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The genus *Argulus* (Crustacea: Branchiura) in Africa: two new species, *A. fryeri* and *A. gracilis*, the previously undescribed male of *A. brachypeltis* Fryer and the identity of the male described as *A. ambloplites* Wilson

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Abstract

Two new species of *Argulus* Müller, 1785 (Crustacea: Branchiura) are described from Africa. *A. fryeri* n. sp., parasitic on an unknown fish species collected from Lake Turkana, Kenya, is characterised by: deep antero-lateral depressions which delimit a pronounced frontal region; robust, square second maxillae ornamented with numerous small, simple scales; and the shape of the respiratory areas. The most distinctive features of *A. gracilis* n. sp., parasitic on *Auchenoglanis occidentalis* var. *tanganicanus* collected from Lake Tanganyika, are the anterior spines on the first antennae and the shape of the respiratory areas. *A. brachypeltis* Fryer, previously known only from the female, is characterised by: a narrow, elongate body with foreshortened carapace lobes; small, slender terminal spines on the first antennae; and short terminal segments on the second maxillae with minute claws. The identity of the male described as *A. ambloplites* Wilson is discussed and renamed *A. confusus* nom. nov.

Introduction

The genus *Argulus* is widely distributed in Africa, and a study of the literature reveals descriptions or reports of 32 different species from this region, the majority of which were collected from freshwater habitats. A new species of *Argulus* collected from Africa was found amongst the type-collection of The Natural History Museum. A number of specimens collected from Lake Turkana, Kenya, were also presented to the Museum and contained the male of a species of *Argulus* previously known only from the female and another new species. All are described below.

Materials and methods

All specimens had been stored in 80% industrial methylated spirits (IMS) for periods up to 80 years. Before examination, the parasites were washed in distilled water and placed in a saturated solution of potassium hydroxide to clear the specimens for drawing. They were taken through two changes of distilled water and placed in a watch glass containing 80% IMS. In a fume-cupboard, 1 ml lactophenol was added a drop at a time to the alcohol and mixed thoroughly. The watch-glass was left uncovered to allow the alcohol to evaporate slowly, leaving the specimen in lactophenol. The parasite was mounted in a cavity slide and drawn with the aid of a camera lucida attached to an Olympus BH2 microscope using Nomarski interference. All measurements were made with an ocular micrometer.

The specimens of *Argulus gracilis* n. sp. were already present in the collections of The Natural History Museum as part of a mixed collection of species registered as the type-specimens of *A. incisis* Cunnington, collected during the ex-

pedition to Lake Tanganyika in 1913. The specimen of *A. fryeri* n. sp. was collected from an unknown fish species caught during the course of a project on Lake Turkana in the early 1970s and was passed on to The Natural History Museum along with a number of specimens of *A. brachypeltis*, which included the previously undescribed male, by Dr G. Fryer.

Argulus fryeri n. sp.

Description

Adult female. General body ovoid (Fig. 1A,B); carapace comprising 76% of total body length. Body length 6.63 mm. Ventral surface of head ornamented with numerous regularly arranged spines of similar size extending along 1/3 of carapace. Compound eyes large; small nauplius eye located on dorsal surface, midway between carapace lobes and posterior to compound eyes. Antero-lateral depressions pronounced forming broad, rounded frontal region. Lateral lobes of carapace rounded, extending midway down abdomen and separated by broad sinus 1/5 length of carapace. Paired respiratory areas (Fig. 1E) on ventral surface of lobes; smaller respiratory area approximately half size of larger and located entirely anterior to large area; both with oval, non-indented outlines. Thorax clearly 4-segmented.

Abdomen longer than broad, posterior lobes tapering to point from behind anal sinus; separated by broad sinus 1/2 length of abdomen. Paired spermathecae located at anterior end of abdomen; furcal rami small, located adjacent to midline at base of anal sinus.

First antenna (Fig. 1C) comprising 2 sections; stout 2-segmented proximal section possessing large spines; slender distal section with setae. First segment bearing large posterior spine; 2nd segment massive, with medial spine, large hook-like terminal spine and anterior spine, lacking hook. Distal section of antenna extending beyond terminal spine; comprising 2 segments; penultimate segment with large seta, terminal segment bearing group of apical spines. First antenna with single well-developed post-antennal spine on ventral surface of cephalothorax. Second antenna (Fig. 1C) 4-segmented. Basal segment massive, with posterior spine. Distal 3 segments tubular, bearing short setae, 4th segment terminating in number of spines.

First maxilla forming large suckers; supporting rods comprising 10 sclerites (Fig. 1D); basal sclerite square; remaining sclerites oval and overlapping. Periphery of suckers fringed with soft setae. Retractile pre-oral spine located midway between maxillary suckers. Mouth tube (Fig. 1G) almost half as broad as long and bearing simple scales; denticulate mandibles visible within mouth-tube. Pair of accessory spines located posterior to mouth-tube.

Second maxilla 5-segmented (Fig. 1F); proximal section 2-segmented, distal section 3-segmented; terminal segment with 2 small, sharp claws and one large, blunt claw. Basal segment produced into 3 unequal spines; basal plate armed with numerous small scales and 2 long, closely set setae. Second segment heavily sclerotised, with thickened ridge at distal end (arrowed in Fig. 1F); 3rd to 5th segments armed with numerous simple and pectinate scales. Pair of post-maxillary spines present on ventral body surface either side of midline.

First to 4th pairs of legs biramous and of near equal size; sympods indistinctly 2-segmented. Flagellum present on 1st and 2nd legs; extending medially from origin on dorsal surface at base of exopod; both rami and flagella armed with 2 rows of plumose setae. Natatory lobe on 4th leg produced laterally. Simple scales present on thorax and swimming legs.

Material examined: Holotype female. Registration number BM(NH).1992.616.
Type-host: Unknown.
Type-locality: Lake Turkana, Kenya.

Remarks

The most distinctive features of *A. fryeri* n. sp. are: the deep antero-lateral depressions of the dorsal carapace which delimit a pronounced fron-

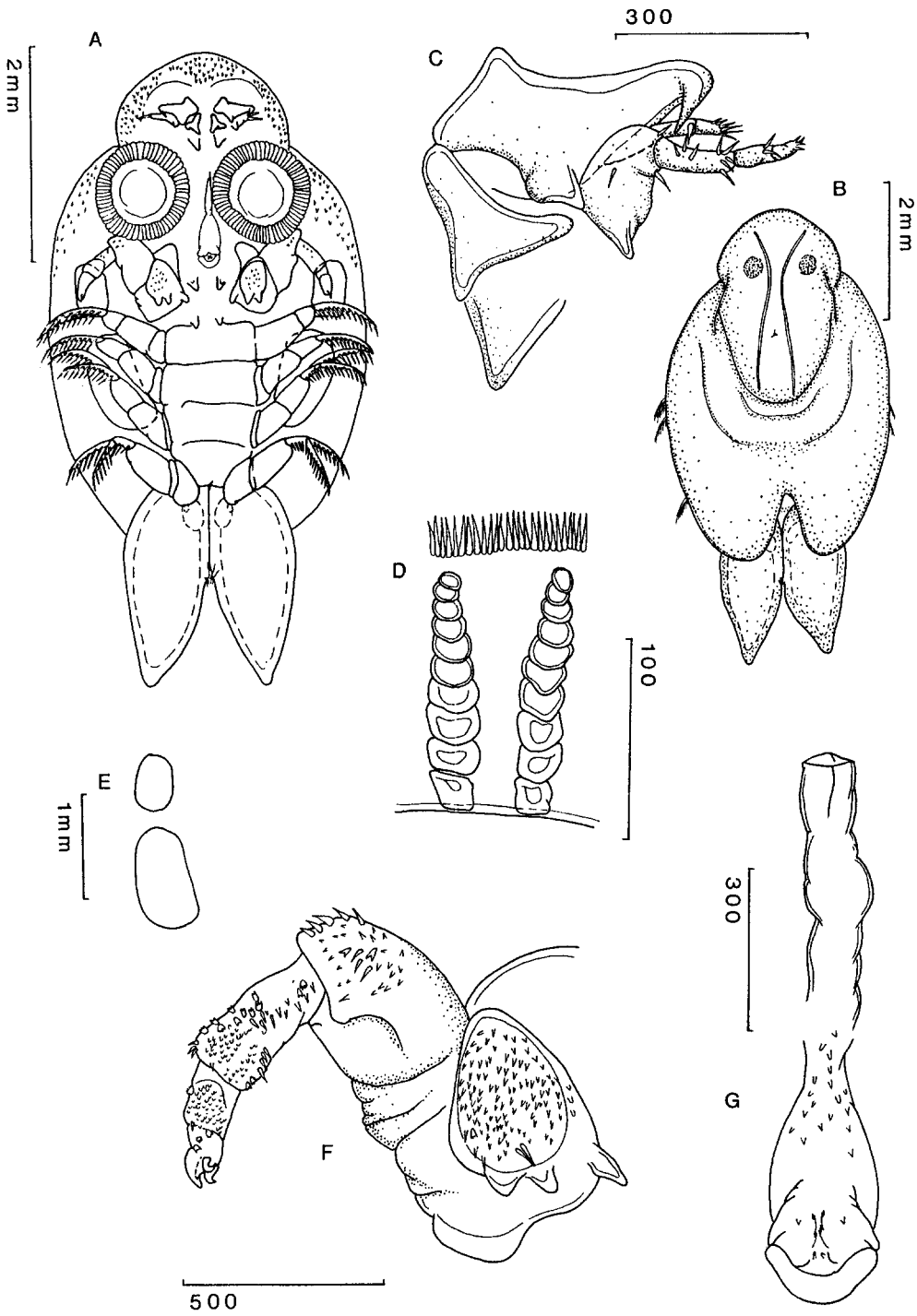

Fig. 1. Argulus fryeri n. sp. holotype female. A, Ventral view; B, Dorsal view; C, First and second antennae; D, Sclerites in supporting rods of first maxilla; E, Respiratory areas; F, Second maxilla (arrow indicates thickened ridge); G, Mouth tube and pre-oral spine. *Scale-bars*: in micrometres unless otherwise stated.

tal region; the robust, squat second maxillae ornamented with numerous small, simple scales; and the shape of the respiratory areas. The smaller, anterior area is approximately half the size of the larger and both have simple oval, non-indented outlines. When compared with all its congeners, *A. fryeri* most closely resembles *A. alexandrensis* Wilson, *A. arcassonensis* Cuénot, *A. capensis* Barnard, *A. multipocula* Schuurmans Stekhoven and *A. trachynoti* Brian. *A. fryeri* can be distinguished from *A. trachynoti* and *A. multipocula* by the reduced number of sclerites in the supporting rods of the suckers and by the dense ornamentation of simple scales on the second maxillae. *A. fryeri* can be distinguished from *A. alexandrensis*, *A. arcassonensis* and *A. capensis* by the absence of a hook on the anterior spines of the first antennae.

Argulus gracilis n. sp.

Description

Adult male. General body form elongate (Fig. 2A,B); carapace comprising 54% of total body length. Body length 5.7 mm. Compound eyes large; small nauplius eye located on dorsal surface, approximately midway down carapace lobes and posterior to compound eyes. Ventral surface of head ornamented with numerous regularly arranged spinules of similar size extending along 2/3 of carapace. Frontal region sparsely ornamented with scales; lateral lobes of carapace more densely ornamented. Lateral lobes broadly rounded, extending midway down thorax and separated by broad sinus 1/6 length of carapace. Paired respiratory areas (Fig. 2A) on ventral surface of lobes; anterior respiratory area small and oval; posterior respiratory area with 2 indentations on medial margin. Thorax distinctly 4-segmented.

Abdomen narrow, 3 times as long as broad; lobes tapering from behind anal sinus to form slightly rounded points; separated by sinus 1/3 length of abdomen. Furcal rami small, located adjacent to midline at base of anal sinus. Paired testes elongate.

First antenna (Fig. 2C) comprising 2 sections; stout 2-segmented proximal section possessing large spines; slender distal section with setae. First segment bearing short, broadly rounded posterior spine and single seta; 2nd segment with elongate, sharply pointed anterior spine; large hook-like terminal spine; lacking medial spine. Distal section of antenna comprising 2 segments, armed with group of apical spines. Paired post-antennal spines on ventral surface of cephalothorax on either side of midline. Second antenna (Fig. 2C) 4-segmented, bearing short setae on all segments; 4th segment terminating in number of apical spines.

First maxillae forming large suckers; supporting rods comprising 7 sclerites (Fig. 2D); periphery of suckers fringed with soft setae. Retractile preoral spine located midway between maxillary suckers. Elongate mouth-tube (Fig. 2E) 1/3 as broad as long, lacking scales; denticulate mandibles visible within mouth-tube; labium entire. Paired accessory spines located on either side of labium.

Second maxilla 5-segmented (Fig. 2F); proximal section 2-segmented; distal section 3-segmented; terminal segment with small, sharp claws and one large, blunt claw. Basal segment produced into 3 long, unequal, blunt spines; basal plate armed with numerous simple and pectinate scales and 3 long, closely set setae. Second and 3rd segments armed with short setae, simple and pectinate scales; 4th and 5th segments bearing simple scales and short setae only. Pair of sharply pointed postmaxillary spines present on ventral body surface either side of midline.

First to 4th pairs of legs biramous and of near equal size; sympods indistinctly 2-segmented. Flagellum present on 1st and 2nd legs; extending medially from origin on dorsal surface at base of exopod; both rami and flagella armed with 2 rows of plumose setae. Simple scales present on thorax and swimming legs.

Accessory copulatory structures comprising large, cup-shaped socket on protopod of 3rd leg located directly above peg on anterior surface of basis of 4th leg, accessory cushion located posterior and medial to copulatory peg.

Female. Unknown.

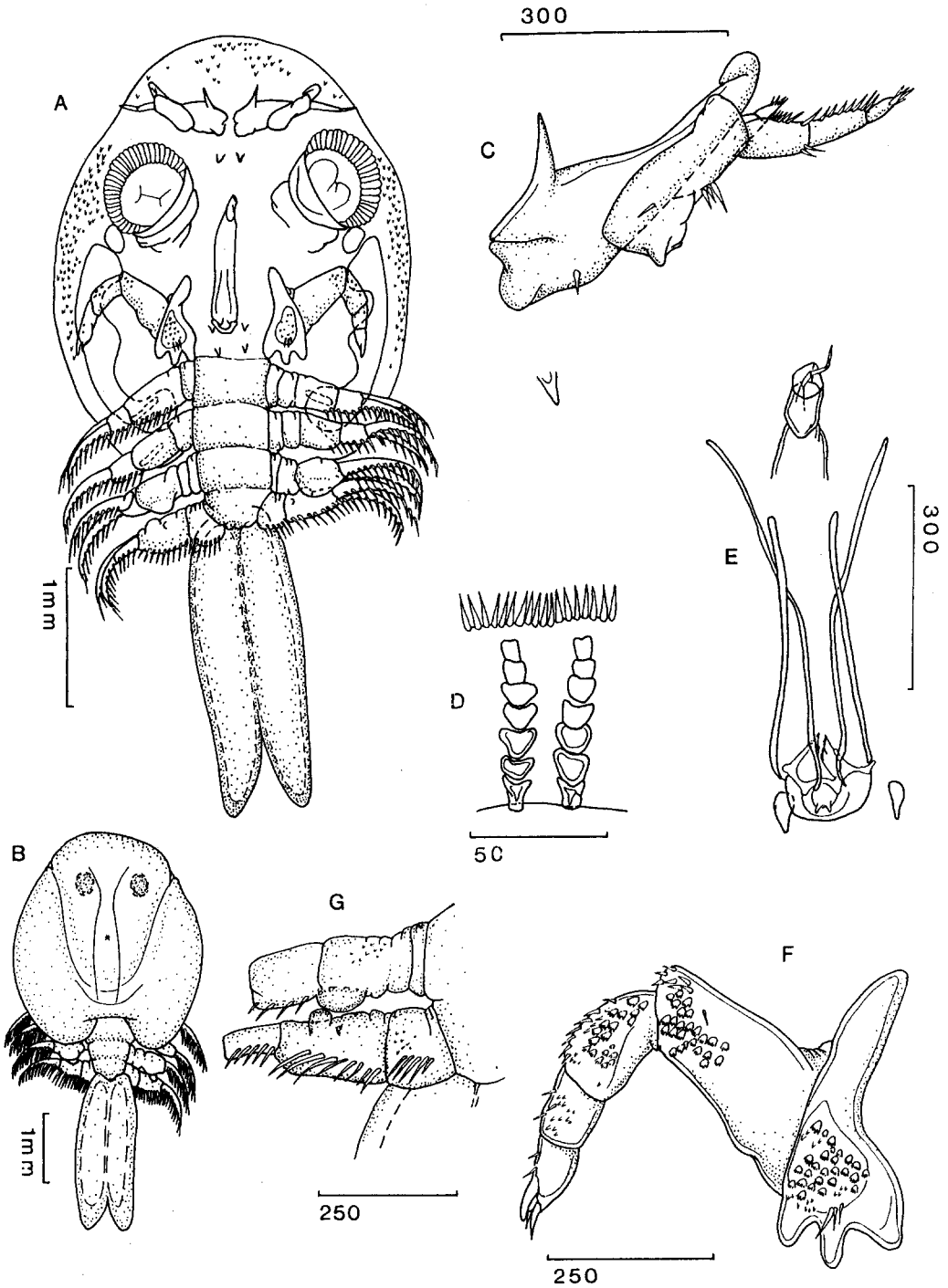

Fig. 2. Argulus gracilis n. sp. holotype male. A, Ventral view; B, Dorsal view; C, First and second antennae; D, Sclerites in supporting rods of first maxilla; E, Mouth tube and pre-oral spine; F, Second maxilla; G, Third and fourth legs. *Scale-bars*: in micrometres unless otherwise stated.

Table I. Points of distinction between *Argulus gracilis* and *A. incisus*.

A. gracilis	*A. incisus*
(i) Antero-lateral depressions slight.	Pronounced antero-lateral depressions.
(ii) Elongate anterior spine on first antenna.	Reduced anterior spine on first antenna.
(iii) Posterior spine on the second antenna present.	Posterior spine on the second antenna absent.
(iv) Labium entire.	Multilobate labium.
(v) Three long, closely-set setae on the basal plate of the second maxilla.	Lacks closely-set setae on the basal plate of the second maxilla.

Material examined: Holotype male. Registration number BM(NH).1992.615.
Type-host: *Auchenoglanis occidentalis* var. *tanganicanus*.
Type-locality: Lake Tanganyika.

Remarks

A. gracilis n. sp. was found in the same storage container as the type material of *A. incisus*, but there are gross morphological differences between the two species which are shown in Table I. The most distinctive features of *A. gracilis* are the anterior spines on the first antennae and the shape of the respiratory areas. These characters, in combination with the overall shape of the parasite, distinguish it from all congeners.

***Argulus brachypeltis* Fryer**

Although a number of female *A. brachypeltis* have been found, no males were hitherto known. Five males were identified in a sample of parasites collected in a tow-net, one of which is described below.

Description

Adult male. General body form elongate (Fig. 3A,B); carapace comprising 52% of total body length. Mean body length 3.5 mm, range 1.6 mm to 5.7 mm (based on 5 specimens). Antero-lateral depressions pronounced, forming narrow, parallel sided frontal region; suckers visible from dorsal surface (Fig. 3B). Compound eyes extremely large, positioned well forward; small nauplius eye located on dorsal surface, approximately midway down carapace, posterior to compound eyes. Ventral surface of head sparsely ornamented with regularly arranged spinules of similar size extending along 2/3 of carapace. Lateral lobes rounded, extending as far back as 2nd pair of swimming legs and separated by sinus 1/5 length of carapace. Paired respiratory areas on ventral surface of lobes; anterior respiratory area almost square; posterior respiratory area elongate, approximately twice as large as anterior, parallel-sided with non-indented outline. Thorax distinctly 4-segmented; 3rd segment with pair of posteriorly-produced projections on ventral surface, positioned medial to coxa of 3rd leg (arrowed in Fig. 3G).

Abdomen large, twice as long as broad; lobes broad anteriorly, tapering between anal sinus and point; separated by sinus about 1/3 length of abdomen. Furcal rami small and located adjacent to midline at base of anal sinus. Paired testes elongate.

First antenna (Fig. 3C) comprising 2 sections; stout 2-segmented proximal section possessing large spines; slender distal section with setae. First segment bearing rounded posterior spine; 2nd segment possessing anterior spine with small hook; short, slender hook-like terminal spine; pointed medial spine. Distal section of antenna comprising 2 segments; terminal section with group of apical spines. Pair of post-antennal spines on ventral surface of cephalothorax on either side of midline. Second antenna 4-segmented; 1st segment with inconspicuous posterior spine; all segments bearing short setae; 4th terminating in group of apical spines.

First maxillae forming large suckers; supporting rods comprising 10 oval, overlapping sclerites in

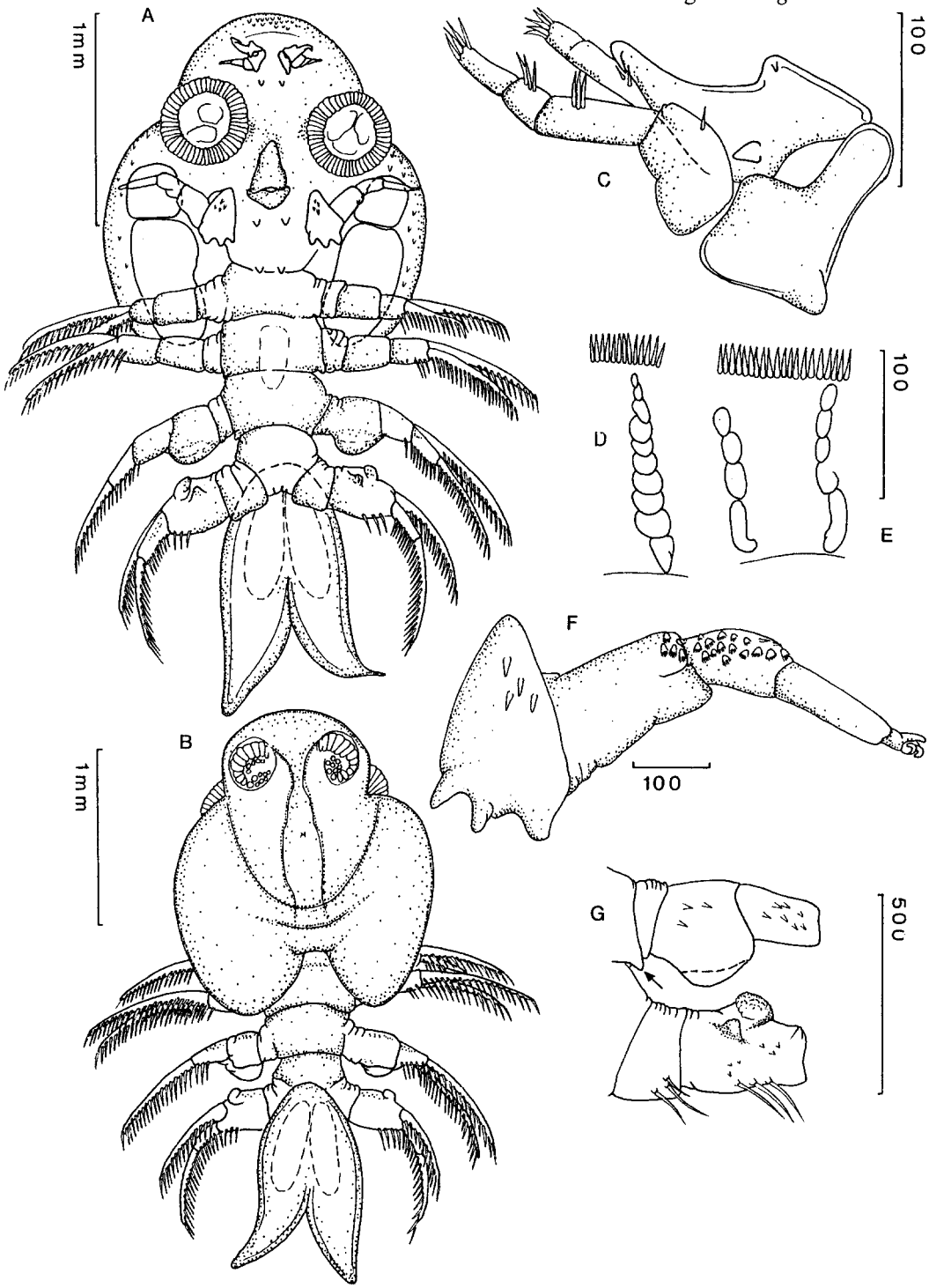

Fig. 3. Argulus brachypeltis, male. A. Ventral view; B, Dorsal view; C, First and second antennae; D, Sclerites in anterior supporting rods of first maxilla; E, Sclerites in posterior supporting rods; F, Second maxilla; G, Coxa and basis of third and fourth legs (arrow indicates projection on second thoracic segment). *Scale-bars*: in micrometres unless otherwise stated.

anterior rods (Fig. 3D); 4–5 sclerites in posterior rods (Fig. 3E); basal sclerite in posterior region elongate, others oval and overlapping; periphery of suckers fringed with soft setae. Retractile preoral spine located midway between maxillary suckers; squat mouth-tube with denticulate mandibles, lacking scales; labium entire. Pair of accessory spines located posterior to mouth-tube.

Second maxilla 5-segmented (Fig. 3F); proximal section 2–segmented; distal section 3-segmented; terminal segment with 2 small, sharp claws and one large, blunt claw. Basal segment produced into 3 small unequal spines; basal plate armed with 4 simple scales, lacking setae. Second and 3rd segments armed with simple and pectinate scales. Pair of post-maxillary spines present on ventral body surface either side of midline.

First to 4th pairs of legs biramous and of near equal size; sympods indistinctly 2-segmented; lacking flagella; rami armed with 2 rows of plumose setae. Simple scales present on thorax and swimming legs.

Accessory copulatory structures comprising large, cup-shaped socket on protopod of 3rd leg located directly above peg on anterior surface of basis of 4th leg; accessory cushion located posterior and medial to copulatory peg.

Material examined: Five males. Registration numbers BM(NH) 1992.626-628; 675-676.
Type-host: Free-swimming in tow-net sample.
Type-locality: Lake Turkana, Kenya.

Remarks

A. brachypeltis is characterised by a narrow, elongate body with foreshortened carapace lobes, a small, slender terminal spine on the first antenna, and a short terminal segment on the second maxilla with three minute claws. The newly described male of *A. brachypeltis* is very similar to the female holotype except for a few features. The natatory lobe of the male lacks the two processes found on that of the female, but sexual dimorphism in the shape of this structure is a common feature in the genus *Argulus*. The posterior spines on the first antennae and the postantennal spines are narrow and not as heavily sclerotised as in the female. Fryer (1959) found a large degree of variation in the armature of the second maxilla within a population of *A. brachypeltis* from a single host: the spines of the maxillae were narrow and rounded in small specimens becoming broader and flatter in larger individuals. He suggested that the increase in size and sclerotisation of the spines may be directly correlated with age of the individual, but he also found a smaller degree of random variation.

The identity of the male described as *Argulus ambloplites* Wilson and its renaming as *A. confusus* nom. nov.

Wilson (1920) described a new species of *Argulus* collected from the Dungu River, which he named *A. ambloplites*. The type-material (BM(NH) 1975, 1066 & 1957.9.6.40-41) comprised single male and female specimens which differed from each other quite considerable: the carapace of the female tapered posteriorly, overlapping the abdomen and the frontal region of the carapace had an indented outline. The carapace lobes in the male specimen were broadly rounded, barely reached the fourth pair of swimming legs, and the frontal region was gently rounded with a non-indented outline.

Fryer (1956) described a new species, *A. jollymani*, the female of which was almost identical to that of *A. ambloplites*, but the male was quite different. The males differed by the size of suckers and the shape and number of sclerites in the supporting rods. The females also differed in the armature of the second maxilla, with the spines on the basal plate being more widely spaced in *A. jollymani* than in *A. ambloplites*. Fryer suggested that the differences seemed to exceed those which might be expected as a result of age differences or geographical variation, and he questioned whether the male and female of *A. ambloplites* described by Wilson (1920) were conspecific. Fryer (1960) received a number of specimens of *A. ambloplites*, one of which was a male which differed from that described originally by Wilson

(1920), but closely resembled the female holotype. Fryer suggested that the male described by Wilson did not belong to the same species as the female holotype and required a new name, and he described the true male of *A. ambloplites*. The differences between *A. ambloplites* and *A. jollymani* were minor and the accessory copulatory structures so similar, that Fryer (1960) suggested *A. jollymani* was probably a subspecies of *A. ambloplites* and named it *A. ambloplites jollymani*. The male of *A. ambloplites* described by Wilson is here designated as the holotype of *A. confusus* nom. nov.

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