

ON THE MALE OF *APHANODACTYLUS LOIMIAE* KONISHI & NODA, 1999 (CRUSTACEA: BRACHYURA: PINNOTHEROIDEA: APHANODACTYLIDAE)

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ABSTRACT. – The pinnotheroid genus *Aphanodactylus* currently includes four species, of which *A. loimiae* Konishi & Noda, 1999, was described from Kuroshima Island, Yaeyama Islands, Japan, based on a single ovigerous female. Here, we report the first known male specimen of *A. loimiae*. Characters used by Konishi & Noda (1999) to distinguish species of *Aphanodactylus* are reevaluated and additional distinguishing features are recognized.

KEY WORDS. – Brachyura, Pinnotheridae, *Aphanodactylus loimiae*, sexual dimorphism, Japan.

INTRODUCTION

Four species of the pinnotheroid crab genus, *Aphanodactylus* Tesch, 1918, are currently known (see Ng et al., 2008): *A. sibogae* Tesch, 1918 (type species; type locality: Indonesia), *A. brevipes* (A. Milne-Edwards, 1853) (type locality: Mayotte), *A. edmondsoni* Rathbun, 1932 (type locality: Hawaii), and *A. loimiae* Konishi & Noda, 1999 (type locality: Japan). Ah Yong & Ng (2009) recently referred them to a new family, Aphanodactylidae. All species are from the Indo-Pacific and, where known, are commensal with polychaete worms of the genus *Loimia* (Terebellidae). Only one species is known from Japan, *Aphanodactylus loimiae* Konishi & Noda, 1999, described from an ovigerous female collected from Yaeyama Islands, Ryukyu Islands.

In 1995 and 1999, the third author obtained additional specimens of *A. loimiae* from the Ryukyu Islands, including the first known male, collected by his colleague K. Nomura of the Kushimoto Marine Park, Japan. All three specimens are clearly referable to *A. loimiae*. The male of the species is reported for the first time and aspects of its taxonomy are discussed. Specimens are deposited in the Natural History Museum, Chiba (CBM), Japan; The Naturalis, Nationaal Natuurhistorisch Museum (ex Rijksmuseum van Natuurlijke Historie, RMNH), Leiden; and Zoological Reference

Collection (ZRC) of the Raffles Museum of Biodiversity Research, National University of Singapore. Carapace width and length are abbreviated as cw and cl, respectively. Morphological terminology follows Ah Yong & Ng (2007, 2009). The walking legs, i.e., pereopods 2–5, respectively, are abbreviated as P2–5.

TAXONOMY

Pinnotheridae De Haan, 1833

Aphanodactylus loimiae Konishi & Noda, 1999

Aphanodactylus loimiae Konishi & Noda, 1999: 223–227, Figs. 1, 2 [type locality: Kuroshima Island, Yaeyama Islands, Japan, in tube of *Loimia ingens* Grube, 1878 (Polychaeta)]; Ng et al., 2008: 247 (list); Ng & Naruse, 2009: 284; Ah Yong & Ng, 2009: 36, Figs. 1, 2.

Material examined. – 1 male (10.3 × 7.4 mm), 1 ovigerous female (13.9 × 8.6 mm) (CBM 5341), Kyan, Kuroshima Island, Yaeyama Islands, Ryukyu, Japan, 10 m deep, coral reef, in tube of *Loimia ingens*, 10 Oct. 1999, coll. K. Nomura on SCUBA; 1 ovigerous female (15.3 × 9.1 mm) (CBM 5443), Ahra Beach, Kume-jima Island, Okinawa Islands, Ryukyu, Japan, 10 m deep, coral reef, inhabited in tube of *Loimia ingens*, 15 Jun. 1995, coll. K. Nomura on SCUBA.

Comparative specimens of *Aphanodactylus edmondsoni*. – 1 male (11.5 × 8.2 mm), 1 female (16.9 × 10.2 mm) (ZRC 2000.0542), Oahu, Hawaii, coll. C. H. Edmondson.

Remarks. – Discovery of a male specimen of *Aphanodactylus loimiae* permits documentation of sexual dimorphism in this species. As in other species of *Aphanodactylus*, the carapace of *A. loimiae* is proportionally narrower in the male than females (width: length ratio 1.39 versus 1.62–1.76); the front is more distinctly concave medially; the male chelipeds are more robust than in females; and the male abdomen is narrowly triangular and tapering to a rounded apex. Perhaps the most significant differences between male and female *A. loimiae*, however, are in the shape of the cornea and thoracic sternal structures. The cornea of female *A. loimiae* is a simple oval shape in anterior view, but in males, the cornea is strongly constricted medially, forming a distal bulb. As far as is known for *Aphanodactylus* species, this corneal dimorphism is unique to *A. loimiae*, being neither present in *A. edmondsoni* nor *A. sibogae* (based on Tesch [1918]). Thoracic sternites 5–7 of male *A. loimiae* are separated by deep, wide grooves, whereas in females, the sternites are demarcated by narrow, shallow grooves. As with the corneal dimorphism, the sternal dimorphism in *A. loimiae* is apparently unique in the genus. This sternal differentiation is similar in both sexes in *A. edmondsoni* (present observation), and presumably

also in *A. sibogae*, based on Tesch's (1918) lack of comment on sternal differences. Thus, the unusual corneal shape and deep sternal grooves will immediately distinguish *A. loimiae* from *A. edmondsoni* and *A. sibogae*.

Availability of additional females of *A. loimiae* also permits documentation of intraspecific variation. The carapace width to length ratio of the present females is 1.62–1.68, which is slightly lower than that recorded for the holotype (1.76), and the frontal margin is slightly sinuous rather than straight as recorded by Konishi & Noda (1999). All three specimens examined in this study also differ from the type description of *A. loimiae* in the ventral armature of the meri of the walking legs. Konishi & Noda (1999) recorded 4–6 ventral teeth on the posterior margins of the meri of P2–4 and one prominent tooth and two vestigial ventral teeth on the posterior margins of the merus of P5. The present specimens bear 3–5 ventral teeth on the posterior margins of the meri of P2–4, none of which are prominently enlarged, and no ventral teeth on the merus of P5. These variations in the ambulatory meral armature are presently interpreted as intraspecific variation.

Features used by Konishi & Noda (1999) to distinguish species of *Aphanodactylus* were the width to length ratio of the carapace, dorsal punctuation of the carapace, shape



Fig. 1. *Aphanodactylus loimiae* Konishi & Noda, 1999 (CBM 5341). A, C, dorsal views. B, D, ventral views. A, B, male (10.3 × 7.4 mm); C, D, female (13.9 × 8.6 mm).

Table 1. Comparison of selected morphological features of both sexes of *A. loimiae*, *A. edmondsoni* and *A. sibogae*. Based on Tesch (1918) Edmondson (1946, 1962), Konishi & Noda (1999) and specimens examined herein.

Male	<i>A. loimiae</i>	<i>A. edmondsoni</i>	<i>A. sibogae</i>
cw:cl	1.39	1.40	1.47
Merus P2–4 ventral teeth	4–6	1–3	4
Merus P5 ventral teeth	0	1	0
Sternal grooves	wide, deep	shallow, narrow	shallow, narrow
Female	<i>A. loimiae</i>	<i>A. edmondsoni</i>	<i>A. sibogae</i>
cw:cl	1.62–1.76	1.65–1.69	1.62–1.88
Merus P2–4 ventral teeth	4–6	1–3	?
Merus P5 ventral teeth	0–1 + 2 small vestigial	2	1
Sternal grooves	shallow, narrow	shallow, narrow	shallow, narrow

of the frontal margin (straight or concave), the number of antennular segments, and the ventral armature of the meri of P2–5. Most of the characters used by Konishi & Noda (1999) to distinguish species of *Aphanodactylus* are invalid, though other features are available for species identification. The width to length ratios of the carapace of *A. loimiae*, *A. edmondsoni* and *A. sibogae* are similar to each other in

males, and overlap in females (Table 1). The shape of the carapace front, presence or absence of dorsal pits on the carapace, and antennular segmentation appear to be similar in *A. loimiae*, *A. edmondsoni* and *A. sibogae*. The front is slightly sinuous in females and distinctly sinuous in males of all three species. Similarly, the presence of dorsal pits on the carapace, cited as diagnostic of *A. sibogae* by Konishi

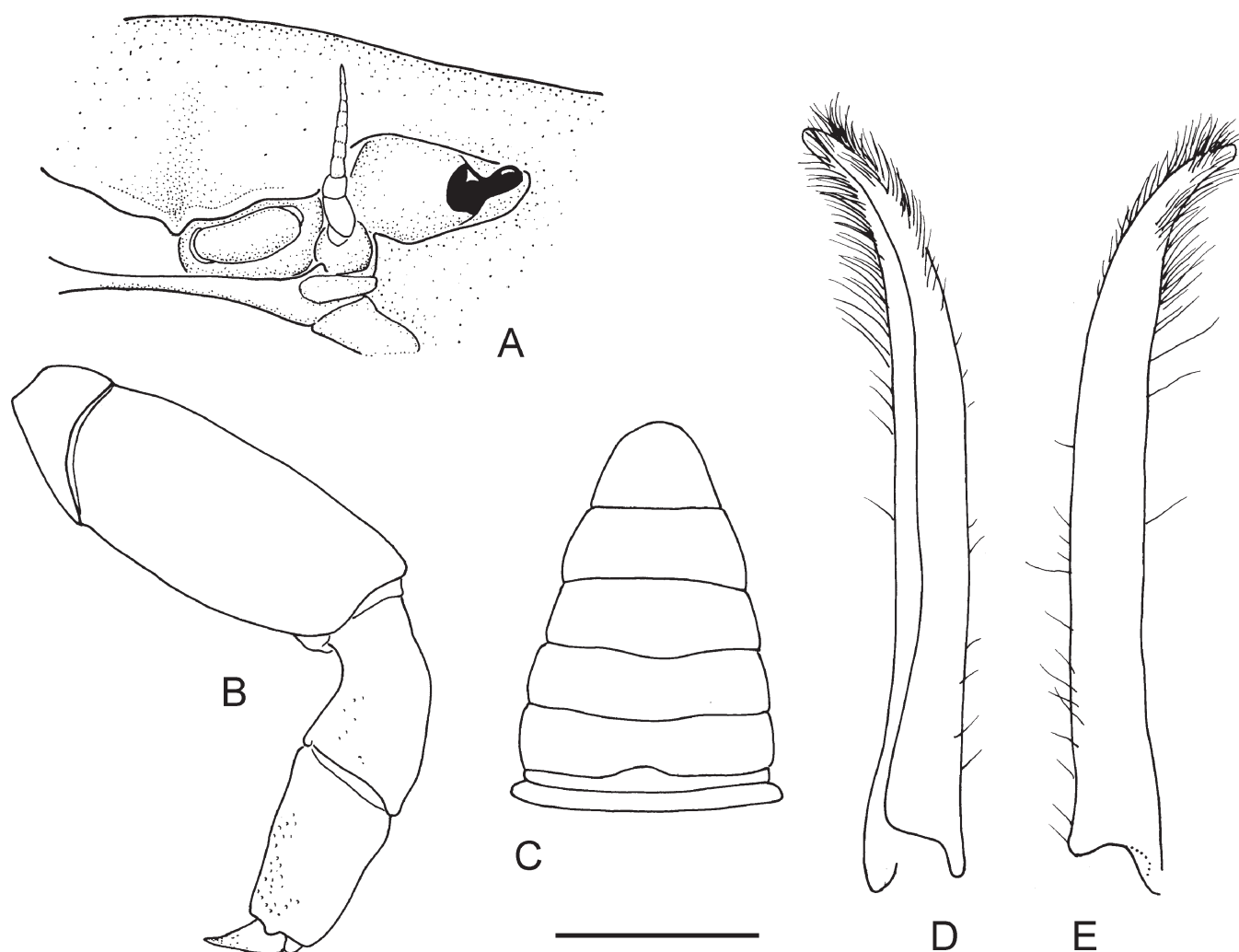


Fig. 2. *Aphanodactylus loimiae* Konishi & Noda, 1999, male (10.3 × 7.4 mm) (CBM 5341). A, left anterior of carapace; B, right P5; C, abdomen; D, E, left G1, abdominal and sternal view, respectively. Scales: A–B = 1.5 mm, C = 3.0 mm, D–E = 1.0 mm.

& Noda (1999) appears to be unreliable — both *A. loimiae* and *A. edmondsoni* have similar pits, but were probably overlooked in the original accounts because the pits are not very deep and can be difficult to observe unless the carapace surface is dried. The carapace pits of *A. sibogae*, as depicted by Tesch (1918), are deeper and more prominent than they actually are. A female syntype of *A. sibogae* (RMNH D2162, cw. 8.8 mm, cl. 5.4 mm) in the Nationaal Natuurhistorisch Museum, Leiden, examined by T. Naruse (National University of Singapore) at our request has very shallow carapace pits, as presently observed in *A. loimiae* and *A. edmondsoni*. The antennular flagellum in all three species appears to number about seven segments. Tesch (1918) cited three segments for female and seven for male *A. sibogae*, but, the low female number is likely to be the result of damage. The differences in meral armature of P2–4 appears to be a useful distinguishing feature, at least for *A. edmondsoni* (1–3 teeth) and *A. loimiae* (4–6 teeth).

Cases & Storch (1981) reported *A. sibogae* from Poro, Camotes Islands, Cebu, Philippines. Although the size and sex of the Cebu specimen was not specifically stated, it appears to be a male with carapace proportions (width: length ratio 1.45) similar to that of male *A. sibogae* reported by Tesch (1918). Notably, Cases & Storch (1918: Fig. 9) did not show dorsal carapace pits, suggesting that if present, the dorsal pits were probably shallow and therefore overlooked. The identity of the Philippines specimen will need to be checked to see if they are really *A. sibogae* or perhaps even *A. loimiae*. Attempts to locate the specimen(s), supposedly in the zoological museum of the University of San Carlos, Cebu City, Philippines, were unsuccessful. The material appears to be lost.

The present specimens of *A. loimiae* were all found to inhabit the tubes of a large polychaete, *Loimia ingens*, as with the holotype (see Konishi & Noda, 1999). The heterosexual pair (CBM-ZC 5341) was collected from the same tube (K. Nomura, pers. comm.). It is still unclear if *Aphanodactylus loimiae* is only found with *Loimia ingens*.

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REFERENCES

- Ahyong, S. T., & P. K. L. Ng. 2007. The pinnotherid type material of Semper (1880), Nauck (1880) and Bürger (1895) (Crustacea: Decapoda: Brachyura). *Raffles Bulletin of Zoology*, Supplement No. **16**: 191–226.
- Ahyong, S. T. & P. K. L. Ng. 2009. Aphanodactylidae, a new family of thoracotreme crabs (Crustacea: Brachyura) symbiotic with polychaete worms. *Zootaxa*, **2289**: 33–47.
- Cases, E. & V. Storch, 1981. Decapods associated with invertebrates from Cebu. *Philippine Scientist*, **18**: 15–26.
- Edmondson, C. H., 1946. Reef and shore fauna of Hawaii. *Occasional Papers of Bernice P. Bishop Museum*, Special Publication **22**: 1–381.
- Edmondson, C. H., 1962. Hawaiian Crustacea: Goneplacidae, Pinnotheridae, Cymopolidae, Ocypodidae, and Gecarcinidae. *Occasional Papers of Bernice P. Bishop Museum*, **23**(1): 1–27.
- Haan, H. M. De, 1833–1849. Crustacea. In: *P. F. von Siebold, Fauna Japonica, sive Descriptio animalium, quae in itinere per Japoniam, jussu et auspiciis superiorum, qui summum in India Batavia imperium tenent, suscepto, annis 1823–1830 collegit, notis, observationibus a adumbrationibus illustravit. Lugduni Batavorum*, fasc. 1–8: I–xxi+vii–xvii+ix–xvi+1–243, Pls. 1–55, A–Q, Circ., Pl. 2.
- Konishi, K. & H. Noda, 1999. A new species of commensal crab genus *Aphanodactylus* (Crustacea: Brachyura: Pinnotheridae) from the Yaeyama Islands, southern Japan. *Publications of the Seto Marine Biological Laboratory*, 38(5/6): 223–229.
- Milne Edwards, H., 1853. Mémoire sur la famille des Ocypodiens. *Suite, Annales des Sciences Naturelles, Zoologie et Biologie Animale*, **20**(3): 163–228, Pls. 6–11.
- Ng, P. K. L., D. Guinot & P. J. F. Davie, 2008. Systema Brachyurorum: Part I. An annotated checklist of extant brachyuran crabs of the world. *Raffles Bulletin of Zoology*, Supplement No. **17**: 1–286.
- Ng, P. K. L. & T. Naruse, 2009. On the identity of Pinnixa brevipes H. Milne Edwards, 1853, and a new species of Aphanodactylus Tesch, 1918 (Crustacea: Decapoda: Brachyura: Pinnotheroidea) from the Philippines. *Raffles Bulletin of Zoology*, Supplement **20**: 283–290.
- Rathbun, M. J., 1932. A new pinnotherid crab from the Hawaiian Islands. *Journal of the Washington Academy of Sciences*, **22**: 181–182.
- Tesch, J. J., 1918. Decapoda Brachyura II. Goneplacidae and Pinnotheridae. *Siboga Expeditie Monographie*, **39c1**: 149–295, Pls. 7–18.

Note added in proof: This paper was supposed to have been published in a supplementary volume of the *Raffles Bulletin* in 2008. As this supplement was badly delayed for a variety of reasons, this paper is published only now; and as such, some of the ideas contained here have since been supplemented by Ng & Naruse (2009) and Ahyong & Ng (2009).