

Report

First record of *Postenterogonia orbicularis* (Schmarda, 1859) (Platyhelminthes: Polycladida) from the North Pacific

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Abstract

Here, I report a record of *Postenterogonia orbicularis* (Schmarda, 1859) based on the specimens collected from Kochi, Japan. So far, *P. orbicularis* has been recorded from New Zealand; this is the first record of the species from the North Pacific. In this study, I describe the anatomical characters of copulatory apparatuses and provide a partial sequence of the mitochondrial cytochrome *c* oxidase subunit I (COI) gene as a DNA barcode for the Japanese specimens.

Keywords: Acotylea, DNA barcoding, genito-intestinal duct, taxonomy

Introduction

Postenterogonia orbicularis (Schmarda, 1859) is the only species in the genus *Postenterogonia* Faubel, 1983. The species is characterized by the presence of a small prostatic vesicle in the male copulatory apparatus and a genito-intestinal duct, a duct connecting the vagina and the intestine, in the female copulatory apparatus (Holleman 2007). The species was initially described as *Polycelis orbicularis* Schmarda, 1859. Stummer-Traunfels (1933) re-observed Schmarda's (1859) specimens and indicated that the species was identical to *Enterogonia pigrans* var. *novae-zealandiae* Bock, 1925. Stummer-Traunfels (1933) transferred the species to *Enterogonia* Haswell, 1907 as *Enterogonia orbicularis*. Later, Faubel (1983) established a new genus, *Postenterogonia*, for this species because of the difference in morphology of the male copulatory apparatus between *E. orbicularis* and *Enterogonia pigrans* Haswell, 1907, the type species of *Enterogonia*. Currently, Faubel's (1983) taxonomic opinion is adopted, although Prudhoe (1982, 1985) has a different opinion for this species (cf. Holleman 2007).

During a faunal survey of polyclad flatworms in Kochi, Japan, I found polyclads identified with *P. orbicularis* from the oyster beds in shallow water. So far, *P. orbicularis* is only recorded from New Zealand (Holleman 2007). In this study, I report the species for the first time in the North Pacific. In addition, I provide a partial sequence of the cytochrome *c* oxidase subunit I (COI) gene as a DNA barcode of the Japanese specimens.

Materials and methods

Ten individuals were collected from Usa, Kochi, Japan. The specimens were anesthetized in a MgCl₂ solution prepared with tap water so that it had the same salinity as the seawater, and then photographed with a digital camera. For DNA extraction, a piece of the body margin was cut away from the specimen and fixed in 100% ethanol. The rest of the body was fixed in Bouin's solution for 24 h and preserved in 70% ethanol. The body size and the pharynx length were measured from the photographs of the anesthetized specimens using ImageJ (Rasband 1997–2022).

Two specimens were employed for histological observation. The posterior half of the body was dehydrated in an ethanol series and cleared in xylene. The cleared specimens were embedded in paraffin wax, then sagittally sectioned at 7- μ m thickness. The sections were stained with hematoxylin and eosin, and mounted in Entellan New (Merck, Germany).

Total DNA was extracted using a DNeasy Blood & Tissue Kit (Qiagen, Germany) from two specimens. As a reference for DNA barcoding, a partial sequence of the cytochrome *c* oxidase subunit I (COI) gene (712 bp) was determined following the protocol by Oya and Kajihara (2017). Sequences were checked and edited using MEGA ver. 7.0 (Kumar et al. 2016).

The voucher slides of two specimens have been deposited in the Invertebrate Collection of the Hokkaido University Museum (ICHUM), Sapporo, Japan. Unsectioned specimens have not been deposited in a museum as they are used for other research. All sequences determined in this study have been deposited in DDBJ/EMBL/GenBank databases with the accession numbers LC734096–LC734097.

Taxonomy

Postenterogonia orbicularis (Schmarda, 1859)

(Fig. 1)

Synonyms

Polycelis orbicularis Schmarda, 1859: p. 20, pl. 3, fig. 43 [Chile; actually New Zealand according to Stummer-Trautfels (1933)]; Lang (1884), p. 504 [secondary literature].

Leptoplana orbicularis: Diesing (1862), p. 527 [secondary literature].

Enterogonia pigrans var. *novae-zealandiae* Bock, 1925: pp. 142–154, text-figs. 27–31, pl. 3, fig. 17, pl. 4, figs. 24, 31–32 [Ponui Island, New Zealand].

Enterogonia orbicularis: Stummer-Trautfels (1933), pp. 3486, 3511–3514, text-figs. 37–43 [re-observation of type specimen].

Postenterogonia orbicularis: Faubel (1983), p. 40 [secondary literature]; Holleman (2007), pp. 2–3,

figs. 1–3 [Leigh Marine Research Laboratory, Whangateau Bay, and Point Chevalier, New Zealand].

Material examined

Ten specimens were collected from Kochi, Japan: seven (one sagittally sectioned specimen, ICHUM 8417, 8 slides; six unsectioned specimens) from the oyster beds on a mooring rope in Usa port (33°26'26"N, 133°26'16"E) on 25 July 2019; three (one sagittally sectioned specimen, ICHUM 8418, 12 slides; two unsectioned specimens) from the oyster beds on a stone in the intertidal zone (33°26'21"N, 133°26'29"E) on 12 June 2021.

Description

External morphology (10 specimens). Live specimens 12–28 mm in length, 8.4–19 mm in width. Body oval, slightly narrow toward posterior end. Small dark brown spots scattered on dorsal surface; no spots on ventral surface (Fig. 1A, B). General appearance brownish (Fig. 1A). Pharynx reffled in shape, 6.3–11 mm in length, located at center of body. Pairs of sperm ducts and oviducts visible whitish (Fig. 1B).

Nuchal tentacles not observed in anesthetized state (Fig. 1C). Cerebro-frontal eyespots, marginal eyespots distributing whole body margin, and tentacular eyespots present.

Internal morphology (two specimens). Male copulatory apparatus lacking seminal vesicle (Fig. 1D). Pair of sperm ducts uniting and forming common sperm duct, latter entering reduced prostatic vesicle. Prostatic vesicle with thin muscular wall lined with thin glandular epithelium (Fig. 1E). Penis papilla large, conical, projecting into male atrium. Male atrium lined with ciliated epithelium.

Female copulatory apparatus consisting of genito-intestinal duct and vagina; Lang's vesicle, vaginal duct, bursa copulatrix absent (Fig. 1F). Common oviduct running postero-dorsally to enter vagina. From this point, genito-intestinal duct running posteriorly to enter intestine (Fig. 1F, G). Genito-intestinal duct and vagina lined with ciliated epithelium.

Sequences. The uncorrected *p*-distance of the partial COI sequences (712 bp) of the two specimens (LC734096–LC734097) were 0.007.

Habitat. Oyster beds in shallow water.

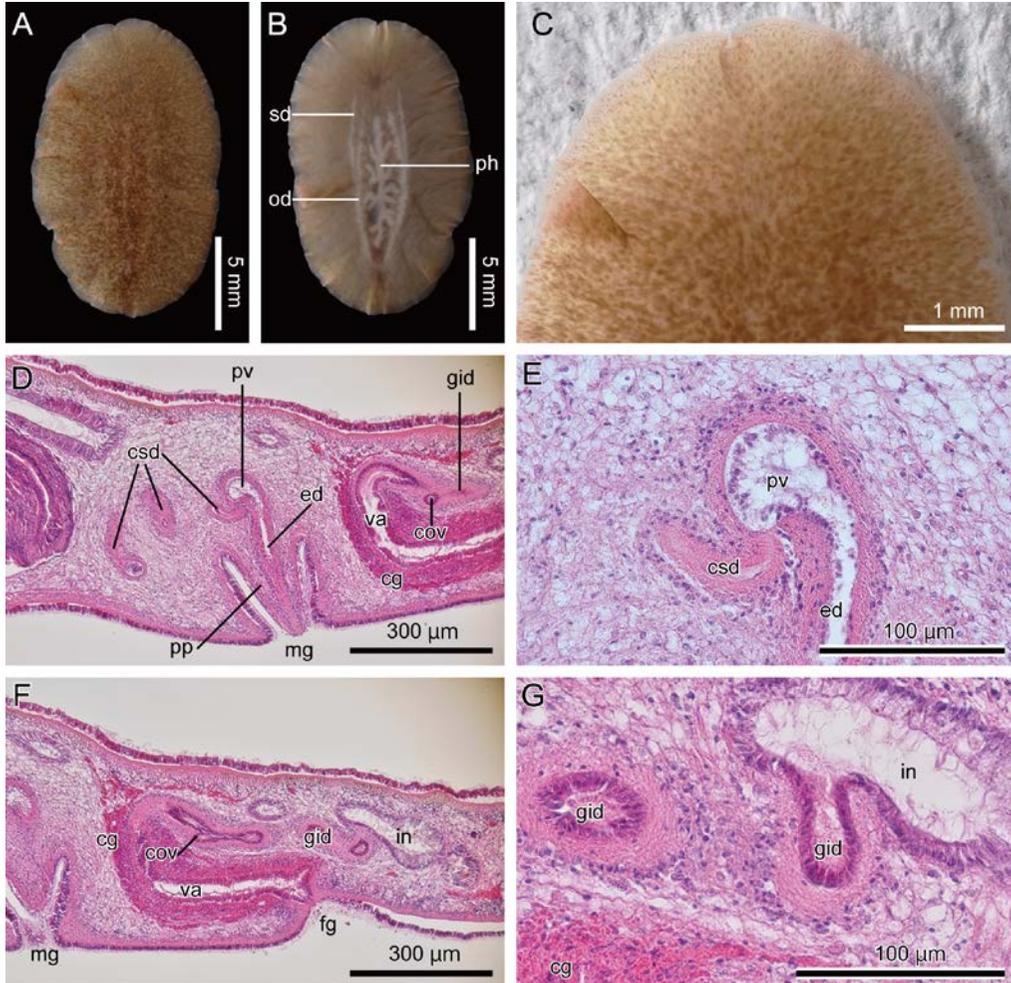


Figure 1. *Postenterogonia orbicularis* (Schmarda, 1859), ICHUM 8418, photographs taken in life (A–C) and histological sections of copulatory apparatuses (D–G). A, dorsal view; B, ventral view; C, head; D, male copulatory apparatus; E, prostatic vesicle; F, female copulatory apparatus; G, connection between genito-intestinal duct and intestine. Abbreviations: cg, cement gland; cov, common oviduct; csd, common sperm duct; ed, ejaculatory duct; fg, female gonopore; gid, genito-intestinal duct; in, intestine; mg, male gonopore; ov, oviduct; ph, pharynx; pp, penis papilla; pv, prostatic vesicle; sd, sperm duct; va, vagina.

Remarks

This is the first record of *Postenterogonia orbicularis* from the North Pacific. The species was initially identified in New Zealand by Schmarda (1859). Schmarda (1859) described the locality of the species as Chile; however, Stummer-Traunfels (1933) noted that the specimens were

collected from New Zealand. The anatomical characters of copulatory apparatuses of my specimens are consistent with those in the type specimens re-described by Stummer-Traunfels (1933, text-figs. 42, 43) and other specimens observed by Bock (1925, text-figs. 29, 30, pl. 4, figs. 24, 30, 31) and Holleman (2007, fig. 3). Genetic comparisons between the present specimens and specimens collected from New Zealand are a future challenge because genetic information (e.g., COI) of the latter is not available.

The fact that *P. orbicularis* shows a geographically separated distribution may simply be due to a lack of information. In pseudocerotid polyclads, not a few species are widely distributed in the Indo-Pacific region (e.g., Marquina, Aguado and Noreña 2015). It is difficult to confidently distinguish the present flatworms from other polyclads, especially stylochoid polyclads, without histological observations because *P. orbicularis* lacks conspicuous characters in the external morphology. It is quite possible that *P. orbicularis* could be found if detailed surveys of polyclads with histological observations are conducted in the blank areas of the distribution. Needless to say, the comparison of molecular data of the specimens is also important.

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References

- Bock, S. (1925). Papers from Dr. Th. Mortensen's Pacific Expedition 1914–1916. XXVII. Planarians, Part IV. New stylochids. *Videnskabelige Meddelelser fra Dansk naturhistorisk Forening i Kjøbenhavn*. 79, pp 97–184.
- Diesing, K.M. (1862). Revision der Turbellarien. Abtheilung: Dendrocoelen. *Sitzungsberichte der mathematisch-naturwissenschaftliche Classe der Kaiserlichen Akademie der Wissenschaften*. 44, pp 485–578.
- Faubel, A. (1983). The Polycladida, Turbellaria. Proposal and establishment of a new system. Part I. The Acotylea. *Mitteilungen des hamburgischen zoologischen Museums und Instituts*. 80, pp 17–121.
- Haswell, W.A. (1907). Observations on Australasian polyclads. *Transactions of the Linnean Society*

- of London, Zoology*. 9 (2), pp 465–485.
- Holleman, J.J. (2007). Some New Zealand polyclads (Platyhelminthes, Polycladida). *Zootaxa*. 1560 (1), pp 1–17.
- Kumar, S., Stecher, G., Tamura, K. (2016). MEGA7: molecular evolutionary genetics analysis version 7.0 for bigger datasets. *Molecular Biology and Evolution*. 33 (7), pp 1870–1874.
- Lang, A. (1884). *Die Polycladen (Seeplanarien) des Golfes von Neapel und der angrenzenden Meeresabschnitte. Eine Monographie*. Leipzig: W. Engelmann.
- Marquina, D., Aguado, M.T., Noreña, C. (2015). New records of Cotylea (Polycladida, Platyhelminthes) from Lizard Island, Great Barrier Reef, Australia, with remarks on the distribution of the *Pseudoceros* Lang, 1884 and *Pseudobiceros* Faubel, 1984 species of the Indo-Pacific Marine Region. *Zootaxa*. 4019 (1), pp 354–377.
- Oya, Y., Kajihara, H. (2017). Description of a new *Notocomplana* species (Platyhelminthes: Acotylea), new combination and new records of Polycladida from the northeastern Sea of Japan, with a comparison of two different barcoding markers. *Zootaxa*. 4282 (3), pp 526–542.
- Prudhoe, S. (1982). Polyclad turbellarians from the southern coasts of Australia. *Records of Southern Australian Museum*. 18, pp 361–384.
- Prudhoe, S. (1985). *A Monograph on Polyclad Turbellaria*. Oxford: Oxford University Press.
- Rasband, W.S. (1997–2022). ImageJ. U. S. National Institutes of Health, Bethesda, Maryland. Available from: <https://imagej.nih.gov/ij/> (accessed 1 August 2022).
- Schmarda, L.K. (1859). *Neue wirbellose Thiere beobachtet und gesammelt auf einer Reise um die Erde 1853 bis 1857. Bd. I. Turbellarien, Rotatorien und Anneliden*. Leipzig: W. Engelmann.
- Stummer-Trautfels, R. (1933). Polycladida. In H.G. Bronn (Ed.), *Klassen und Ordnungen des Thier-Reichs, Vol 4, 1c. Akademische Verlagsgesellschaft Geest and Portig* (pp. 3485–3596). Leipzig: C.F. Winter.