

Reassignment of a Central American Species of the Branchiobdellida (Annelida: Clitellata) to *Forbesodrilus* n. g.

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Abstract: A new genus of branchiobdellidan or crayfish worm (Annelida: Clitellata) is described for a Central American species. *Forbesodrilus nanagnathus* (HOLT, 1973) had previously been placed in the genus *Cambarincola*. However, as its prostate gland arises from the ectal third of the glandular atrium, the species no longer qualifies as a *Cambarincola* according to the current generic diagnosis (HOLT 1986). The male genitalia are very similar to *Pterodrilus missouriensis* HOLT, 1968; however, *F. nanagnathus* lacks the pterodrilid character of a dorsal transverse ridge across segment 8. Therefore a new genus was required, and for completeness, information on species hosts and distribution were reviewed.

Key words: Branchiobdellidan, crayfish worm, new genus, Central America, taxonomy

Introduction

Ectosymbiotic branchiobdellidan annelids on freshwater crustaceans have a disjunct distribution in North America, East Asia and Euro-Mediterranean region (GELDER 1999, FARD, GELDER 2011). In North America crayfish worms extend from Canada to Costa Rica (GELDER *et al.* 2002).

The species reported in Central America (HOLT 1973) are particularly interesting as the freshwater fauna in this region are typically more closely related ecologically to the southern continent rather than the northern. Central America or Mesoamerica is described as northern Neotropical (WALLACE 1876) or Central Mexican subregion (Ic) and Middle American/Antillean transitional area (I-V) according to BĂNĂRESCU (1990). From these data, it is clear that branchiobdellidans have dispersed into the region from the north.

Of the 15 genera recorded in North America, *Cambarincola* contains not only the largest number species in any branchiobdellidan genus but is distrib-

uted throughout the continent (GELDER *et al.* 2002). Species of *Cambarincola* in Central America were described, reviewed, and possible evolutionary affinities discussed by HOLT (1973). At the time, the diagnosis for *Cambarincola* was, 'Body terete without specialized projections; anterior nephridia opening through common pore on dorsum of segment III [3]; deferent ducts entering ental end of spermiducal gland [= glandular atrium]; prostate and ejaculatory duct [= muscular atrium] present; penis non-eversible [= protrusible]; bursa subpyriform to obcordate; spermatheca never bifid.' (HOLT 1973); square brackets give current terminology (GOVEDICH *et al.* 2010). In a '... symposium of branchiobdellidan genera', HOLT (1986) modified the previous diagnosis of *Cambarincola* to its currently accepted version: 'Prostate arising at ectal end (junction with ejaculatory duct) of spermiducal gland; penis muscular, protrusible; ...'

While examining Mesoamerican specimens and corresponding species descriptions, it became

apparent that one species no longer fell within the current *Cambarincola* diagnosis. As a result, I have erected a new genus for this species, produced an emended species description, and added some supplementary observations.

Materials and Methods

Specimens of *Cambarincola nanagnathus* HOLT, 1973 were preserved in paraformaldehyde-glutaraldehyde-picric acid (PAFG) (ERMAK, EAKIN 1976) following removal from *Potamocarcinus nicaraguensis* RATHBUN, 1893, collected off the Solentiname Islands, Lago de Nicaragua, by Giuliano Trezzi in 2000. One specimen was made into a permanent microscope mount by me following the procedure in GOVEDICH *et al.* (2010). The holotype (USNM 45444) was loaned from the National Museum of Natural History, Smithsonian Institution, Washington DC, USA, and examined under a Nikon microscope with Differential Interference Contrast (DIC) illumination at the University of Maine at Presque Isle, USA.

Results

The new genus is a member of the subfamily Cambarincolinae GOODNIGHT, 1940 with the diagnostic morphological characters of a common median anterior nephridial pore, and vasa deferentia entering the glandular atrium entally.

Genus *Forbesodrilus* n. gen.

Type species: *Forbesodrilus nanagnathus* (HOLT, 1973).

Diagnosis: Prostate gland arising from ectal third of glandular atrium (not adjacent to muscular atrium); dorsal ridge on segment 8 absent; two pairs of testes in segments 5 & 6; penis protrusible; spermatheca unbranched, segment 5.

Etymology: The name refers to William H. Forbes, Professor Emeritus of Geology at the University of Maine at Presque Isle and long-time supporter of crayfish worm research at the Institution. This name is combined with *drilus*, meaning worm-like and an accepted ending for generic names in the Branchiobdellida.

Rationale for proposing new genus: *Cambarincola* species have a prostate gland arising

from the ectal end of the glandular atrium adjacent to the muscular atrium, the glandular atrium and prostate gland are usually not connected, and a dorsal ridge on segment 8 is absent. In contrast *Pterodrilus* species have a prostate gland arising from the ectal third of the glandular atrium not adjacent to the muscular atrium, the glandular atrium and prostate gland are connected, and have a dorsal ridge across segment 8. At present, *Forbesodrilus* n.g. contains one species that is characterized by having a prostate gland arising from the ectal third of the glandular atrium not adjacent to the muscular atrium, and no dorsal ridge across segment 8. The designated type species of the new genus and emended brief description are presented below.

Forbesodrilus nanagnathus (HOLT, 1973)

Fig. 1-3

Type specimens: Holotype (USNM 45444); one paratype (PCH 1830); one paratype, Instituto de Biología, Universidad de México, on *Potamocarcinus nicaraguensis* taken at Isleta de Granda, Lago de Nicaragua, Nicaragua, by G. Alviléz, 13 July 1964.

Synonym: *Cambarincola nanagnathus* HOLT, 1973 syn. nov.

Brief description: Length 1.6 to 2.1 mm, head tubular, width about equal to segment 1, body terete slim, segments indistinct; dorsal ridges absent, dorsal projections absent, supernumerary muscles absent; lateral paired lobes segments 8 and 9 absent; dorsal lip smooth, lateral lobes absent, ventral lip median emargination; oral papillae present; jaws small, similar size, shape subrectangular, teeth small, dental formula 5/4; pharyngeal sulci two; glandular atrium tubular ental half dilated slightly, length 0.5x segment diameter, deferent lobes absent; prostate gland tubular, ends 0.8 over glandular atrium, undifferentiated, ental bulb present; muscular atrium terete thick; bursa ovoid, length 0.2x segment diameter; penis protrusible; spermatheca club-like, length 0.7x segment diameter, duct shape tubular, length 0.4x organ, bulb shape ovoid, length 0.4x organ, ental process 0.2x organ (emended).

Variations: Dental formula varied but no range was given by HOLT (1973). GELDER (unpub. obs.) observed a specimen with 4/4 teeth. The two pharyngeal sulci differ in size, one deep midway along the pharynx and a shallower one just posterior to the

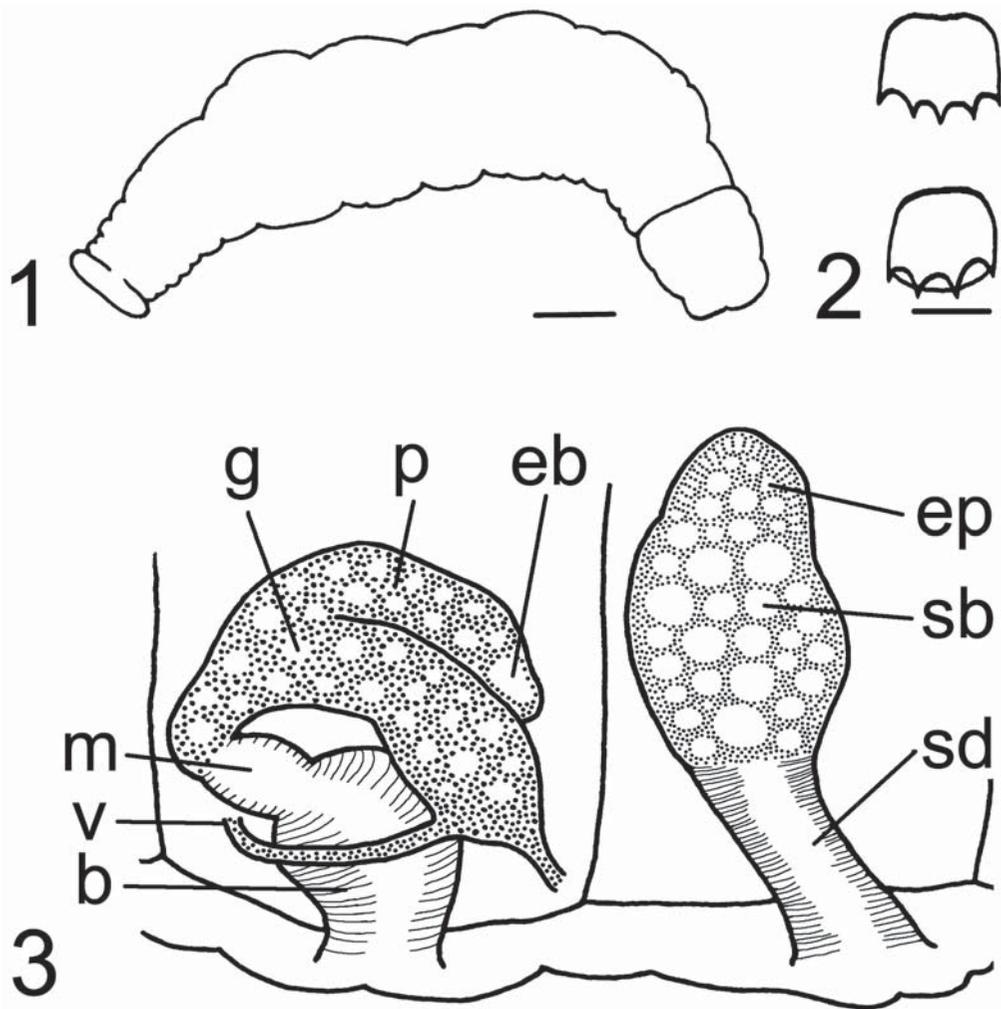


Fig. 1-3. *Forbesodrilus nanagnathus*. 1 – lateral view of holotype, scale bar = 0.2 mm; 2 – jaws (dorsal over ventral, teeth pointing posteriorly), scale bar = 10 µm; 3 – lateral view of male genitalia in segment 6 and spermatheca in segment 5. 1 to 3, redrawn and modified from HOLT (1973); b, bursa, eb, ental bulb, ep, ental process, g, glandular atrium, m, muscular atrium, p, prostate gland, sd, spermathecal bulb, sd, spermathecal duct, v, vas deferens.

jaws. (A pharyngeal sulcus is a transverse, circular invagination of the wall. This can be seen in both dorso-ventral and lateral views of the head; sometimes incorrectly described as a pair.). The prominent ental process described and shown in the type description does not appear as obvious as drawn and so should be considered questionable until additional specimens have been examined.

Microhabitat: External surfaces of hosts.

Hosts: *Potamocarcinus nicaraguensis* RATHBUN, 1893 (freshwater crab), *Tehuana* (= *Pseudothelphusa*) *veracruzana* RODRÍGUEZ and SMALLEY, 1969 (giant shrimp), *Procambarus vasquezae* VILLALOBOS, 1954 (crayfish).

Distribution: Laguna de Catemaco, Playa Azul, and Río Tapalapa, Santiago Tuxtla, south-

ern Veracruz, México; Isleta de Granda, and off the Solentiname Islands, Lago de Nicaragua, Nicaragua.

Discussion

In a review of the cambarincolids, HOLT, OPELL (1993) recognized that with the description of new 'intermediate' species, the number of characters separating some branchiobdellidan genera and species was starting to decrease markedly. HOLT (1982) gave *Cambarincola* and *Sathodrilus* as a particularly good example. The position, connection and shape of the prostate gland in relation to the glandular atrium is a prime character in assigning a species to a genus; however, this is not the only character used to assign

a species to a genus. A prostate arising subectally from the glandular atrium is found in *Ellisodrilus*, *Sathodrilus*, and *Pterodrilus*. In addition to this character, *F. nanagnathus* possess a protrusible penis and so it differs from *Ellisodrilus* which lacks a penis, and from *Sathodrilus* that has only an eversible penis (HOLT 1986). In contrast, the male genitalia in *F. nanagnathus* is strikingly similar to *Pterodrilus missouriensis* and the two taxa also have similar jaw shape, dental formula and body length. However, *F. nanagnathus* lacks the defining pterodrilid dorsal ridge across segment 8 (HOLT 1968, 1973). Known distribution and host affinity also differs between *P. missouriensis* and *F. nanagnathus*. The former species is known from a crayfish, *Orconectes* sp. in Missouri – a second record in Maine (GELDER *et al.* 2002) was the result of introduced crayfish stocking – while *F. nanagnathus* inhabits a range of crustacean hosts (HOLT 1973), *Potamocarcinus nicaraguensis*, *Pseudothelphusa veracruzana* and *Procambarus vazquezae*, in Mesoamerica.

HOLT (1973) suggested *F. nanagnathus* had the closest morphological affinities to *Cambarincola smalley* HOLT, 1964 and *Cambarincola acudentatus* HOLT, 1973. Although neither *Cambarincola* species possessed the characteristic arising prostate gland and other morphological characters listed appear tenuous, all three species are found in Mesoamerica (HOLT 1973). To ensure no other *Cambarincola* species were misplaced, the author examined all published descriptions and figures, and unpublished personal drawing of all *Cambarincola* species. No other *Cambarincola* species were found with the characteristic subectal arising prostate gland, but a number of figures did indicate that some species had the prostate gland arising just anterior to the glandu-

lar and muscular atrial confluence. It would be unwise to speculate how many, if any, of these species should be transferred into the new genus without first examining mounted or live specimens.

Branchiobdellidan taxonomy and phylogeny suffers from a paucity of morphological characters and detail. As a result, additional character sets (e.g., ultrastructural, physiological, genetic) are needed to help resolve intra- and inter-specific affinities. One such set is based on spermatozoan ultrastructure and has been used to assess phylogenetic relationships in the Euclitellata (FERRAGUTI 2000). Our investigation described the spermatozoan ultrastructure of 25 branchiobdellidan species (CARDINI *et al.* 2000, CARDINI, FERRAGUTI 2004, GELDER, FERRAGUTI 2001, 2004) which included six *Cambarincola* species, *F. nanagnathus*, and two *Pterodrilus* species. The most notable results from the investigation showed that branchiobdellidans had a wider variation in spermatozoan ultrastructure than that found in all oligochaetes, and one species had one of the longest spermatozoa known in the animal kingdom. Unfortunately no significant similarities in ultrastructural characters were found between *F. nanagnathus* and either the *Cambarincola* or *Pterodrilus* species.

Placement of *F. nanagnathus* in a new genus has restored conformity to the generic diagnosis of *Cambarincola*. Future examinations of described species and new material will determine if *Forbesodrilus* will continue as the first monotypic branchiobdellidan genus in Mesoamerica.

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