

2009

"A Revision of the Freshwater Crabs of Mt Kenya and the Aberdare Mountains, Kenya, East Africa"

Neil Cumberlidge
Northern Michigan University

Follow this and additional works at: https://commons.nmu.edu/facwork_journalarticles



Part of the [Biology Commons](#)

Recommended Citation

Cumberlidge, N. 2009. A revision of the freshwater crabs of Mt Kenya and the Aberdare Mountains, Kenya, East Africa (Brachyura: Potamoidea: Potamonautidae). *Zootaxa* 1981: 29–42.

This Journal Article is brought to you for free and open access by the FacWorks at NMU Commons. It has been accepted for inclusion in Journal Articles by an authorized administrator of NMU Commons. For more information, please contact kmcdonou@nmu.edu, bsarjean@nmu.edu.



A revision of the freshwater crabs of Mt Kenya and the Aberdare Mountains, Kenya, East Africa (Brachyura: Potamoidea: Potamonautidae).

NEIL CUMBERLIDGE

Department of Biology, Northern Michigan University, Marquette, Michigan 49855-5301, USA. E-mail: ncumberl@nmu.edu

Abstract

The taxonomy of the freshwater crabs of Mt Kenya and the Aberdare Mountains in central Kenya, East Africa is revised based on a large collection of previously unreported material. Three species belonging to the genus *Potamonautes* MacLeay, 1838 (Potamonautidae Bott, 1970) are recognized from the region and redescribed. *Potamonautes jeanneli* (Bouvier, 1921) and *P. odhneri* (Colosi, 1924) are both resurrected from synonymy and *P. alluaudi* (Bouvier, 1921) is recognized as a valid species rather than as a subspecies of *P. suprasulcatus* (Hilgendorf, 1898). All three species are endemic to the Central Province, Kenya.

Key words: Crustacea, Brachyura, Potamoidea, Potamonautidae, *Potamonautes*, freshwater crab, taxonomy, Mt Kenya, Aberdare Mountains, Kenya, East Africa

Introduction

European and American expeditions to Mt Kenya and the Aberdare Mountains in Kenya in East Africa in the early 20th Century led to the description of three species of freshwater crabs from this region (Bouvier 1921, Colosi 1924). These included two species from Mt Kenya itself, *Potamon* (*Geothelphusa*) *jeanneli* Bouvier, 1921, and *Potamon* (*Potamonautes*) *odhneri* Colosi, 1924, and *Potamon* (*Potamonautes*) *alluaudi* Bouvier, 1921, from Nairobi Forest south of Mt Kenya. These three species were also recognized by Balss (1929) and Chace (1942), but the major taxonomic revision of Bott (1955) did not consider any of them to be valid. For example, Bott (1955) treated *P. (G.) alluaudi* as *Potamonautes (Arcopotamonautes) suprasulcatus alluaudi*, a subspecies of *Potamonautes suprasulcatus* (Hilgendorf, 1898) (Reed & Cumberlidge 2006); *P. (G.) jeanneli* as a junior synonym of *Potamonautes (Platypotamonautes) neumanni* (Hilgendorf, 1898); and *P. (P.) odhneri* as a junior synonym of *Potamonautes (Platypotamonautes) pilosus* (Hilgendorf, 1898).

Williams (1968) did not entirely accept Bott's (1955) opinions and recognized two species of freshwater crabs from Mt Kenya and the Aberdare Mountains (*P. alluaudi* and *P. odhneri*), and Williams (1991) recognized a third species, *P. jeanneli*, from high altitude localities east of the Rift Valley in the region that includes the Aberdare Mountains and Mt Kenya. The result of the above series of shifting taxonomic opinions has been that freshwater crabs collected from this area of Kenya have proved difficult to identify and because the only available keys are still those of Bott (1955).

The present work has been prompted by the need to identify material from the central Kenyan highlands that was collected by T. R. Williams and his colleagues in the 1960s during a survey of highland areas with the potential to be a focus of onchocerciasis (river blindness), a parasitic disease of humans caused by *Onchocerca volvulus*, a tissue nematode. Freshwater crabs are obligate phoretic hosts of the aquatic larvae of biting blackflies (*Simulium* sp.) that are the main vectors of this disease in Africa (Barnley & Prentice 1958;

McMahon *et al.* 1958; Hynes *et al.* 1961; Williams *et al.* 1964; Williams 1964; Crosskey 1990). Other specimens included here were collected by M. Dobson during recent ecological studies of the freshwater aquatic communities of Mt Kenya (Dobson 2004; Dobson *et al.* 2002, 2007a, b). The species of *Potamonautes* from Mt Kenya redescribed here were collected from forests on the slopes of the mountain from streams, rivers, and nearby land. In the absence of reliable keys, the present revision is based on the examination of the type specimens of all of the relevant taxa, as well as a large series of specimens from this region collected since Bott's (1955) monograph. The results indicate that Mt Kenya and the Aberdare Mountains support three valid species of *Potamonautes* MacLeay, 1838: *P. jeanneli* (Bouvier, 1921), *P. odhneri* (Colosi, 1924), and *P. alluaudi* (Bouvier, 1921), which are redescribed here based on characters of the carapace, thoracic sternum, chelipeds, and G1. Specimens are deposited in the Natural History Museum, London, U.K. (NHM) and in the museum of the Department of Biology, Northern Michigan University, Marquette, MI, USA (NMU).

The following abbreviations are used: CW, distance across the carapace at the widest point; CL carapace length measured along the median line, from the anterior to the posterior margin; CH, carapace height, the maximum height of the cephalothorax; FW, front width measured along the anterior margin; GO1, first gonopod; s, thoracic sternite; s4/s5, 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, pereopods 1–5. MNHN = Muséum national d'Histoire Naturelle, Paris, France; SMF = Senckenberg Museum, Frankfurt, Germany; SMNH = Swedish Museum of Natural History (Naturhistoriska Riksmuseet) Stockholm, Sweden; USNM = United States National Museum of Natural History, Smithsonian Institution, Washington DC, USA; ZMB = Museum für Naturkunde der Humboldt-Universität, Berlin, Germany.

All measurements are given in mm. The terminology is adapted from Cumberlidge (1999).

Taxonomy

Family POTAMONAUTIDAE Bott, 1970

Genus *Potamonautes* MacLeay, 1838

Potamonautes jeanneli (Bouvier, 1921)

(Figs. 1–16, 43, Table 1)

Potamon (Geothelphusa) jeanneli Bouvier, 1921: 51–56, figs. 5, 6.

Potamon jeanneli Chace, 1942: 214.

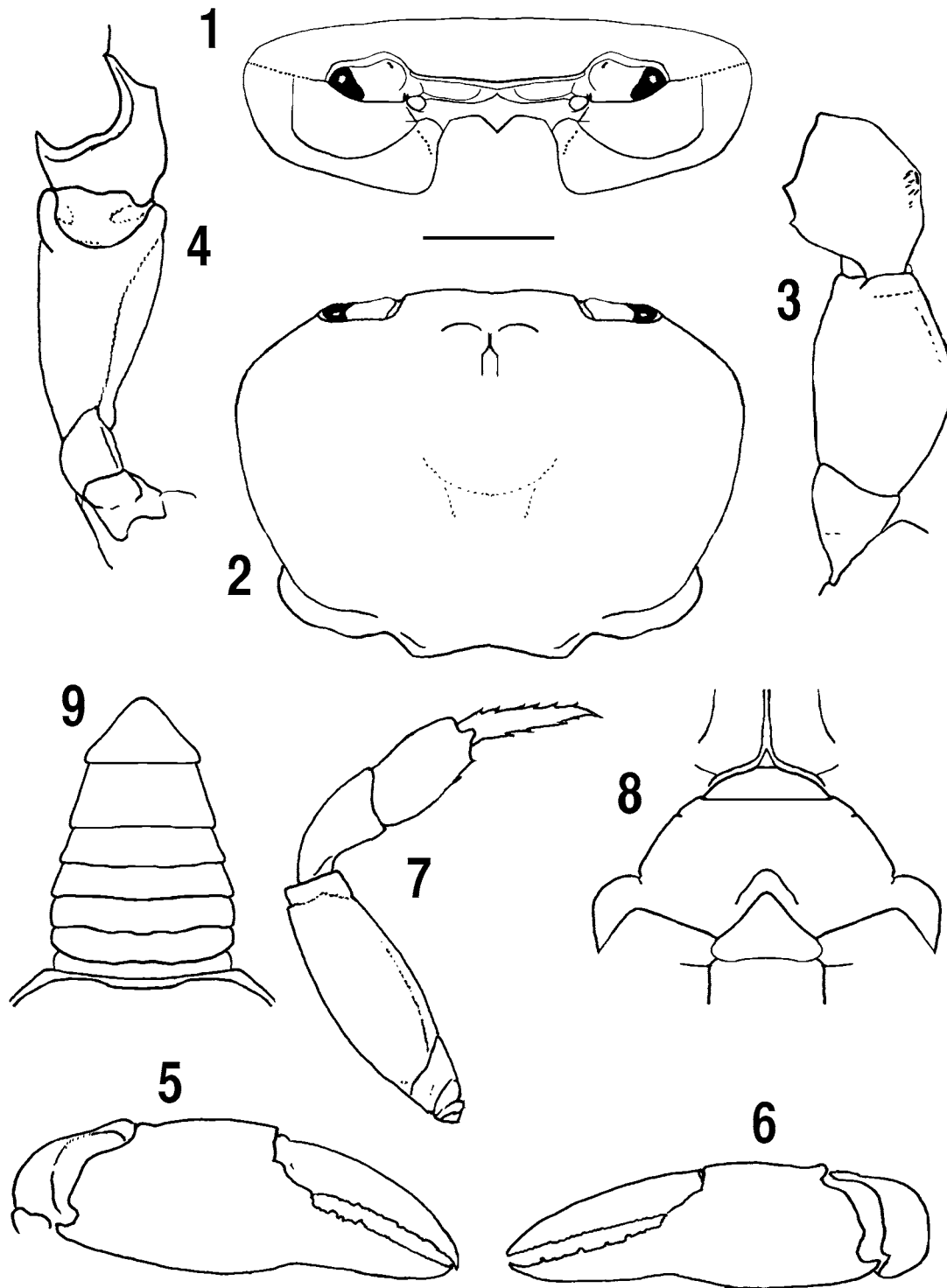
Potamon jeanneli Capart, 1954: 834, fig. 22.

Potamonautes jeanneli Williams, 1968: 214; Williams, 1991: 182.

Type material examined. KENYA: adult male, *Potamon (Geothelphusa) jeanneli* (CW 22, CL 19.5, CH 7.1, FW 7.4 mm), mid-altitude forest (2,400–2,700 m) on western slopes of Mt Kenya, 22.i.1912 (CH. Alluand and R. Jeannel coll.). This specimen was illustrated by Bouvier (1921, figs. 5, 6) and is one of four adult males that he referred to as types, and is herein designated the lectotype (Figs. 1–16).

Other material. KENYA: Mt Kenya, Sirimon River (0°08'N, 37°06'E), 13–15 km north of Nanyuki on the road to Meru, 3.7 m wide, up to 0.6 m deep, part shaded, river bed with rounded stones, some larger blocks, 6 males (CWs 16.5 to CW 23.6 mm), one female (CW 14.5 mm) 8.iii.1962 (T. R. Williams) (NMU EA62.78).

Diagnosis. Carapace smooth; anterolateral margin behind epibranchial tooth smooth, continuous with posterolateral margin; postfrontal crest missing, epigastric crests low, postorbital crests absent; exorbital tooth



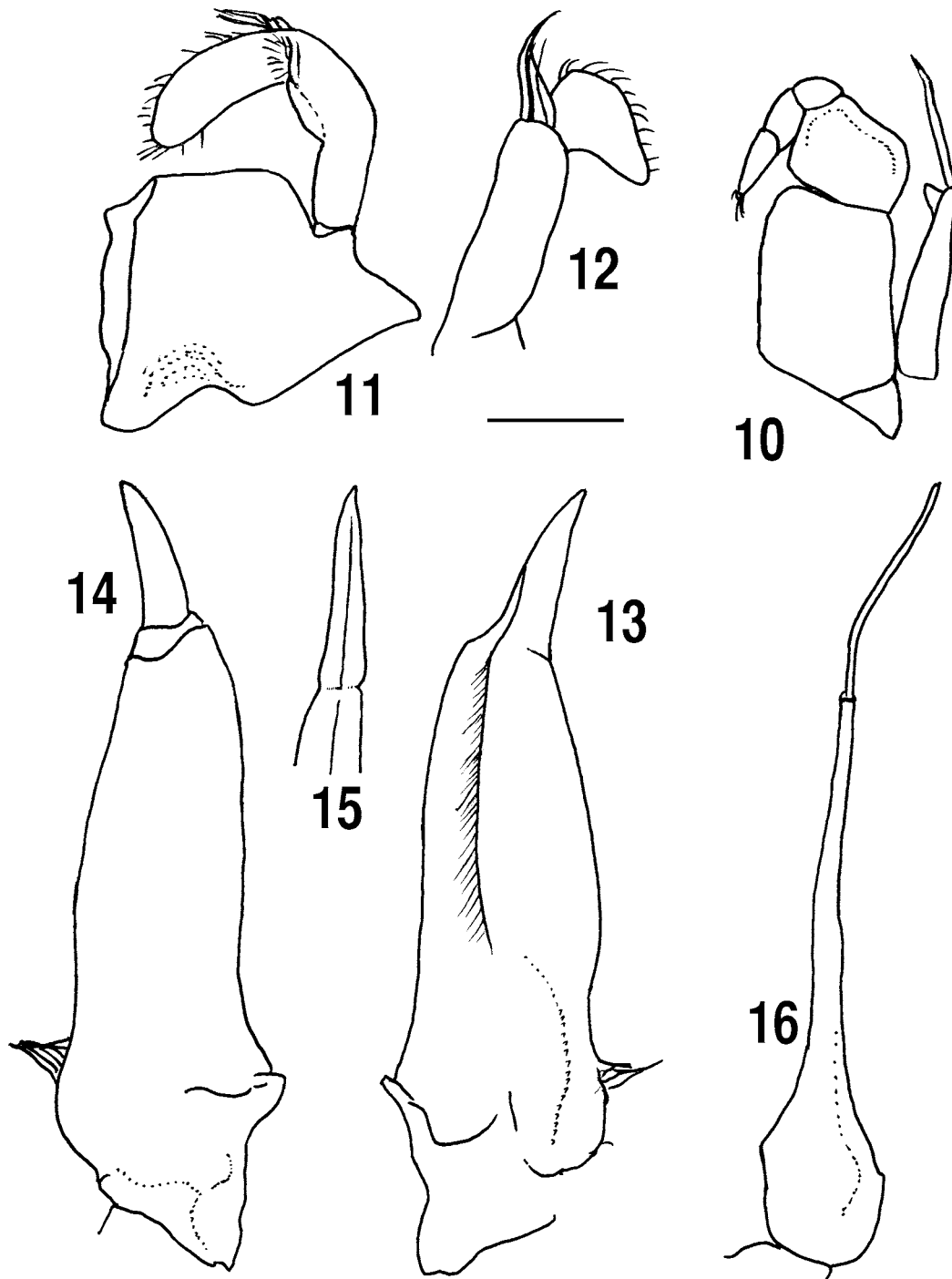
FIGURES 1–9. *Potamonautes jeanneli* (Bouvier, 1921) adult male (CW 21.2 mm) western slopes of Mt Kenya, Kenya. 1, cephalothorax, carapace and eyes, frontal view; 2, carapace and eyes, dorsal view; 3, carpus and merus of right cheliped, dorsal view; 4, merus of right cheliped, inferior view; 5, right cheliped, frontal view; 6, left cheliped, frontal view; 7, left fifth pereiopod; 8, anterior sternum; 9, abdomen. Scale = 6.6 mm.

low, epibranchial tooth absent; carapace sidewalls smooth; vertical groove meeting anterolateral margin; sternal sulcus s2/s3 complete, horizontal, s3/s4 reduced to two notches; episternal sulci s4/e4, s5/e5, s6/e6, s7/e7 all missing; ischium of third maxilliped lacking vertical groove; first carpal tooth on carpus of cheliped low, second carpal tooth smaller; dactylus of major cheliped slightly arched, closed fingers enclosing long narrow

interspace; terminal article of G1 slim, almost straight, distal half curving slightly outward; lateral, medial folds of equal height; distal margin of subterminal segment highest on medial side forming pronounced shoulder lowest on lateral side; dorsal membrane broad, widest at lateral edge, narrowest at medial edge.

Size. Small-sized species, adult size range from CW 22 to CW 23.6 mm.

Type locality. Kenya: mid-altitude forest on western slopes of Mt Kenya, from a fast-flowing mountain stream in a clearing in a bamboo forest (2,700 m asl).



FIGURES 10–16. *Potamonautes jeanneli* (Bouvier, 1921) adult male (CW 22 mm) western slopes of Mt Kenya, Kenya. 10, left third maxilliped; 11, left mandible; 12, detail of terminal segment of the palp of the left mandible; 13, right G1, ventral aspect; 14, right G1, dorsal aspect; 15, terminal segment turned to show groove; 16, gonopod 2, ventral aspect. Scale = 6.6 mm (10); 2.7 mm (11–16).

Distribution. Kenya: Mt Kenya (2,400–2,700 m asl), from streams in mid-altitude bamboo forest, from the Burguret River on an ascent trail of Mt Kenya in a podocarp forest (2,400 m asl), and from the Sirimon River.

Natural history. This species lives in the rivers and streams draining the slopes of Mt Kenya and was first collected by members of the French Expedition led by Ch. Alluaud and R. Jeannel in 1912. Other material was collected fifty years later from Mt Kenya by T. R. Williams as part of an onchocerciasis study in 1962.

Comments. The male lectotype of *Potamon (Geothelphusa) jeanneli* from Mt Kenya (CW 22 mm) was partly figured by Bouvier (1921, figs 5, 6). Although this species was originally described from an adult male the gonopods, anterior sternum, and chelipeds are described here for the first time. Colosi (1924) identified a male specimen (CW 28.3 mm) from Mt Elgon collected by S. A. Lovén, 30.vi.1920, from a stream at 4,000 m asl (SMNH 7556 ex. 13215) as *P. (G.) jeanneli*. However, it is by no means certain that this specimen actually belongs to this species, because the sketches provided in the original description and the locality indicate that it might be a misidentified subadult specimen of *P. loveni* (Colosi, 1924). Bott (1955) included Colosi's (1924) *P. (G.) jeanneli* from Mt. Elgon in the synonymy of *Potamonautes granviki*, and treated Bouvier's (1921) *P. jeanneli* from Mt Kenya, as a junior synonym of *Potamonautes (Platypotamonautes) neumanni* (Hilgendorf, 1898). However, the latter opinion is doubtful. The male lectotype of *Telphusa neumanni* (CW 35 mm) from Ngari Longai, Masailand, Kenya, 36°W, 1.5°S (ZMB 11386) was compared here with the adult male type of *P. (G.) jeanneli* from Mt Kenya (CW 22 mm). The G1 of *P. jeanneli* (Figs. 13–15) is clearly different from that of the lectotype of *P. neumanni* (Bott 1955, fig. 14) and this raises doubts about the validity of Bott's (1955) synonymization. *Potamonautes jeanneli* is resurrected here from synonymy with *P. (P.) neumanni* and both taxa are treated as valid species.

Conservation status. The conservation status of *P. jeanneli* from Mt Kenya is assessed as least concern (LC) because it has an extent of occurrence and area of occupancy that are both in excess of the thresholds for vulnerability (VU) and there are no known widespread threats (IUCN 2004; Cumberlidge et al. 2009). Its population is estimated to be stable based on indirect measures such as its representation in museum collections, although it was most recently collected back in 1962

***Potamonautes odhneri* (Colosi, 1924)**

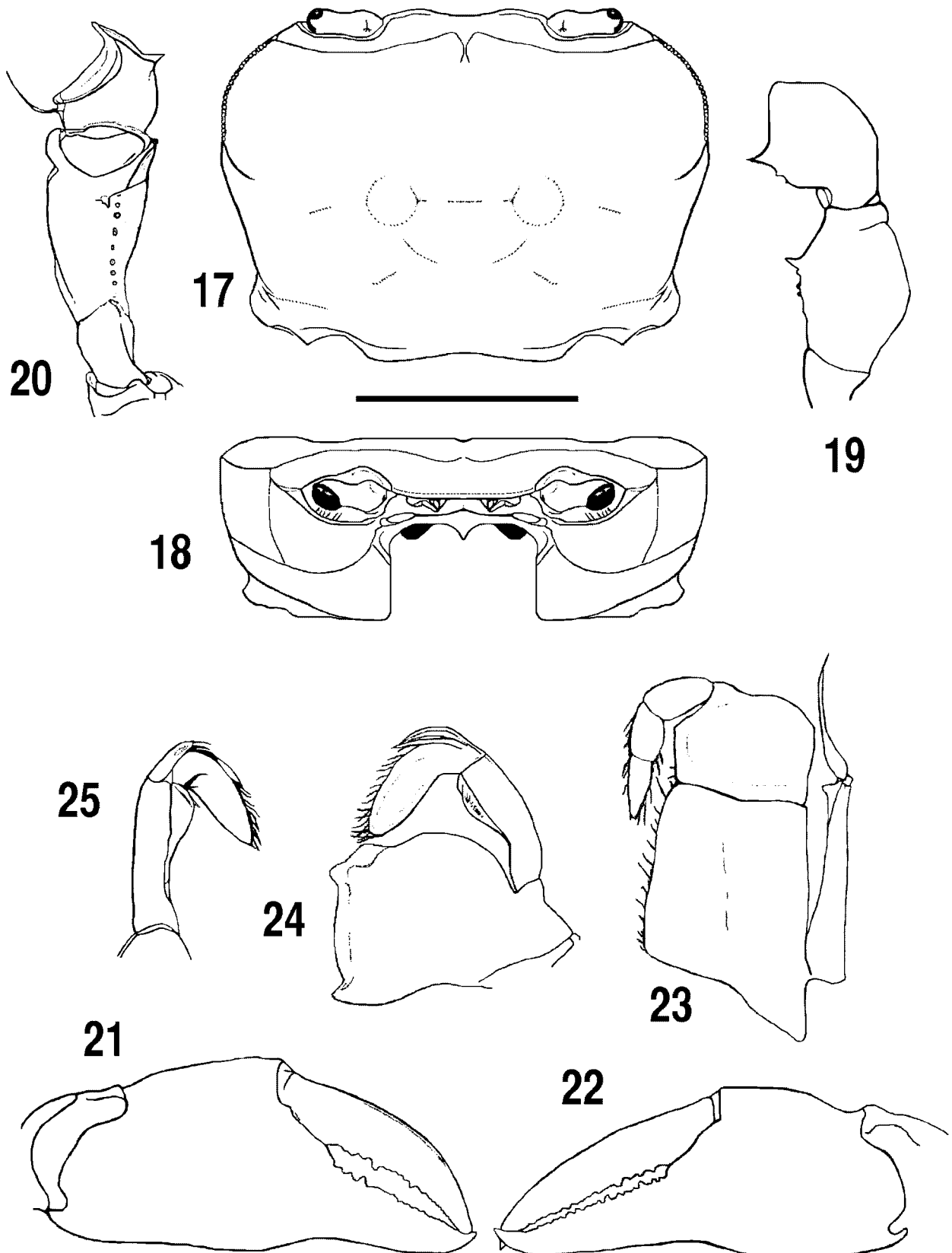
(Figs. 17–29, 44, Table 1)

Potamon (Potamonautes) odhneri Colosi, 1924: 7–8, figs. 1, 3, pl. 4.

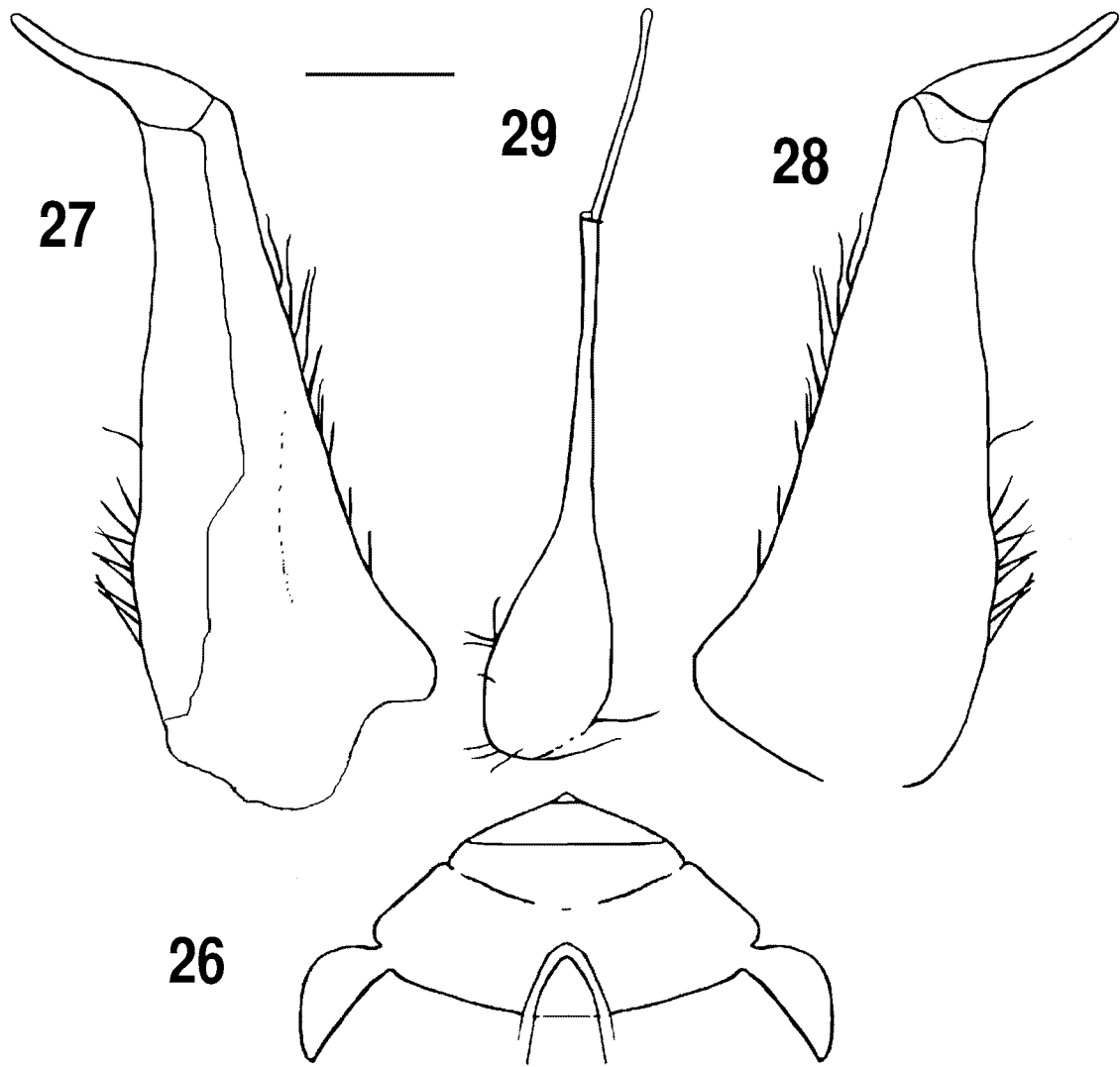
Potamon odhneri Chace, 1942: 218.

Type material examined. KENYA: Mt Kenya, 2,500 m asl, adult male (CW 23.5, CL 21 mm), figured by Colosi (1924), lectotype (here designated), 1911 (E. Lönnberg) (SMNH 7558 [ex. 11859, ex. 6430]); adult female (CW 23.5 mm), abdomen very broad but no eggs or hatchlings, paratype (here designated) (CW 25, CL 17.9, CH 9.3, FW 7.9 mm), forest near Meru, north of Mt Kenya, 19–30.i.1911 (E. Lönnberg) (SMNH 7557 [ex. 11852]) (Figs. 17–25); Limuru, southern Aberdare Mountains, 2 adult females, paratypes (here designated) (largest CW 25.5, CL 16.9, CH 11.4, FW 7.8 mm).

Other material. KENYA: northern Aberdare Mountains, Chania River below Kiandongoro Forestry station (2,187 m asl) (0°27'S, 36°50'E), river shallow, 6–9 m wide, river bed stony with boulders, partly tree shaded, adult male (CW 25.5, CL 16.9, CH 11.4, FW 7.8 mm) 17.iii.1962 (T. R. Williams coll.) (NMU EA62.114); Gituambugi/Mutonga Rivers, eastern slope of Mt Kenya, 2 males (CWs 23.6, 22.2 mm), iv.2003 (A. Magana coll.) (NMU 4.2003.1); Nano Moru River west of Mount Kenya, adult male (CW 32.5 mm) 14.7.2004 (M. Dobson coll.) (NMU MD 14.7.2004); Mt Kenya, Smithsonian Africa Expedition (Theodore Roosevelt coll.) x.1909 (USNM 57304); Mt Kenya, adult male, CW 24.1 mm (USNM 82312) (Figs. 26–29, 44).



FIGURES 17–25. *Potamonautes odhneri* (Colosi, 1924) adult female paratype (CW 25 mm) (SMNH 7557), Mt Kenya, Kenya. 17, carapace and eyes, dorsal view; 18, cephalothorax, carapace and eyes, frontal view; 19, carpus and merus of right cheliped, dorsal view; 20, merus of right cheliped, inferior view; 21, right cheliped, frontal view; 22, left cheliped, frontal view; 23, left third maxilliped; 24, left mandible; 25, detail of terminal segment of the palp of the left mandible. Scale = 6.1 mm (17–20, 21–23); 3.3 mm (24–25).



FIGURES 26–29. *Potamonautes odhneri* (Colosi, 1924) adult male (CW 24.1 mm) (USNM 82312), Mt Kenya, Kenya. 26, anterior sternum; 27, right G1, ventral aspect; 28, right G1, dorsal aspect; 29, gonopod 2, ventral aspect. Scale = 3.3 mm.

Diagnosis. Carapace smooth; anterolateral margin behind epibranchial tooth faintly granulated, curving inward over carapace in branchial region; postfrontal crest sharp; exorbital tooth low, epibranchial tooth reduced to a granule; carapace sidewalls smooth; vertical groove meeting anterolateral margin; sternal sulcus s2/s3 complete, horizontal, s3/s4 reduced to two side notches; episternal sulci s4/e4, s5/e5, s6/e6, s7/e7 all visible; third maxilliped ischium with vertical groove; first carpal tooth of cheliped carpus small, pointed, second carpal tooth small, granular, followed by several other granules; dactylus of major cheliped highly arched, closed fingers enclosing wide oval interspace; terminal article of G1 curving sharply outward at 45° angle to longitudinal axis of gonopod; lateral, medial folds unequal, high; distal margin of subterminal segment highest on medial side forming pronounced shoulder lowest on lateral side; dorsal membrane broad, widest at lateral edge, narrowest at medial edge.

Size. Small-sized species, pubertal molt occurring around CW 23.5 mm, adult size range up to CW 32.5 mm.

Type locality. Mt Kenya and the Aberdare Mountains, Kenya.

Distribution. Mt Kenya and the Aberdare Mountains, in the highlands of central Kenya.

Remarks. This species was originally described from an adult female, so this is the first time that the gonopods, sternum, and chelipeds of *P. odhneri* have been described. The specimens from Mt Kenya and the Aberdare Mountains included here were identified following comparison with the male lectotype and the female paratype of *Potamon (Potamonautes) odhneri* from the forest near Meru, north of Mt Kenya (SMNH 7557), which was examined in the present study and figured by Colosi (1924). Bott (1955) treated *P. odhneri* as a junior synonym of *Potamonautes (Platypotamonautes) pilosus* (Hilgendorf, 1898). However, Reed & Cumberlidge (2006) doubted this synonymization following examination of the female paratype of *P. (P.) odhneri* from Meru, Kenya and the male lectotype of *Telphusa pilosa* Hilgendorf, 1898 (ZMB 11387) from a rain forest near Maranga at the base of Mt Kilimanjaro, Tanzania. Those authors pointed out that Bott's (1955) photographs of *P. pilosus* (Pl. V, 1a–d) actually show the female paratype of *P. (P.) odhneri* Colosi, 1924 (SMNH 7558, CW 23, CL 17, CH 10, FW 7.5 mm) from Limuru, near Mt Kenya, Kenya, and not the lectotype of *T. pilosus*. In addition, Williams (1968) also doubted Bott's (1955) opinion regarding these two taxa. *Potamonautes odhneri* is therefore resurrected from synonymy and recognized here as a valid species.

Conservation status. The conservation status of *P. odhneri* is categorized as least concern (LC) because it has an extent of occurrence and an area of occupancy that are both in excess of the thresholds for vulnerable (VU) and there are no known widespread threats (IUCN 2004; Cumberlidge et al. 2009). Its population is estimated to be stable based on indirect measures such the fact that it is well represented in museum collections, and because it has been collected recently.

***Potamonautes alluaudi* (Bouvier, 1921)**

(Figs. 30–42, 45, Table 1)

Potamon (Geothelphusa) alluaudi Bouvier, 1921: 46–49, figs. 1–3.

Potamon alluaudi Balss, 1929: 350; Chace, 1942: 240.

Type material examined: KENYA: holotype, *Potamon (Geothelphusa) alluaudi* Bouvier, 1921, female sub-adult (CW 26.5, CL 18.9, CH 9.7, FW 7.8 mm), Ruaha River. Nairobi Forest (0°24'0"S, 36°59'0"E), 1,000 m asl, 25 km from Nairobi, Central Province, 22.ii.1911 (Ch. Alluau and R. Jeannel coll.) (MNHN B-17); specimen illustrated is the adult male (CW 54 mm) from the Aberdare Mountains (T.R. Williams coll.) (NMU TRW 1963.02a.1-2).

Additional material examined: KENYA: Amboni River, southern Aberdare Mountains, subadult female (CW 21 mm) (damaged); Kiganjo, northern Mt Kenya, Chania River at road bridge below Nyeri (0°06'S, 37°52'E) river 6.1 m wide, fast, river bed with small boulders and stones, 7 juveniles (CW 12.7 to CW 21 mm), juvenile female (CW 22.2 mm), male (CW 32.2 mm), subadult female (CW 34.9 mm), male (damaged), 7.iii.1962 (T. R. Williams coll.) (NMU TRW EA62.75); Mt Kenya, Kiganjo, Nairobi River on road to Trout Research Station, river bed sandy with large stones, and occasional small waterfalls flowing over outcrops and large rocks, 7.iii.1962 (T. R. Williams coll.) (NMU TRW EA62.76); Meru, northern Mt Kenya, Kiganjo, first stream north of last station, 2–2.5 m wide, open, stream bed sandy with some embedded large stones and a cattle watering pool, 9.iii.1962 (T. R. Williams coll.) (NMU TRW EA62.85); Nyambeni Hills, north of Mt Kenya, Thangatha River (0°07'S, 38°13'E), 1,585 m asl, 8.4 km from Mikinduri (00°07'N, 37°50'E) river 3.7–4.6 m wide, river bed stony with some boulders, shaded, at forest edge, about 90 juveniles, 10.iii.1962 (T. R. Williams coll.) (NMU TRW EA62.89); Nyambeni Hills, north of Mt Kenya, Thangatha River, 1,585 m asl, from mid stream, adults, 10.iii.1962 (T. R. Williams coll.) (NMU TRW EA62.91); Nyambeni Hills north of Mt Kenya, unnamed stream, 1.2 km nearer Mikindwi than Thangatha River, 0.7 m wide, shallow, river bed with occasional boulders, otherwise sandy with a few stones, crab collected from beneath a boulder, adult male, 10.iii.1962 (T. R. Williams coll.) (NMU TRW EA62.93); Nyambeni Hills, north of Mt Kenya, Ngobit River at Ngobit on road between Naro Moru and Rumuruti (1°17'N, 36°47'E), a tributary of the Ewaso Ngiri River, river 3.7–4.6 m wide, up to 0.7 m deep, river bed with gravel embedded in silty clay, occasional large

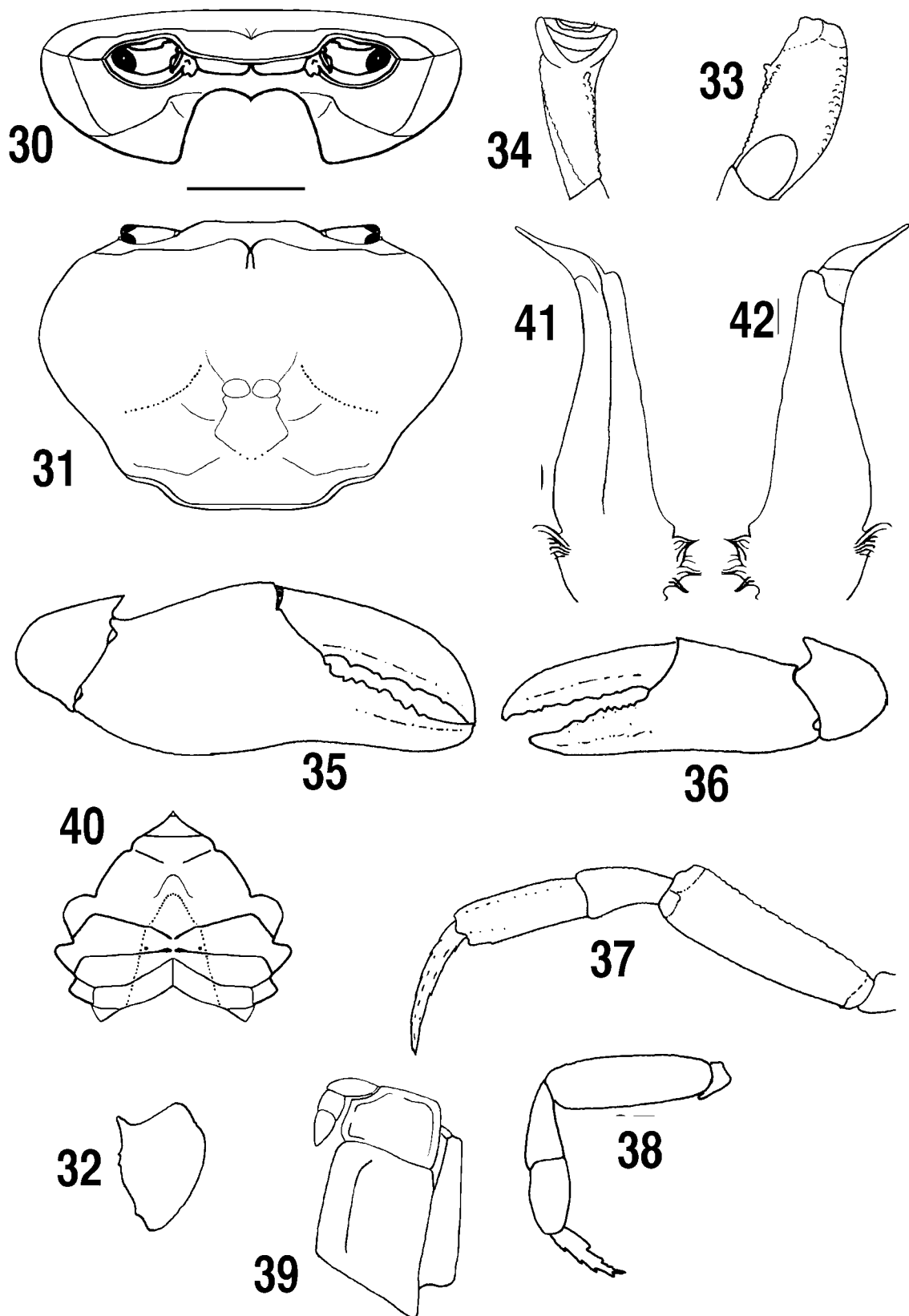
stones, crab collected from rubble at sides of river below bridge, juvenile male (CW 27.9 mm), 16.iii.1962 (T. R. Williams coll.) (NMU TRW EA62.106); Mt Kenya, juvenile female (CW 19.9 mm), 1972 (Joy coll.) (NMU JOY 07.2001.a.1) Mt Kenya, juvenile male (CW 32.4 mm), juvenile female (damaged) i.1972 (Joy coll.) (NMU TRW 01.1972.2); Chania River, Nyeri, Aberdare Mountains (M. J. Clarkson coll.) adult male (CW 46.8 mm) adult female (CW 51.5 mm) (NMU TRW 1963.02b.1–2); Meru, Mt Kenya, 10.iii.1962 (NHM 10.III.1962.1); Murang'a (formerly Fort Hall), male (USNM 82309); Mt Kenya, 2 females (CWs 54.5, 50.0 mm), male (CW 48.9 mm), 29.ix.1909 (Smithsonian African Expedition coll.) (USNM 82317); Mt Kenya, Murang'a (formerly Ft. Hall), 2,833 m asl, juvenile (damaged), 4 males (CW 23.1 to CW 48.9 mm), 2 juvenile males (CW 17.2 to CW 21.8 mm), 6 females (CW 23.7 to CW 36 mm), 2 juveniles (CW 14.6 to CW 15.6 mm), ovigerous female (CW 51.8 mm), x.1909 (Smithsonian African Expedition coll.) (USNM 82318); Kasarongai River, west of Mt Kenya, 15 males (CW 27.1 to CW 48.7 mm), 9 females (CW 24.9 to CW 35.1 mm), 3 juveniles (CW 7.4 to CW 21.9 mm) x.1909 (Smithsonian African Expedition coll.) (USNM 82319); Kasarongai River, west of Mt Kenya, adult male, 3 subadult males, 3 juvenile males, 3 adult females (CW 46.6 to CW 53 mm), 2 adult females with hatchlings, ovigerous female, 6 subadult females, 9 juvenile females, 7 juveniles, x.18–19.1909 (Smithsonian African Expedition coll.) (USNM 82320); Mt Kenya to Murang'a (formerly Fort Hall), 2,833 m asl, 15 males (CW 18.8 to CW 41 mm), 7 females (CW 21.5 to CW 51.8 mm), 3 juvenile females (CW 18 to CW 25.3 mm), 11 juvenile males (CW 17.5 to CW 23.7 mm), 25 juveniles (CW 12.6 to CW 24.4 mm), juvenile (damaged), female subadult (damaged), x.1909 (Smithsonian African Expedition coll.) (USNM 82321); Kasarongai River, west of Mt Kenya, 27 males, 32 females (17 juveniles), 18–19.x.1909 (E. A. Mearns) (USNM 82322); between Mt Kenya and Murang'a (formerly Fort Hall), 2,833 m asl, 27 juveniles (CW 10.3 to CW 25.9 mm), 14 juvenile females (CW 19.4 to CW 31.8 mm), 5 juvenile males (CW 20.9 to CW 32.7 mm), subadult female (CW 38.5 mm), female subadult (CW 39.5 mm), adult female (CW 47 mm), female with hatchlings (CW 44.3 mm), 2 juveniles (damaged), x.1909 (Smithsonian African Expedition coll.) (USNM 82323).

Diagnosis. Carapace medium height (CH/FW 1.3), smooth; anterolateral margin granular; postfrontal crest distinct, completely crossing carapace, granular at junction with anterolateral margins; exorbital, epibranchial teeth low; carapace sidewalls smooth; third maxilliped ischium with deep vertical sulcus; thoracic sternal sulcus s3/s4 not complete, v-shaped, tapering inward at sides, absent across middle; episternal sulcus s4/e4 absent, s5/e5, s6/e6, s7/e7 complete; dactylus of major cheliped broad, highly arched, closed fingers enclosing oval interspace; first carpal tooth on carpus of cheliped large, blunt; second carpal tooth reduced to small granule, followed by several other small granules; ventral margins of pereopod 1 merus granulated; distal meral tooth pointed; terminal article of G1 curving outward at 60° angle to longitudinal axis of gonopod; terminal article broad proximally (lateral, medial folds high in basal half), terminal article outwardly curved, narrowing distally, tapering to point; distal margin of subterminal segment highest on medial side (forming rounded shoulder) lowest on lateral side; dorsal membrane broad, widest at lateral edge, narrowest at medial edge.

Size. A large-sized species, pubertal molt between CW 44 and CW 54.5 mm.

Type locality. Ruaha River, Nairobi Forest, Kenya.

Distribution. Kenya, in the region of Mt Kenya and the Aberdare Mountains, Central Province. The records from the NMU collection combined with those the USNM collected by the Smithsonian African Expedition in 1909 that have been re-identified here define the species as endemic to the highlands of the Central Province of Kenya, in the region of Mt Kenya and the Aberdare Mountains. Bouvier (1921) also included in this species an adult male syntype from the Amboni River (1,800 m asl) in the Aberdare Mountains collected on January 13, 1912. However, Bouvier's (1921) further inclusion in this species of two male specimens from the Ngare Rongai (now Ngare Longai) River in the grasslands east of Mt. Kilimanjaro is considered doubtful, and these are not listed under this species in the present work.



FIGURES 30–42. *Potamonautes alluaudi* (Bouvier, 1921) adult male, CW 54 mm, NMU TRW 1963.02a.1–2, Chania River, Nyeri, Aberdare Mountains, Kenya. 30, carapace and eyes, dorsal view; 31, cephalothorax, carapace and eyes, frontal view; 32, carpus of right cheliped, dorsal view; 33, merus of right cheliped, dorsal view; 34, merus of the right cheliped, inferior view; 35; right cheliped, frontal view; 36, left cheliped, frontal view; 37, left third pereopod; 38, left fifth pereopod; 39, left third maxilliped; 40, sternum; 41, right G1, ventral aspect; 42, right G1, dorsal aspect. Scale = 16.4 mm (30–40); 3.6 mm (41–42).



43



44



45

FIGURES 43–45. Right G1, dorsal aspect. 43, *Potamonautes jeanneli* (Bouvier, 1921) adult male (CW 21.2 mm) (NMU TRW EA62.78), Sirimon River, Mt Kenya, Kenya; 44, *Potamonautes odhneri* (Colosi, 1924) adult male (CW 24.1 mm) (USNM 82312) from Mt Kenya, Kenya; 45, *Potamonautes alluaudi* (Bouvier, 1921) adult male, CW 54 mm (NMU TRW 1963.02a.1–2), Chania River, Nyeri, Aberdare Mountains, Kenya. Sizes adjusted for comparative purposes.

Natural history. This large-sized species lives in the rivers and streams of Mt Kenya and the Aberdare Mountains.

Remarks. The specimens included in the present study were assigned to *P. alluaudi* because they all conform strongly to the characters of the female subadult holotype of *Potamon* (*Potamonautes*) *alluaudi* Bouvier, 1921 (CW 26.5, CL 18.9, CH 9.7, FW 7.8 mm) from Nairobi Forest (MNH B-17) and to Bouvier's (1921) detailed account of its carapace, chelipeds, mouthparts, and pereopods. Bott (1955) treated *P. alluaudi* as *Potamonautes* (*Arcopotamonautes*) *suprasulcatus alluaudi*, a subspecies of *T. suprasulcatus* Hilgendorf, 1898. However, comparison of G1 and carapace characters of the adult male specimen of *P. alluaudi* from the Nyambeni Hills north of Mt Kenya with the adult male lectotype of *T. suprasulcatus* Hilgendorf, 1898, from Tanzania (CW 54.6, CL 37.2, CH 17.4, FW 14.5 mm) (ZMB 9037) indicates that these two taxa are not conspecific. *Potamonautes alluaudi* (and *P. suprasulcatus*) are both treated here as valid species, based on characters of the carapace, carpus of the cheliped, and the first gonopod (Reed & Cumberlidge 2006).

All three species of freshwater crabs found in the region of Mt Kenya and the Aberdare Mountains (*P. jeanneli*, *P. odhneri*, and *P. alluaudi*) are similar in that they all have exorbital and epibranchial teeth that are reduced to small granules, a carapace sidewall that is completely smooth, and an s3/s4 groove on the thoracic sternum that is reduced to two side notches. The species can be distinguished from each other as follows (Table 1).

Potamonautes jeanneli and *P. odhneri* are similar in that both are small to medium-sized species (adult at CW 22 and 32 mm respectively), and both have exorbital and epibranchial teeth that are reduced to small granules, anterolateral margins of the carapace that are completely smooth lacking teeth of any kind, carapace sidewalls that are completely smooth, and an s3/s4 groove that is reduced to two side notches. However, *P. jeanneli* has a completely smooth carapace lacking a postfrontal crest, while *P. odhneri* has a sharp postfrontal

crest; the episternal sulci s4/e4, s5/e5, s6/e6, s7/e7 of *P. jeanneli* are missing and not visible (smooth), whereas these sulci are all deep and distinct in *P. odhneri*; the ischium of the third maxilliped in *P. jeanneli* is smooth and lacks a vertical groove, whereas it is deep in *P. odhneri*; the first tooth on the carpus of the cheliped of *P. jeanneli* is blunt and low, whereas it is small but pointed in *P. odhneri*. Finally, the terminal article of G1 of *P. jeanneli* is straight and slim (its lateral and medial folds are equal and low) and it is not turned outward, whereas in *P. odhneri* the terminal article of G1 is broadened basally and curves outward at a 45° angle to the longitudinal axis of gonopod (Figs. 43, 44).

TABLE 1. Comparison of morphological characters of the freshwater crabs of Mt Kenya, Kenya.

	<i>P. alluaudi</i>	<i>P. odhneri</i>	<i>P. jeanneli</i>
Adult size range (mm)	44–55	23–33	22–24
Postfrontal crest	Sharp	Sharp	Absent
3 rd maxilliped: groove on ischium	Deep	Deep	Absent
Cheliped carpus: 1 st carpal tooth	Large, pointed	Large, pointed	Low, blunt
Cheliped merus: distal meral tooth	Large, pointed	Large, pointed	Low, blunt
GO1: terminal article	Broad based; curving outward 60°	Broad based; curving outward 45°	Slim; straight
GO1: subterminal segment	Pronounced shoulder	No shoulder	No shoulder

Potamonautes alluaudi can be distinguished from the other two species found on Mt Kenya by the size of adult specimens (Williams 1991; Cumberlidge 1997, 1998). With an adult size range from CW 44 to 55 mm, *P. alluaudi* is a much larger species than either *P. jeanneli* or *P. odhneri* that are both adult at CW 22 and 32 mm respectively, whereas a specimen of *P. alluaudi* in this size range would only be a subadult (Table 1). *Potamonautes alluaudi* can be distinguished from *P. jeanneli* as follows: a sharp postfrontal crest whereas *P. jeanneli* has a completely smooth carapace lacking a postfrontal crest; the third maxilliped ischium has a deep vertical groove, whereas in *P. jeanneli* the ischium of the third maxilliped is smooth and lacks a vertical groove; the first carpal tooth of the cheliped carpus is large and pointed whereas in *P. jeanneli* the tooth is blunt and low; the distal meral tooth on the cheliped merus is large and pointed whereas in *P. jeanneli* this tooth is blunt and low; and the terminal article of G1 of *P. alluaudi* curves sharply outward (at a 60° angle to the longitudinal axis of the gonopod) and is broadened basally, whereas the terminal article of G1 of *P. jeanneli* is straight and slim (Figs. 43, 45).

Potamonautes alluaudi is similar to *P. odhneri* in that they both have a sharp postfrontal crest, a deep vertical groove on the ischium of the third maxilliped, a first carpal tooth on the carpus of the cheliped that is large and pointed, a pointed distal meral tooth, and a terminal article of G1 that curves outward rather than continuing straight. *Potamonautes alluaudi* can be distinguished from *P. odhneri* as follows. The terminal article of G1 of *P. alluaudi* curves sharply outward at a 60° angle to the longitudinal axis of the gonopod, and the distal margin of the subterminal segment is highest on the medial side forming a pronounced, rounded shoulder; whereas the terminal article G1 of *P. odhneri* curves outward at a 45° angle to longitudinal axis of the gonopod, and the distal margin of the subterminal segment does not form a pronounced shoulder (Figs. 44, 45).

Conservation status. The conservation status of *P. alluaudi* is categorized as least concern (LC) because it has an extent of occurrence and an area of occupancy are both in excess of the thresholds for vulnerable (VU) and because there are no known threats (IUCN 2004; Cumberlidge et al. 2009). Its population is estimated to be stable based on indirect measurements such as its representation in museum collections, although its most recent collection dates back to 1962.

Acknowledgements

Trefor R. Williams is thanked for kindly donating most of the material used in this study (which is now part of the NMU collection), much of which was originally collected by J. N. Raybould. Paul Clark and Miranda Lowe (NHM) are thanked for loaning specimens and for hosting visits, and Rafael Lemaitre and Marilyn Schotte (USNM) are thanked for their support during work on the USNM collection. A number of funding sources contributed to this project, including the National Science Foundation (grant DES 1308 417 22). Jon Bedick drew the first versions of the illustrations of *P. jeanneli* and *P. odhneri*, and Sadie K. Reed prepared the first draft of the illustrations of *P. alluaudi*.

References

- Balss, H. (1929) Ueber Ostafrikanische Potamonidae (Decapoda). Mit Anhang; Potamoniden von Madagascar. *Zoologische Jahrbücher, Abteilung für Systematik, Geographie und Biologie der Thiere*, 58, 339–358, Fig. 1–2.
- Barnley, G.R. & Prentice, M.A. (1958) *Simulium neavei* in Uganda. *East African Medical Journal* 35, 475.
- Bott, R. (1955) Die Süßwasserkrabben von Afrika (Crust., Decap.) und ihre Stammesgeschichte. *Annales du Musée du Congo belge, (Tervuren, Belgique) C-Zoologie*, (3,3),3(1), 209–352.
- Bott, R. (1970) Betrachtungen über die Entwicklungsgeschichte der Süßwasserkrabben nach der Sammlung des Naturhistorischen Museums in Genf/Schweiz. *Revue Suisse Zoologie*, 77 (2), 327–344, Pl. 1, 2.
- Bouvier, E.L. (1921) *Decapoda*. In: *Voyage de Ch. Alluaud et R. Jeannel en Afrique orientale (1911–1912)*. Résultats scientifiques, Crustacés, III (Paris), 23–62.
- Capart, A. (1954) Révision des types des espèces de Potamonidae de l'Afrique tropicale conservés au Muséum d'Histoire Naturelle de Paris. *Volume Jubilaire de Victor Van Strahlen, Directeur de l'Institut royal des Sciences naturelles de Belgique*, 1925–1934, II, 819–847.
- Chace, F.A. (1942) III. Decapod Crustacea. In: *Scientific results of the fourth expedition to forested areas in eastern Africa. Bulletin of the Museum of Comparative Zoology, Harvard College*, 91(3), 185–233.
- Colosi, G. (1924) Potamonides africains du Museum de Stockholm. *Arkiv für Zoologie*, 16, 1–24.
- Crosskey, R.W. (1990) *The Natural History of Blackflies*, John Wiley & Sons, London, 722 pp.
- Cumberlidge, N. (1997) The African and Madagascan freshwater crabs in the Museum of Natural History, Vienna (Crustacea: Decapoda: Brachyura: Potamoidea). *Annalen des Naturhistorischen Museums in Wien*, 99B, 571–589.
- Cumberlidge, N. (1998) The African and Madagascan freshwater crabs in the Zoologische Staatssammlung, Munich (Crustacea: Decapoda: Brachyura: Potamoidea). *Spixiana*, 21(3), 193–214.
- Cumberlidge, N. (1999) *The freshwater crabs of West Africa. Family Potamonautidae*. Faune et Flore Tropicales 35, Institut de recherche pour le développement IRD (ex-ORSTOM), Paris, 382 pp.
- Cumberlidge, N., Ng, P.K.L., Yeo, D.C.J., Magalhaes, C., Campos, M.R., Alvarez, F., Naruse, T., Daniels, S.R., Esser, L.J., Attipoe, F.Y.K., Clotilde-Ba, F.-L., Darwall, W., McIvor, A., Baillie, J.E.M., Collen, B. & Ram, M. (2009). Freshwater crabs and the biodiversity crisis: importance, threats, status, and conservation challenges. *Biological Conservation*, in press.
- Dobson, M. (2004) Freshwater crabs in Africa. *Freshwater Forum*, 21, 3–26.
- Dobson, M., Magana, A., Lancaster, J. & Mathooko, J.M. (2007a) Aseasonality in the abundance and life history of an ecologically dominant freshwater crab in the Rift Valley, Kenya. *Freshwater Biology* 52, 215–225.
- Dobson, M., Magana, A., Mathooko, J.M. & Ndegwa, F.K. (2002) Detritivores in Kenyan highland streams: more evidence for the paucity of shredders in the tropics? *Freshwater Biology* 47, 909–919.
- Dobson, M.K., Magana, A., Mathooko, J.M. & Ndegwa, F.K. (2007b) Distribution and abundance of freshwater crabs (*Potamonautes* spp.) in rivers draining Mt Kenya, East Africa. *Fundamental and Applied Limnology* 168, 271–279.
- Hilgendorf, F. (1898) Die Land- und Süßwasser-Dekapoden Ostafrikas. In: *Die Thierwelt Deutsch Ost-Afrikas*, 4(7), 1–37.
- Hynes, H.B.N., Williams, T.R. & Kershaw, W.E. (1961) Freshwater crabs and *Simulium neavei* in East Africa. I. – Preliminary observations made on the slopes of Mt. Elgon in December, 1960, and January, 1961. *Annals of Tropical Medicine and Parasitology* 55(2), 197–201.
- MacLeay, W.S. (1838) Brachyurous Decapod Crustacea, Illustrations of the Zoology of South Africa 5; being a Portion of the Objects of Natural History Chiefly Collected during an Expedition into the Interior of South Africa, under the Direction of Dr. Andrew Smith, in the Years 1834, 1835, and 1836; Fitted Out by “The Cape of Good Hope Association for Exploring Central Africa.” In: *A. Smith, Illustrations of the Zoology of South Africa; Consisting Chiefly of Figures and Descriptions of the Objects of Natural History Collected During an Expedition into the Interior of*

- South Africa, in the Years 1834, 1835, and 1836; Fitted Out by "The Cape of Good Hope Association for Exploring Central Africa"*, 5, *Invertebrata* (3), 53–71.
- McMahon, J.P., Highton, R.B. & Goiny, H. (1958) The eradication of *Simulium neavei* from Kenya. *Bulletin of the World Health Organisation* 19, 75–107.
- Reed, S.K. & Cumberlidge, N. (2006) Taxonomy and biogeography of the freshwater crabs of Tanzania, East Africa (Brachyura: Potamoidea: Potamonautidae, Platythelphusidae, Deckeniidae). *Zootaxa*, 1262, 1–139.
- Williams, T.R. (1968) The taxonomy of the East African river crabs and their association with the *Simulium neavei* complex. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 62 (1), 29–34.
- Williams, T.R. (1991) Freshwater crabs and *Simulium neavei* in East Africa. III. morphological variation in *Potamonautes loveni* (Decapoda: Potamidae). *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 85, 181–188.
- Williams, T.R., Hynes, H.B.N. & Kershaw, W.E. (1964) Freshwater crabs and *Simulium neavei* in East Africa II. Further observations made during a second visit to East Africa in February–April 1962. *Annals of Tropical Medicine and Parasitology* 58, 159–168.