

## A new species of bathyal elasipod sea cucumber from New Zealand (Echinodermata: Holothuroidea)

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**Abstract** *Orphnurgus dorisae* new species is described from bathyal depths to the north of New Zealand, near the Kermadec Islands. It is distinctive in possessing spatulate rods and spinous rods dorsally, and spinous rods and perforated plates ventrally. A key to *Orphnurgus* species is provided. Egg size suggests that this species, and other *Orphnurgus* species, may have planktonic lecithotrophic embryos.

**Keywords** Holothuroidea; New Zealand; new species; *Orphnurgus dorisae*; key to *Orphnurgus*; lecithotrophy

### INTRODUCTION

For almost 50 years, the New Zealand Oceanographic Institute, now incorporated into the National Institute of Water and Atmospheric Research Limited (NIWA), has systematically sampled the seabed in the New Zealand Exclusive Economic Zone, in bathyal to abyssal depths. The several thousand stations occupied have revealed an echinoderm fauna that is far more extensive than formerly believed (see, e.g., Clark & McKnight 2000; Pawson et al. in press), and numerous new taxa of echinoderms, including at least 10 new species of sea cucumbers, have been found. The present paper describes a new species of a typically bathyal elasipod sea cucumber, the description being based on two specimens collected near the Kermadec Islands to the north of New Zealand. This is the first

record of the genus from the New Zealand/Australia region, but it was expected to occur there, as members have been described from South Africa, Hawaii, Indonesia, and other Pacific localities.

### CLASS HOLOTHUROIDEA

Order Elasipodida

Family Deimatidae Ekman, 1926

*Orphnurgus* Théel, 1879

Type species *Orphnurgus asper* Théel, 1879

### Diagnosis

Tentacles 15–20, non-retractile; discs with ramified processes. Circum-oral papillae absent. Ossicles include spatulate crosses and/or rods of greatly varying shape. (After Hansen 1975.)

### Remarks

This genus is bathyal, with a known depth range of 174–1301 m. In his monograph of the elasipod holothurians, Hansen (1975) revised the eight species of *Orphnurgus* known at that time, and recognised just four species; four nominal species were synonymised with *O. glaber* Walsh (1891), which was regarded as having a wide distribution in the central and western Pacific Ocean. Clark (1977) recorded *O. glaber* from off South Africa, considerably extending the known range of the genus. In their treatment of Campagnes MUSORSTOM holothurians from the Philippines, Cherbonnier & Féral (1982) removed *O. insignis* Fisher (1907) from synonymy with *O. glaber* and established it again as a valid species, based on their single Philippines specimen. Cherbonnier & Féral (1982) also described a new species, *O. bacillus*, based on a single Philippines specimen from 174 to 223 m depth. Thandar (1992) recorded three species of *Orphnurgus* from off South Africa: *O. insignis* Fisher, *O. aspersignis* new species (= *O. glaber* in the sense of Clark 1977), and *O. natalasper* new species. Thus, at this time, eight nominal species of *Orphnurgus* are currently recognised.

In this genus the bodywall ossicles are highly variable in type and shape, and it has been difficult to define the limits of some of the species. It is regrettable, but perhaps not unexpected given the variability of the ossicles, that four of the known species (*vitreus* Fisher (1907), *protectus* Sluiter (1901), *bacillus* Cherbonnier & Féral (1982), and *natalasper* Thandar (1992)) are based upon single specimens. The new species described below is represented by just two specimens. Populations of *Orphnurgus* may be scattered on the seabed. Until some growth series of this genus become available, it is difficult to assess the validity of some of the nominal species.

### Distribution

The relatively large egg diameter of 500  $\mu\text{m}$  in the new species described below is not unusual in deep-sea holothurians (Billett 1991). A study of material of *O. glaber* in the National Museum of Natural History, Washington, DC, United States, collections by Doris J. Vance (pers. comm.) revealed an approximate

average egg diameter of 325  $\mu\text{m}$ . Billett (1991) suggests that eggs of this size probably indicate lecithotrophic development. Several authors (see Pearse 1994) have shown that lecithotrophic embryos can be planktonic, and thus might drift for considerable distances in deep currents. Bathyal-dwelling taxa of holothurians show a general tendency to be less widely distributed than their abyssal relatives, although some individual species may have an almost cosmopolitan distribution (see Hansen 1975). With one exception, species of *Orphnurgus* appear to have a limited distribution range. The exceptional species, *O. glaber* Walsh, seems to be widely distributed in the Indo-west-Pacific (Hansen 1975), ranging from the Bay of Bengal in the Indian Ocean to Hawaii in the Pacific Ocean. More detailed analyses would be premature, for vast areas of the bathyal zone across the Indo-Pacific have never been sampled, and it seems likely that other species of *Orphnurgus* are more widely distributed. Further sampling should also throw some light on the validity of the currently recognised species in this genus.

### KEY TO SPECIES OF *ORPHNURGUS*

1. Bodywall ossicles include rods with spatulate extremities ..... 2  
    No spatulate rods in bodywall ..... 5
2. Bodywall ossicles comprise only spatulate crosses ..... *O. protectus* (Sluiter 1901)  
    Bodywall ossicles may include spinous rods or perforated plates, in addition to a few spatulate crosses 3
3. Bodywall ossicles include spinous rods dorsally and ventrally; ventral ossicles include perforated plates ..... *O. dorisae* new species  
    Perforated plates and spinous rods absent from bodywall ..... 4
4. Ventrally, rods with dichotomous ramifications ..... *O. vitreus* (Fisher 1907)  
    Ventrally, spatulate rods reduced to spindles, ellipsoids, and amorphous bodies .... *O. glaber* Walsh 1891
5. Spinous rods present, at least dorsally ..... 6  
    Spinous rods absent; dorsally and ventrally, ossicles mostly smooth rods with a few low terminal spines ..... *O. bacillus* Cherbonnier & Féral 1982
6. Spinous rods, with spines along entire length, present dorsally and ventrally; no other ossicles in bodywall ..... *O. asper* Théel 1879  
    Spinous rods present dorsally only. Other ossicles may include ellipsoids, dumbbell-shaped bodies ..... 7
7. No conspicuous dumbbell-shaped bodies present ventrally. Dorsal ossicles smooth rods, with often spiny dichotomous terminal ramifications; ventral ossicles include rods with terminal ramifications and ellipsoidal to rounded bodies ..... *O. insignis* Fisher 1907  
    Conspicuous dumbbell-shaped bodies ventrally. Dorsal ossicles spinous rods ..... 8
8. Dorsal spinous rods often perforated. Ventrally, rods with spinous ends and conspicuous dumbbell-shaped bodies with spinous ends ..... *O. natalasper* Thandar 1992  
    Dorsally, spinous rods without perforations, and rods with spinous ends. Ventral ossicles include dumbbell-shaped bodies with spinous ends, ellipsoids, and occasional primary crosses .....  
    ..... *O. aspersignis* Thandar 1992

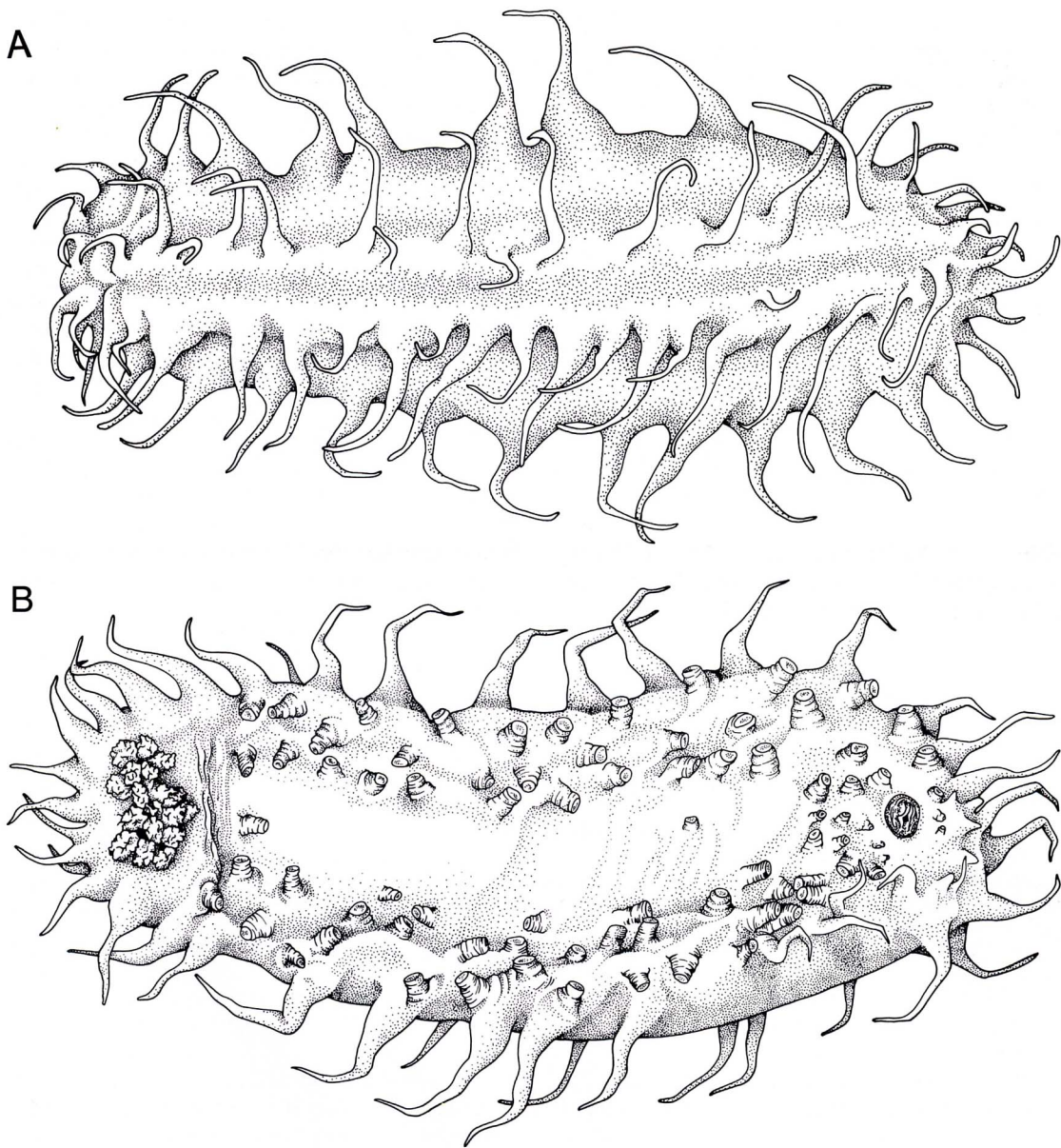


Fig. 1 *Orphnurgus dorisae* n. sp., holotype, 140 mm in total length. A, Dorsal view; B, ventral view.

***Orphnurgus dorisae* n. sp.** (Fig. 1, 2)

**Diagnosis**

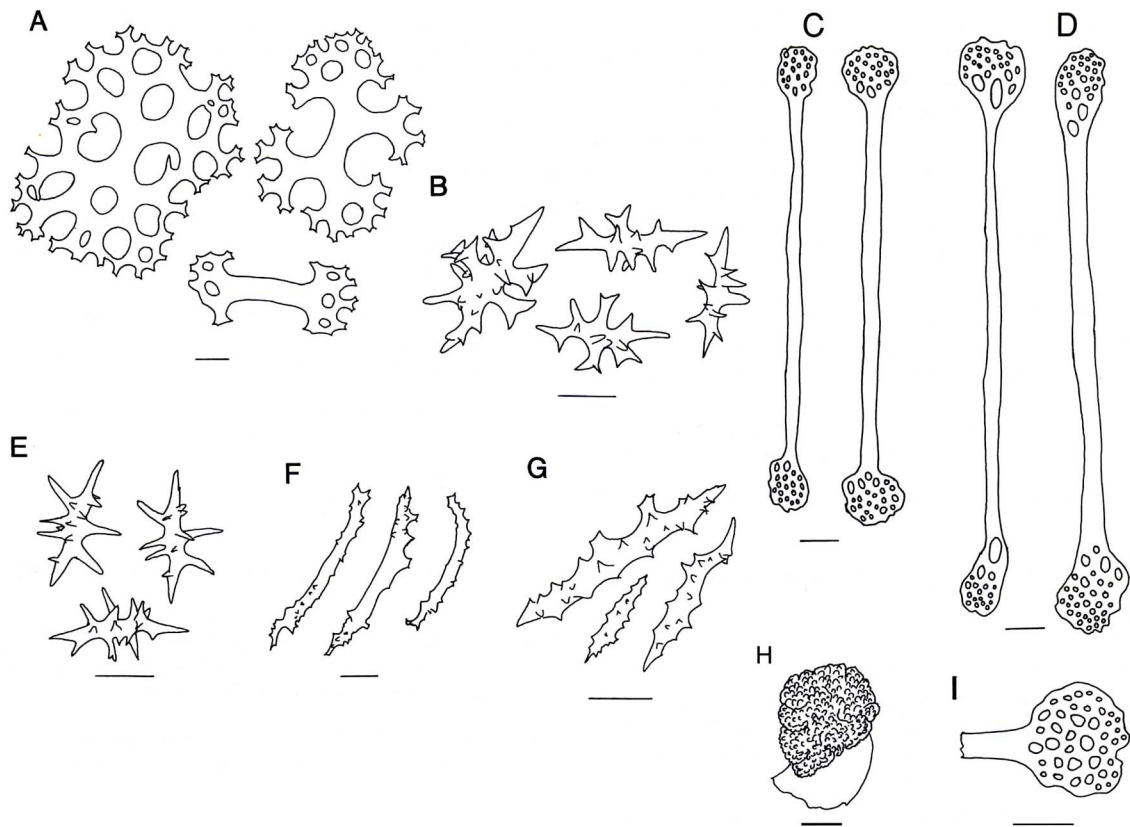
Body cylindrical, up to 140 mm in length. Ventrolateral tube feet 35–46 in each radius. Lateral papillae 14–17. Dorsal papillae 23–26 in each radius. Ossicles spatulate rods and spinous rods dorsally, perforated plates and spinous rods ventrally.

**Etymology**

This species is named for my invaluable research associate Doris J. Vance. The species name is of feminine gender.

**Material examined**

Holotype (deposited at NIWA, Catalogue No. NZOI H-861) and Paratype (deposited at National Museum



**Fig. 2** *Orphnurgus dorisae* n. sp. **A**, Perforated plates from ventral bodywall; **B**, spinous rods from ventral bodywall; **C**, spatulate rods from dorsal bodywall; **D**, spatulate rods from dorsal and lateral projections; **E**, spinous rods from dorsal bodywall; **F**, straight to curved rods from tentacles; **G**, rods from ventral tube feet; **H**, tentacle, showing numerous contracted papillae and ramified process appearing as rounded excrescences; **I**, part of spatulate rod from dorsal bodywall, showing tendency for perforations to become angular. Scale bars in A–G and I are 100  $\mu$ m long; in H the bar is 1 mm long.

of Natural History, Smithsonian Institution, Washington, DC, Catalog No. USNM 1003397) from New Zealand Oceanographic Institute Station K861, west of Kermadec Islands, New Zealand, 30°36.50'S, 178°22.50'W, 30 July 1974, 1030 m.

### Description

Body (Fig. 1) approximately cylindrical, mouth anteroventral, anus posteroventral to terminal. Bodywall stiff, parchment-like, because of presence of immense numbers of ossicles. Conspicuous projections in 1–2 rows along left and right dorsal radii; middorsal interradius naked. Conspicuous lateral projections present. Ventral feet in 2–3 rows, restricted to ventrolateral radii. Midventral radius

essentially naked, with 1–2 feet, and with a few feet posteriorly in vicinity of anus. Tentacles 20. Colour in alcohol uniformly light brown, tips of feet and projections often darker.

Holotype total length 140 mm, breadth 45 mm. Tentacles 20. Ventral feet 8–10 mm long, diameter at distal end 2 mm; left ventral feet 46, right ventral feet 38. Lateral papillae up to 22 mm long; left lateral papillae 14, right lateral papillae 15. Dorsal papillae conspicuous, variable in length, up to 35 mm long; left dorsal papillae 23, right dorsal papillae 25. Paratype total length 130 mm, breadth 45 mm. Tentacles 20. Ventral feet 8–10 mm long, diameter at distal end 2 mm; left ventral feet 39, right ventral feet 35. Lateral papillae up to 22 mm long; left lateral

papillae 17, right lateral papillae 16. Dorsal papillae conspicuous, variable in length, up to 35 mm long; left dorsal papillae 26, right dorsal papillae 25.

Tentacles non-retractile, although papillae and ramified processes on tentacle discs are retractile, in present material appearing as numerous rounded excrescences (Fig. 2H). Gonad of paratype in form of several sacs containing eggs averaging 500  $\mu\text{m}$  in diameter. Other aspects of internal anatomy not studied.

Dorsal bodywall contains spatulate rods (Fig. 2C, I) and spinous rods (Fig. 2E). Spatulate rods of variable length with perforated extremities, the perforations angular when viewed under higher magnification (Fig. 2I). Average length of spatulate rods 1336  $\mu\text{m}$  ( $n = 20$ ; SD 14.36). Spinous rods (Fig. 2E) of average length 249  $\mu\text{m}$  ( $n = 20$ ; SD 2.49). Ventral bodywall with perforated plates (Fig. 2A) and spinous rods (Fig. 2B). Plates range from simple rod-like forms to large flat plates with numerous large perforations; perhaps rod-like forms more common in smaller specimens. Average length of plates 663  $\mu\text{m}$  ( $n = 20$ ; SD 53.94). Spinous rods similar in size to dorsal rods, but more complex, with spines tending to branch (Fig. 2B). Ventral feet contain only rods with short spikes (Fig. 2G), rods greatly variable in length, mostly straight, few slightly curved. Dorsal and lateral projections contain spatulate rods (Fig. 2D) and a few spinous rods, similar to ossicles in dorsal bodywall, although the spatulate rods are larger, averaging 1773  $\mu\text{m}$  in length ( $n = 20$ ; SD 19.18) in dorsal projections, and 1579  $\mu\text{m}$  in length ( $n = 20$ ; SD 18.12) in lateral projections. Tentacles with straight to curved rods (Fig. 2F) with short spines; rods greatly variable in size up to a maximum length of c. 630  $\mu\text{m}$ .

### Remarks

In general body shape this species resembles *O. glaber* Walsh, but this new species is characterised by possession of a unique combination of ossicle types in its bodywall. Of the four species possessing rods with spatulate extremities (see Key above), *O. dorisae* is distinctive in having spatulate rods and spinous rods dorsally, and spinous rods and perforated plates ventrally.

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### REFERENCES

- Billett, D. S. M. 1991: Deep-sea holothurians. *Oceanography and Marine Biology Annual Review* 29: 259–317.
- Cherbonnier, G.; Féral, J.-P. 1982: Echinodermes: Holothuries. *Résultats des Campagnes Musorstom. I. Philippines* 17: 357–412.
- Clark, A. M. 1977: The South African Museum's *Meiring Naude* cruises. 4. Echinoderms. *Annals of the South African Museum* 73(6): 133–147.
- Clark, H. E. S.; McKnight, D. G. 2000: The marine fauna of New Zealand: Echinodermata: Asteroidea (sea stars) Order Paxillosoida. *NIWA Biodiversity Memoir* 116: 5–196.
- Ekman, S. 1926: Systematisch-phylogenetische Studien über Elasipoden und Aspidochiroten. *Zoologische Jahrbucher (Anatomie)* 47: 429–540.
- Fisher, W. K. 1907: The holothurians of the Hawaiian Islands. *Proceedings of the United States National Museum* 32: 637–744.
- Hansen, B. 1975: Systematics and biology of the deep-sea holothurians. Part 1. Elasipoda. *Galathea Report* 13: 1–262.
- Pawson, D. L.; Alcock, N.; Vance, D. J. in press. Aphrodite's gift—New Zealand's sea cucumbers. In: Gordon, D. ed. *Species 2000: New Zealand*. Wellington, NIWA.
- Pearse, J. S. 1994: Cold-water echinoderms break "Thorson's Rule". In: Young, C. M.; Eckelbarger, K. J. ed. *Reproduction, larval biology, and recruitment of the deep-sea benthos*. New York, Columbia University Press. Pp. 26–39.
- Sluiter, C. P. 1901: Neue Holothurien aus der Tief-See des Indischen Archipels. Gesammelt durch die *Siboga Expedition*. *Tijdschrift der Nederlandsche Dierkundige Vereeniging* 2(7): 1–28.
- Thandar, A. S. 1992: The South African Museum's *Meiring Naude* cruises. Part 18. Holothuroidea. *Annals of the South African Museum* 101(7): 159–180.
- Théel, H. 1879: Preliminary report on the Holothuridae of the exploring voyage of H.M.S. Challenger I. *Bihang till K. Svenska Vetenskapsakademiens Handlingar* 5(19): 1–20.

Walsh, J. H. T. 1891: Natural history notes from H.M. Indian Marine Survey Steamer Investigator, No. 24. List of deep-sea holothurians, collected during seasons 1887-91, with descriptions of new species. *Journal of the Asiatic Society of Bengal* 60: 197-204.