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Morphological variability of *Bathybdella sawyeri* (Hirudinida: Piscicolidae) from hydrothermal vents on the Galápagos Rift and the South East Pacific Rise.

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Abstract:

The deep-sea fish leech *Bathybdella sawyeri* Bureson has recently been collected from two sites on the South East Pacific Rise at approximately 14° and 17°S, 2623–2586 m depth. Leeches were obtained from washings of vent mussels *Bathymodiolus thermophilus* (Mytilidae) and clams *Calyptogena magnifica* (Vesicomyidae) collected with a grab by a submersible, or were found attached to the cheliped of the crab *Cyanograea praedator* (Bythograeidae) collected in baited traps at 14°S. Most individual leeches had morphology typical of *B. sawyeri* as originally described, with suckers of approximately equal size, but all specimens collected from the crab *C. praedator* had unusually large oral suckers that were distinctly larger than the caudal sucker. However, internal morphology of the specimens from *C. praedator* was identical to *B. sawyeri* on the basis of serial sections; thus all specimens were identified as *B. sawyeri*. The only previous report of *B. sawyeri* is from the Galápagos Rift, so these collections extend the range to the South East Pacific Rise.

Key words: Hirudinida, Piscicolidae, East Pacific Rise, hydrothermal vent, *Bathybdella*, Bythograeidae, *Cyanograea*

Introduction

Bathybdella sawyeri Burreson was described from material collected on the first Galápagos Rift Biology Expedition in the eastern Pacific Ocean in 1979 (Burreson 1981). Most specimens collected have been found free in washings from clumps of mussels *Bathymodiolus thermophilus* Kenk & Wilson (Mytiloida: Mytilidae), the clam *Calyplogena magnifica* Boss & Terner (Veneroida: Vesicomidae), or the vestimentiferan tube worm *Riftia pachyptila* Jones (Sabellida: Siboglinidae). *Bathybdella sawyeri* is unusual in a number of respects including depth of capture, high abundance, and reproductive system anatomy. Like all members of the family Piscicolidae, the leech feeds on fish blood as evidenced by nucleated red blood cells in the gut, although no specimen has ever been collected from a fish host. Because of its common association with invertebrates, it seems likely that *B. sawyeri* leaves the fish host after each blood meal and attaches to the hard surface of various invertebrates or other hard substrate until ready to feed again.

Recent collections at two sites along the South East Pacific Rise have extended the range of *B. sawyeri* and also provided specimens from the crab *Cyanagraea praedator* de Saint Laurent (Decapoda: Bythograeidae) that differ from *B. sawyeri* in size of the oral sucker. In this paper we describe the morphological variability and discuss some aspects of the biology of the leech.

Material and Methods

The specimens were collected during the French diving cruise BIOSPEEDO, using R/V *L'Atalante* and D/S *Nautille*, from 31 March to 13 May 2004, Chief scientist D. Jollivet (CNRS, Roscoff), and carried out along the South East Pacific Rise between 7°24'S and 21°33'S (Jollivet et al. 2004) (Fig. 1). The majority of the leech specimens were found free from washings of the bivalves *C. magnifica* and *B. thermophilus* or the crabs *Bythograea thermydron* Williams (Decapoda: Bythograeidae) and *C. praedator* and of what is likely a new genus and species of fish (Ophidiiformes: Bythitidae) collected using the grab of the submarine or with baited traps. Eleven specimens were attached to the cheliped of the crab *C. praedator* collected in baited traps, and two were on the external part of the hinge of a clam *C. magnifica*. Seven specimens came from four dives on the Oasis site (17°25.38'S, 113°12.29'W, 2586 m) and eleven specimens from the Pagoda site (13°59.06'S, 112°28.94'W, 2623 m), nearly 6 km N of Oasis. Onboard, the leeches were fixed either in formalin or in 95% ethanol for DNA analysis.

Material examined

Oasis site, 17°25.38'S, 113°12.29'W, 2586 m.

PL 1582, 22.04.2004, baited trap C2: 1 specimen in formalin, found with 3 crabs *B. thermydron* and 2 bythitid fish gen. et sp. nov. Muséum National d'Histoire Naturelle (MNHN), Paris, France AH1-12VV.

PL 1583, 24.04.2004, basket 1: 1 sp. in formalin, with clams *C. magnifica*, MNHN AH1-13VV.

PL 1586, 27.04.2004, basket 1: 2 sps. in formalin, with mytilid *B. thermophilus*, MNHN AH1-14VV.

PL 1589, 30.04.2004, baited trap B3: 3 sps. in formalin, with 5 crabs *B. thermydron*, MNHN AH1-15VV.

Pagoda site (marker BS 17), 13°59.06'S, 112°28.94'W, 2623 m.

PL 1592, 04.05.2004, baited trap F2: 6 sps. (2 in formalin, 4 in ethanol), on crab *C. praedator*, MNHN AH1-16VV. Baited trap F2: 1 sp. in formalin, serial transverse sections, on crab *C. praedator*. Basket 1: 4 sps. in formalin, on crab *C. praedator*, MNHN AH1-17VV.

In addition to the newly collected specimens, the holotype (USNM 65773) and paratypes (USNM 65774, 65775) of *B. sawyeri* housed in the U. S. National Museum were re-examined, as well as 109 individuals collected on Woods Hole Oceanographic Institution Alvin Dive 884. That dive occurred on January 25, 1979 on the Galápagos Rift (00°47.69'N, 86°07.7'W). Leeches were from washings of tubeworms *R. pachyptila* and bivalves *B. thermophilus*. These leeches are housed at the U. S. National Museum, but are uncatalogued.

Habitat of the hosts

Oasis vent site

The Oasis site is characterized by a milky fluid diffusing from crevices, where the temperature varies between 2 and 7°C, surrounded by a very abundant vent community composed of mussels, *B. thermophilus*, clams, *C. magnifica*, a stalked barnacle, *Neolepas* n. sp., sea anemone *Chondrophellia* cf. *coronata* (Verrill) (Actinostolidae), the crabs *B. thermydron* and *Munidopsis subsquamosa* Henderson (Galatheididae), and a recently described shrimp, *Nematocarcinus burukovskyi* Komai & Segonzac (Nematocarcinidae) (Komai & Segonzac 2005). Numerous fish occur in this environment such as *Ilyophis saldanhai* Karmovskaya & Parin (Synphobranchidae), *Thermychthys hollisi* (Cohen, Rosenblatt & Moser) (Bythitidae) (Nielsen & Cohen in press), a very abundant Ophidiidae species, and one hagfish species.

Pagoda vent site (BS 17)

This site is composed of two black smokers covered by an apparently declining tubeworm polychaete colony (Alvinellidae); temperature varied from 2°C in the vicinity of the black smokers to 10°C near the tubeworm colony. A surprising abundance of the crab *C. praedator* (12 specimens were collected in a baited trap) was observed among the alvinellid colony. A small number of fish (Ophidiidae) was present within 3 m of the trap.

Results

All leeches from the Oasis site were typical *B. sawyeri* with maximum length of 11 mm and suckers of equal size (maximum 1.0 mm in diameter). Photographs taken in life showed them to be colorless except for the red blood in the gut that was visible through the transparent body wall. Most leeches from Oasis were engorged with blood (Fig. 2).

All leeches from Pagoda site were attached to the crab *C. praedator*. They were unusual in that the overall length of the leeches was larger (13 mm) than typical *B. sawyeri* and the oral sucker was distinctly larger than the caudal sucker (Fig. 3). There was little variation in the leeches from Pagoda; they were all 13 mm in length and all had an oral sucker with a diameter of 1.3 mm and a caudal sucker with a diameter of 1.0 mm. A single leech from Pagoda that was serial sectioned transversely for its entire length revealed an internal anatomy identical with *B. sawyeri* in all respects.

All 109 leeches examined from Alvin dive 884 were typical *B. sawyeri* in terms of sucker size, with one possible exception. A single leech, 9 mm in length, had an oral sucker that was larger than the caudal sucker, 0.8 mm vs 0.6 mm. The other leeches were remarkably consistent with the holotype and paratypes of *B. sawyeri* and had suckers that were approximately equal in size.

Discussion

The collections reported here extend the range of *B. sawyeri* from the Galápagos Rift to the South East Pacific Rise, and suggest that the leech is widely distributed at vent sites in the Pacific Ocean. None of the leeches from the Oasis site was sectioned, but externally they are identical to *B. sawyeri*. The leeches from the Pagoda site were not originally identified as *B. sawyeri* because of the large oral sucker. However, the serial sections revealed that the internal anatomy of these leeches is identical to *B. sawyeri*, including 6 pairs of testisacs, and the very unusual reproductive system that has a large bilobed spermatheca connected via conducting tissue to paired, deep lateral invaginations of the epidermis (Burreson 1981). These leeches clearly belong in the genus *Bathydella* based on internal anatomy, but the oral sucker is unusually large for *B. sawyeri*. It is possible that the leeches from the Pagoda site are a separate species of *Bathydella*; however, we have chosen to identify the leeches with the large oral sucker as *B. sawyeri* because the internal anatomy is identical with that species. DNA sequence data will likely be necessary to confirm the identification or provide evidence that it is a separate species.

It is also interesting that all the leeches from Pagoda were collected from the crab *C. praedator*, and none of the leeches from Oasis were collected on this crab. The association with *C. praedator* is likely not specific, however. Many marine leeches are known to associate with decapod crustaceans, mainly for hard surface attachment sites after they leave the fish host, and often for sites of cocoon deposition (Meyer & Barden 1955; Daniels & Sawyer 1975; Sloan et al. 1984; Khan and Paul 1995).

Leeches in the collections reported here were also recovered from clams, supporting the notion that they are attaching to any hard substrate available after leaving the fish host.

Specimens of *B. sawyeri* never have been recovered from a fish host, but few fish have actually been collected from vent sites. Thus, it is tempting to speculate that the leech feeds on the hemolymph of the clam *C. magnifica* or the tube worm *R. pachyptila*. Both these species have hemoglobin free in the hemolymph giving it a red color resembling the red color of the leech gut contents. However, histological sections of the leech gut reveal the abundance of nucleated red blood cells typical in size and morphology to fish red blood cells. Their presence is evidence that *B. sawyeri*, like all other leeches in the family Piscicolidae, feeds on fish blood. Although they were not directly observed on the two Bythitidae fish collected in the baited trap C2 from the Oasis site, these leeches are most probably parasitic of this fish. They may, however, be parasitic also on other fish species present at the sites visited during the BIOSPEEDO cruise between 7°24'S and 21°33'S (Jollivet et al. 2004) including a species of the family Ophidiidae, visible in large numbers on the video documents taken at the same sites, but not captured. Marine leeches vary considerably in their host specificity. Many species occur only on a single species of fish (Burreson 1977), while other species feed on a wide variety of fish hosts (Burreson & Zwerner 1982); the host specificity of *B. sawyeri* is unknown.

The unusually high abundance of *B. sawyeri* at vent sites, noted previously by Burreson (1981), is supported by the collection of over 100 specimens from a single Alvin dive at the Galápagos Rift in 1979. The high abundance of leeches observed on or among invertebrates suggests that *B. sawyeri* leaves the fish host after each blood meal and attaches to any hard substrate available. When ready to feed again individuals must reattach to a fish, but finding a fish host (by random contact) is likely not difficult considering the high abundance of demersal fishes in the vent areas. When ready to reproduce, marine leeches mate and deposit cocoons (egg cases), containing usually a single egg, on any hard substrate available, including the carapaces of decapod crustaceans. A search for clusters of leech cocoons on the hard surface of the various invertebrates or other hard substrate at thermal vent sites should be productive. Almost nothing is known of the biology of *B. sawyeri* at vent sites, but the high abundance of the leech suggests that the life cycle of *B. sawyeri* is completed in the vicinity of the vents, with fish hosts for feeding, and hard substrate for cocoon deposition, in abundance.

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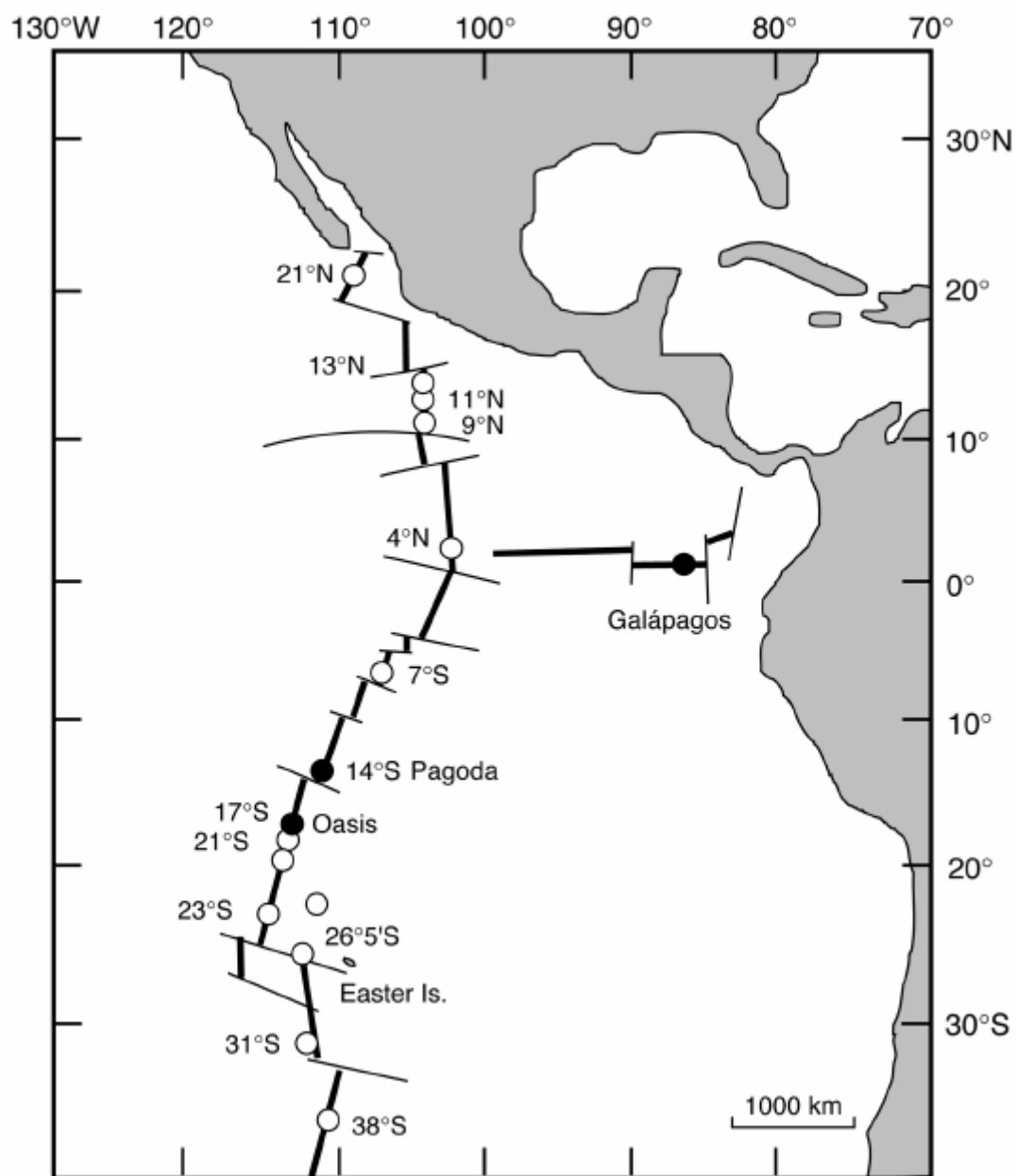
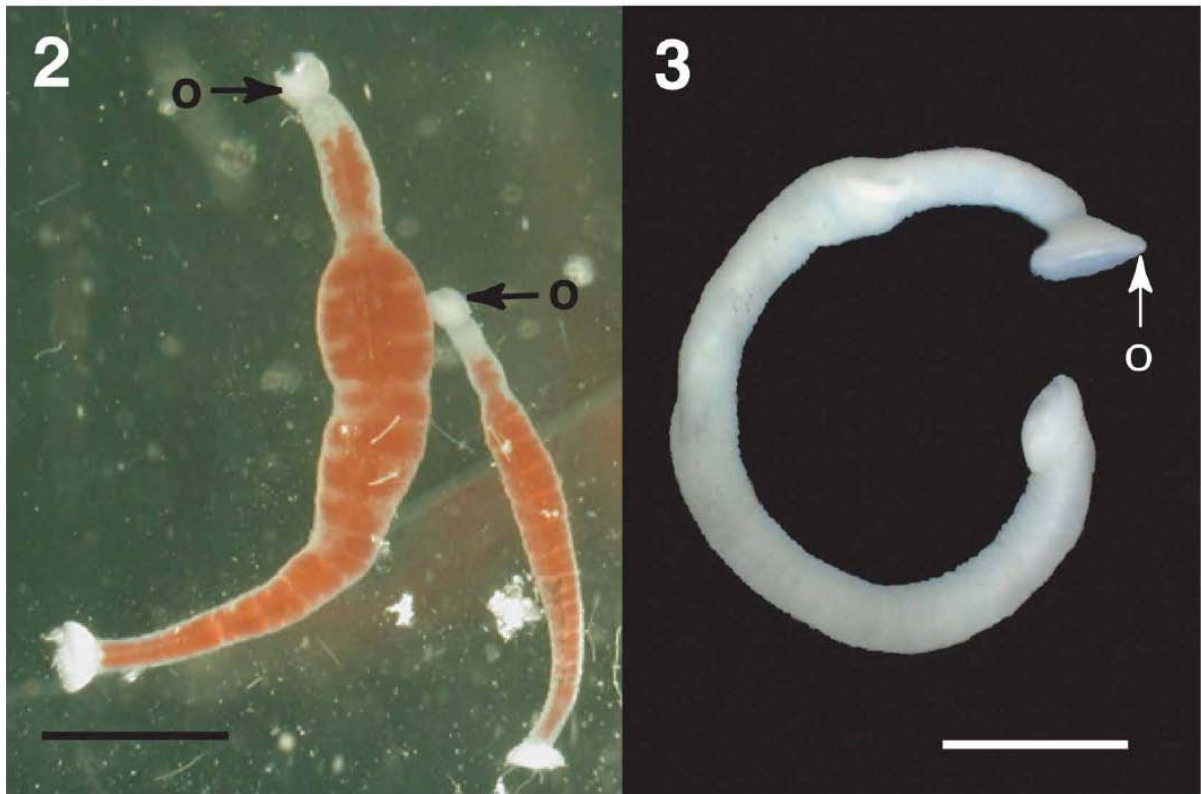


FIGURE 1. Map of collection sites (open circles) on the Galápagos Rift and South East Pacific Rise and the known distribution of *B. sawyeri* (closed circles).



FIGURES 2-3. *Bathybdella sawyeri*. 2: specimens from Oasis showing lack of pigmentation and the gut full of blood, ventral view. 3: specimen from Pagoda taken from the crab *Cyanagraea praedator*, lateral view. o, oral sucker. Scale bars = 2.0 mm.