped and the distal meral tooth of the merus of the cheliped are both small and low in *P. holthuisi* but large and pointed in *P. niloticus* (fig. 1; Cumberlidge & Clark, 2010).

Both *P. berardi* and *P. holthuisi* are relatively small species with a weak and incomplete postfrontal crest; the ischium of the third maxilliped in both species has a very faint or absent vertical sulcus; and the first carpal tooth of the carpus of the cheliped and the distal meral tooth of the merus of the cheliped are small and pointed in both species. However, these two taxa can be easily distinguished by examination of the tip of the terminal article of GO1: that of *P. holthuisi* is upturned whereas this tip is straight in *P. berardi*.

Potamonautes antheus is similar to *P. holthuisi* in that both species have a weak postfrontal crest, a faint to absent vertical groove on the ischium of the third maxilliped, and short cervical grooves. These two taxa can be easily distinguished by the following characters: the tip of the terminal article of GO1 of *P. holthuisi* is upturned, whereas the tip is straight in *P. antheus*; also, the first carpal tooth of the carpus of the cheliped and the distal meral tooth of the merus of the cheliped are both small and low in *P. holthuisi* but large in *P. antheus*. The vertical sulcus on the carapace sidewall meets the anterolateral margin in *P. holthuisi* but does not meet in *P. antheus* (see Bott, 1955). Both *P. holthuisi* and *P. ignestii* are similar in that they are medium-sized species with a third maxilliped ischium that has a very faint or absent vertical sulcus, a first carpal tooth of the carpus of the cheliped that is small and pointed, and a distal meral tooth of the merus of the cheliped that is small and pointed. These two taxa can be easily distinguished by the tip of the terminal article of GO1 (which is upturned in *P. holthuisi* but straight in *P. ignestii*), by the anterolateral margins of the carapace (which are smooth in *P. holthuisi* and raised and granular in *P. ignestii*), and by the postfrontal crest (which is faint in *P. holthuisi* and strong and complete in *P. ignestii*) (figs. 1, 2; Cumberlidge, 1997).

Potamonautes holthuisi is also superficially similar to two medium-sized species found in the highlands of neighboring Kenya: *P. jeanelli* (Bouvier, 1921) from Mount Kenya and *P. loveni* (Colosi, 1924) from Mount Elgon. All three taxa lack a strong postfrontal crest, have smooth carapace sidewalls, reduced or missing exorbital and epibranchial teeth, and reduced teeth on the carpus of the cheliped (Williams, 1991; Cumberlidge, 1998, 2009a). These three taxa can be distinguished as follows. Sternal sulcus s3/s4 is complete, strong and deep at the edges in *P. holthuisi*, but missing except for notches at both ends in both *P. jeanelli* and *P. loveni*. The terminal article of GO1 in *P. holthuisi* curves sharply outward and has an upturned tip, whereas the terminal article of GO1 of both *P. jeanelli* and *P. loveni* is straight and tapers evenly to a point. In addition, episternal sulci s4/e4, s5/e5, s6/e6, s7/e7, of *P. holthuisi*

are visible (although faint and incomplete), whereas these sulci are completely lacking (smooth) in *P. jeanelli*. The exorbital tooth of *P. holthuisi* is small and pointed but distinct, whereas in *P. loveni* this tooth is reduced and appears to be lacking (Cumberlidge, 2009a).

Elsewhere in East Africa, the distinct upward curve of the tip of the terminal article of GO1 of *P. holthuisi* is present in the GO1 of three species of *Potamonautes* from the border region between Tanzania and Kenya (*P. gerdalensis* Bott, 1955; *P. johnstoni* (Miers, 1885); and *P. raybouldi* Cumberlidge & Vannini, 2004). The anterior margin of the sternoabdominal cavity also meets or nearly meets sternal sulcus s3/s4 in all four of these species (Reed and Cumberlidge, 2006). However, *P. holthuisi* can easily be distinguished from these three other species by the postfrontal crest (which is faint and incomplete in *P. holthuisi*, but distinct, complete, and sharp-edged in *P. gerdalensis*, *P. johnstoni*, and *P. raybouldi*), by the carapace sidewalls (which are smooth in *P. holthuisi* but heavily granulated in the other three species), by the ischium of the third maxilliped (which is faint or absent in *P. holthuisi* but deep and distinct in the other three species), and by the distal meral tooth on the merus of the cheliped (which is small and pointed in *P. holthuisi*, low and indistinct in *P. gerdalensis*, and large and pointed in *P. raybouldi* and *P. johnstoni*). In addition, the smooth, even coloration of the chelipeds of *P. holthuisi* clearly distinguish this species from *P. raybouldi*, which has distinctive reticular patterns on the propodus and carpus of the chelipeds (Cumberlidge & Vannini, 2004; Reed & Cumberlidge, 2006).

Distribution. — *Potamonautes holthuisi* is known from two localities in the highlands of southwestern Ethiopia, in the Bodessa and Werka Rivers. The Bodessa River is a tributary of the Sagan (= Segan) River that flows into Lake Chamo, while the Werka River drains into Lake Abaya, just north of Lake Chamo.

Habitat. — Both of the two known localities for *P. holthuisi* lie in the Lake Turkana freshwater ecoregion that comprises Lakes Turkana (mostly in Kenya), Lakes Abaya and Chamo (in the northeastern portion of the Turkana ecoregion in Ethiopia), and the headwaters of the Omo River in southwestern Ethiopia. Five major rivers feed Lake Abaya, the most important of which is the Bilate River. During the rainy season, overspill from Lake Abaya is carried to Lake Chamo via the Ualo River (Hughes & Hughes, 1992). Although not joined today, there is evidence of a previous connection between the Sobat and Nile Rivers during the wet periods of the Pleistocene (Beadle, 1981), with the most recent connection occurring not more than 7000 years before present (Beadle, 1981; Dgebuadze et al., 1994).

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