

First record of genus *Paradota* Ludwig & Heding in New Zealand waters and description of a new species (Echinodermata: Holothuroidea: Synaptida)

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Abstract

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The genus *Paradota* Ludwig and Heding is recorded in New Zealand waters for the first time; nineteen specimens were found in the Bay of Plenty region of north-east New Zealand. A new species, *Paradota plentyensis* sp. nov. is described and its taxonomic position within the Order Synaptida is considered.

Keywords

Echinodermata, Holothuroidea, *Paradota*, taxonomy, new species.

Introduction

A recent collection from New Zealand's eastern Bay of Plenty yielded 19 purple synaptid holothuroid specimens which lacked any body wall ossicles and did not fit into any known New Zealand genus. New Zealand currently has 12 known species in the three families Chiridotidae Östergren, 1898, Myriotrochidae Théel, 1877 and Synaptidae (Burmeister, 1837), sensu Östergren, 1898 within the order Synaptida Cuénot, 1891 (Mah et al., 2009). Most synaptid species have a worm-like appearance that can make identification quite difficult. Thus, it is likely that many more species exist in the New Zealand Exclusive Economic Zone (EEZ) which may have been misidentified in the early collection stage. Specimens in this order are relatively elusive with many species living buried in sand, mud or under various hard substrates, and are not easily seen in dive or photographic surveys. As exploration of the deep sea environment increases as part of the National Institute of Water and Atmosphere Research Ltd's (NIWA) Oceans 2020 objective to expand the knowledge of New Zealand's ocean resources, and other associated deep sea voyages are undertaken we are starting to find more new species, often with numerous representatives.

To date only three species have been described for the genus *Paradota* Ludwig and Heding, 1935 worldwide: the type species *P. ingolfi* Ludwig and Heding, 1935, from the European and American North Atlantic Coasts, *P. weddellensis* Gutt, 1990 from Antarctic waters, and *P. marionensis* Massin, 1992 from Marion Island in the southern Indian Ocean. The aim of this paper is to provide a first record of the genus

Paradota in New Zealand waters, and to describe a fourth species in this genus. The diagnostic characters of this new species are discussed in the context of other species.

Methods

Specimens were collected by epibenthic sled and box corer from the National Institute of Water and Atmospheric Research (NIWA) research vessel *RV Tangaroa*, and after sorting were immediately preserved in 100% ethanol. Gross external morphology and basic gross internal morphology were studied under a stereomicroscope. In order to extract ossicles, the body tissue sample was dissolved in commercial bleach and initially studied with light microscopy (Nikon YS2-H). Ossicles were further examined by scanning electron microscopy (SEM) using a Hitachi TM3000 table top using the high vacuum mode at 15kV. Clean ossicles were mounted on a stud, air-dried and then coated with gold. Photos and length and width measurements of any ossicle types seen were taken using both microscope methods. All specimens were registered within the NIWA Invertebrate Collection using the prefix NIWA.

Abbreviations

NIWA National Institute of Water and Atmospheric Research Ltd, Wellington, New Zealand. TANXXXX/xx. Voyage abbreviation and station number for *RV Tangaroa* research voyages undertaken by NIWA. Followed by year of the voyage, trip number and station number.

Systematics

Order **Synaptida** Cuénot, 1891

Diagnosis. (Smirnov, 2012) As for subclass Synaptacea Cuénot, 1891.

“Usually worm-like Holothuroidea. Tentacles peltato-digitate, digitate, pinnate, or can be secondarily simplified, simple or forked. Radial canals absent; tubefeet and anal papillae absent; canals of tentacles extending from the ambulacral ring; ampullae of tentacles are not free hanging into the body cavity. No radial hemal canals. Ring muscles not interrupted by radial muscle bands. The suborder Synaptina has organs of balance (5 pairs of statocysts) in places where radial nerves extend from the neural ring. Topographically, the primary tentacles are arranged in the way that they were initially connected with the following now missing radial canals: two with medioventral, two with the left dorsal, and one—with the right dorsal. The stone canal is attached to the body wall and opens externally or terminates in the body wall or opens into the body cavity. Respiratory trees absent. The mesentery supporting the posterior loop of the intestine is attached to the body wall in the right ventral interradius. Longitudinal muscle bands are undivided. The calcareous ring is stout. The radial and interradius segments are usually similar in shape and size. Radial segments of the ring in their upper (anterior) part have a perforation for a nerve, or sometimes it is secondarily not closed on the top and is in a shape of notch (in paedomorphic species, the segments are simple, without an anterior projection, while the radial segments do not have a perforation, or a notch for passage of the nerve). Ossicles: myritrochid or chyridotid wheels, sigmoids, anchors and anchor plates. There are no tables.”

Remarks. A recent review by Smirnov (2012) into the system of class Holothuroidea resulted in changes including four new subclasses and associated orders. The order Synaptida replaces what was previously known as Apodida Brandt, 1835 and it contains the two suborders Myritrochina Smirnov, 1998 and Synaptina Smirnov, 1998. *Paradota* belongs in the latter suborder and the Family Chiridotidae Østergren, 1898.

Suborder **Synaptina** Smirnov, 1998

Family **Chiridotidae** Østergren, 1898

Diagnosis (Smirnov, 2012). “Synaptina with 10, 12 or 18 peltato-digitate, pinnate, or secondarily simple tentacles with forked terminations. Ossicles: chiridotid wheels and/or sigmoids. Chiridotid wheels with six spokes, numerous small denticles on the inner rim and complex hub. The lower side of each spoke branches toward lower side of the egg-shaped hub to form a star-shaped structure in the centre. The tentacles and the body wall also contain rod-like ossicles with branching ends.”

Genus **Paradota** Ludwig and Heding, 1935

Diagnosis. (Ludwig and Heding, 1935, translated by M. Reich, 10/2013; emended here). Tentacles 12, palmate in shape. Calcareous ring consists of regular flat calcareous plates with

radial pieces which are usually perforated and with muscle insertion areas at the outer side. Polian vesicles numerous; ciliated funnels small and occurrence sparse. Calcareous ossicles completely missing in the body wall (except for the anterior part close to the tentacles), but present in the tentacles in the form of small rods.

Type species

P. ingolffi Ludwig and Heding, 1935: 150

Remarks. The original diagnosis for *Paradota* stated that species have 15 tentacles, yet the genus type *P. ingolffi* only has 12 tentacles. This anomaly was discussed by Gutt (1990), who noted that all *Paradota* species, including type species *P. ingolffi*, have 12 tentacles. The new species described here, *P. plentyensis* sp. nov. also has only 12 tentacles, altering this diagnostic character in Ludwig and Heding (1935). The diagnosis given here has been emended accordingly.

Paradota plentyensis sp. nov.

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Figure 1A–D, Table 1.

Material examined. Holotype. New Zealand, Bay of Plenty, White Island: NIWA 87163, Stn TAN1206/144, 37.53° S, 177.29° E, 1182 m, 28/04/2012. *Paratypes.* NIWA 83152 (13 specimens); same station data as holotype.

Other material. New Zealand, Bay of Plenty, Tauranga Canyon: NIWA 82999 (1 specimen) Stn TAN1206/113, 37.25° S, 176.97° E, 1222 m, 25/04/2012. Bay of Plenty, White Island: NIWA 83167 (1 specimen) Stn TAN1206/145, 37.52° S, 177.30° E, 918–1003 m, 28/04/2012. NIWA 83224 (1 specimen) Stn TAN1206/152, 37.55° S, 177.27° E, 918–1003 m, 28/04/2012. NIWA 87164 (2 specimens) Stn TAN1206/144, 37.53° S, 177.29° E, 1182 m, 28/04/2012.

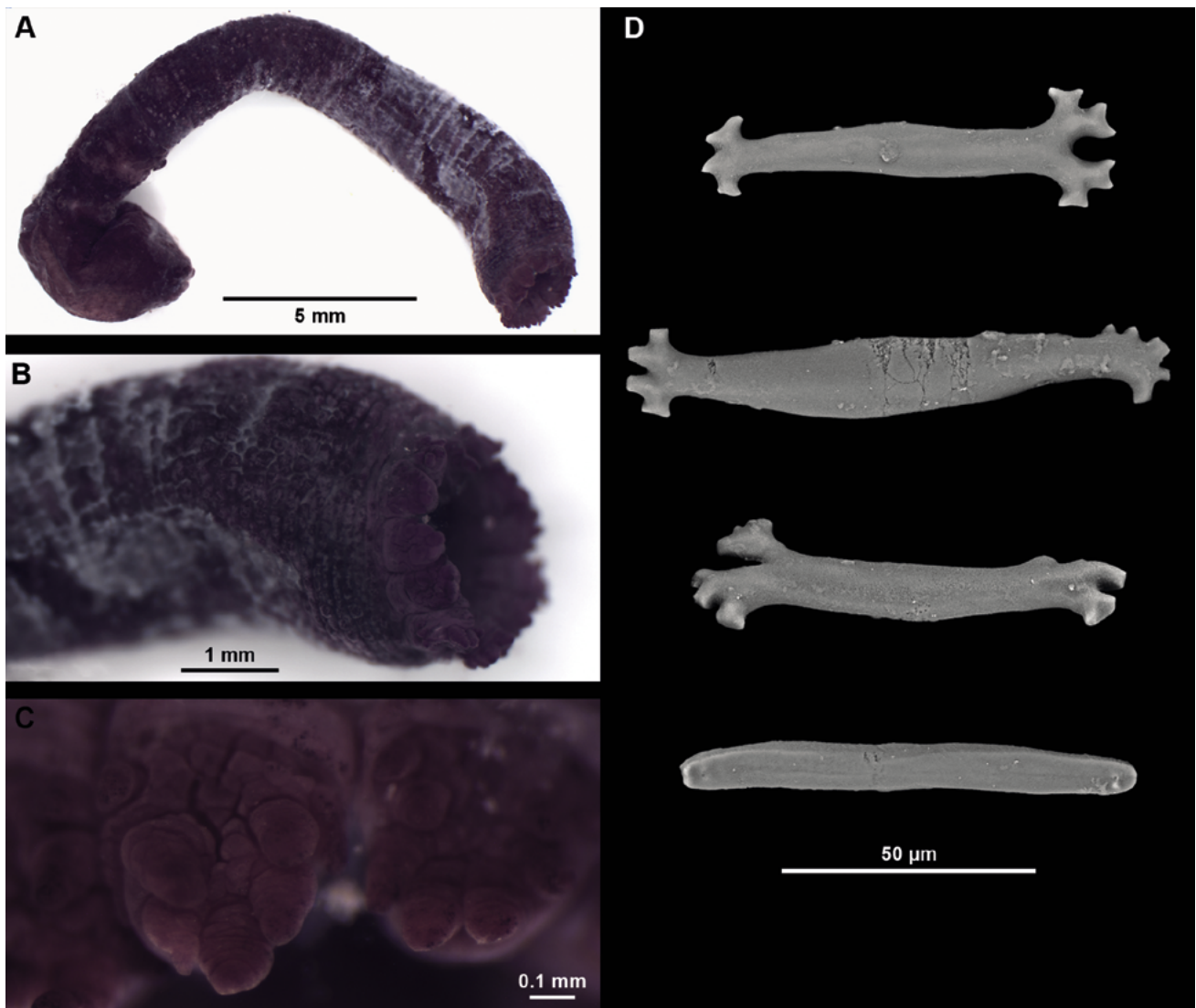
Description of holotype. *Paradota* species 20 mm long, 4 mm wide, 4 mm high (preserved). Body form long, cylindrical with slightly bulbous posterior end (possible preservation artefact), bulbous end skin is thinner than rest of the body. Skin contracted, covered in small papillae giving a granular texture. No tube feet. Mouth is terminal, surrounded by a tentacle crown with 12 equal sized tentacles of peltato-digitate shape with 4–5 digits per side of each tentacle, which become smaller nearer the tentacle trunk.

Paratypes follow the general description above with the following differences: specimens are up to 40 mm long, 4 mm wide and 4 mm high (preserved). The bulbous end can be either anteriorly or posteriorly located.

Due to the small size of specimens the paratypes were extensively dissected. Internally the majority of the coelomic cavity is occupied by sediment filled intestine. The longitudinal muscles are large, up to 2 mm high and wide, divided. One large (1.5 mm) polian vesicle (structure responsible for maintaining water vascular system pressure) is present with 2–3 smaller thinner ones. Gonads not visible in dissected specimens but tubule like strands present posteriorly which may be undeveloped gonad material. Calcareous ring consists

Table 1. Morphological characters for all species in the *Paradota* genus.

	Location	Tentacle ossicle rod shape	Miliary granule present	Colour (preserved)	Polian vesicle number	Depth of occurrence	Number of tentacle digits (each side)	Tentacle rod length
<i>Paradota ingolfi</i> Ludwig and Heding, 1935	European and American North Atlantic Coast	curved	Not mentioned	Pale body with darker tentacles (no specific colour given)	>1	1750 m	7–9	200 μm
<i>Paradota weddellensis</i> Gutt, 1990	Antarctica	curved	No	Pale red/violet	>1	646–661 m	5–7	60 μm
<i>Paradota marionensis</i> Massin, 1992	Southern Indian Ocean.	'C' shaped	No	Purplish-white/ Opaque	1	237–243 m	5–7	50–100 μm
<i>Paradota plentyensis</i> sp. nov.	New Zealand	straight	Yes	Dark purple	>1	1182 m	4–5	70 μm

Figure 1. *Paradota plentyensis* sp. nov. holotype (A–D, NIWA 87163): A, specimen view; B, anterior view including tentacle crown; C, close up of tentacles showing 10 lobes; D, ossicle rods from tentacles.

of 12 large square pieces, radial and interradial pieces evenly sized, some radial pieces have a perforation in the upper part, posterior rim undulating.

The only ossicles present are in the tentacles and the longitudinal muscles. The body wall proper is completely devoid of ossicles. Ossicles of tentacles— smooth rods to slightly curved branched rods with varying degrees of branching distally: up to 70 μm length and 15 μm width. Ossicles of longitudinal muscles are miliary granules—smooth, oval, baton to rod-shaped: up 70 μm length and 10 μm width.

Colour. Deep purple (preserved and live)

Etymology. Named for the Bay of Plenty in the North Island of New Zealand as the type locality and presently the only known distribution for this species.

Distribution. New Zealand, Bay of Plenty, 918–1222 m.

Remarks. The lack of ossicles in the body wall and associated number of tentacles immediately indicated that we had encountered a new genus in New Zealand waters. There are three known genera within the Chiridotidae that are devoid of body wall ossicles: *Achiridota* Clark, 1908 which has 12 tentacles and is completely devoid of any ossicles; *Kolostoneura* Becher, 1909 which has 10 tentacles which do contain ossicles; *Paradota* with 12 tentacles and tentacle ossicles. Already known from New Zealand shallow waters is *Kolostoneura novae-zealandiae* Dendy and Hindle, 1907 with 10 tentacles. Our new species clearly falls into the genus *Paradota*.

Three species have been previously described for this genus. Our new species differs from them all (Table 1). Firstly the type species *P. ingolfi* from European and American North Atlantic Coast has tentacle rods which are similar in appearance to *P. plentyensis* with straight smooth lengths and branching at the extremities. However the tentacles rods are much longer (200 μm compared to 100 μm) in *P. ingolfi*.

Secondly, *P. weddellensis* Gutt, 1990 has been described from Antarctic waters. This species differs from *P. plentyensis* as it does not have miliary granules in the longitudinal muscles and the tentacle ossicles are more curved. *P. weddellensis* is a pale red to pale purple colouration compared to the deep even purple colour (live and preserved) found in *P. plentyensis*. *Paradota marionensis* Massin, 1992 was described from Marion Island in the Southern Indian Ocean. This species has similar tentacle arrangement and polian vesicles to *P. plentyensis* but is an opaque pale purple. The calcareous ring is almost identical to our new species. The tentacle ossicles are distinctly more curved in *P. marionensis* forming an almost complete 'C'.

With a combination of the features described above we have a new species and a first encounter of the *Paradota* genus in New Zealand waters.

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