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A new species of pseudocerotid flatworm (Platyhelminthes, Polycladida) from the Indo-Pacific

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Abstract—A new species of pseudocerotid flatworm *Pseudoceros indicus* nov. sp. (Platyhelminthes, Polycladida) is described. This species was found to be widespread and abundant from Chuuk Lagoon, Micronesia, common from eastern Australia and Papua New Guinea, and rare from the Indian Ocean. There has been much confusion over the name of this and similarly patterned species. Remarks on other pseudocerotids from Micronesia are also presented.

Introduction

Polyclad flatworms are common inhabitants of tropical reefs and their color patterns often rival those of nudibranch molluscs, for which they are often mistaken (Newman & Cannon 1994, Newman et al. 1994, Ang & Newman 1998). For all their interest, these turbellarians remain poorly studied. Polyclads are notoriously difficult to fix, but adequate fixation is critical for histological examination of the reproductive structures. Furthermore, many species have been described from immature or damaged specimens, and their color patterns have not been accurately documented. Species records and museum type material are often scarce.

There is surprisingly little known regarding the polyclad flatworm fauna of Micronesia. Only Kato (1943), Hyman (1955, 1959) and Newman and Cannon (1997) have published reports on the polyclads from this region. According to Newman et al. (in press) 29 polyclad species are known from Micronesia, 8 of which belong to the Pseudocerotidae. Within *Pseudoceros*, only four of these species (*Pseudoceros ferrugineus, P. fuscogriseus, P. perviolaceus* and *P. tristriatus*) all described by Hyman 1959, are considered valid (see Newman & Cannon 1994, Newman et al. 2002).

In contrast, Newman & Cannon (1994, 1995a, 1998) and Newman & Anderson (1997) recognize 47 species of *Pseudoceros* worldwide, the majority of these occur in the Indo-Pacific. They are commonly associated with their prey, colonial ascidians growing under ledges subtidally or under rocks and rubble intertidally. Little is known about the ecology of these turbellarians.

Pseudocerotids appear to be wide-spread widehyphenspread throughout the Indo-Pacific and many species are quite common (Newman & Cannon, 1994) yet the past literature has been so confusing that several relatively common species remain incorrectly named. The new species, *P. indicus* nov. sp., is described here and confusion over two similarly patterned species is discussed.

Material and methods

Specimens were hand collected inshore from under rubble at the reef crest or by snorkeling in shallow waters. Animals were photographed *in situ* and in the laboratory, fixed on frozen polyclad fixative (see Newman & Cannon, 1995b), and preserved in 70% ethanol for histological preparations. Whole mounts were stained with Mayer's haemalum, dehydrated in graded alcohol and then mounted in Canada balsam. Longitudinal serial sections of the reproductive region were obtained from specimens embedded in Paraplast (56ºC), sectioned at 5-7 µm, and then stained with Mayer's haemalum and eosin Y solution.

Measurements of the body were taken from live animals in a quiescent state and are given as length mm x width in mm. Measurements can only be used as a general guide due to the 'plastic' nature of these animals. Diagrammatic reconstruction of the reproductive system is given and is derived from the sections with minimal interpretation.

Color descriptions are based on live animals, and definitions of the color terms used are given in Newman & Cannon (1994). Drawings were made with the aid of a camera lucida by Kylie Jennings and Leslie Newman. Specimens were collected and photographed by Leslie Newman, Andrew Flowers, and Peter Schupp. This material is lodged at the Queensland Museum (QM) as whole mounts (WM), serial sections (LS), and wet specimens (S). Color transparencies are held by Leslie Newman and Peter Schupp.

***Pseudoceros* Lang, 1884**

***Pseudoceros indicus*, nov. sp.**

(Figures 1-5)

Pseudoceros unidentified sp. Stummer-Traunfels, 1933: 3565, fig. 16.
Pseudoceros concinnus (Collingwood, 1876) Prudhoe, 1989:79, fig. 21a,b,c

Material examined. Holotype: WM (QM G210855), inshore, under oyster rubble, Dunwich, Stradbroke Island, Moreton Bay, southeast Queensland, Australia, Clare Peterken, 10 September 1991.

Paratype — LS (QM G210932), same data.

Other material — WM (QM G210854), inshore, under rubble, Wellington Point, Redland Bay, southeast Queensland, Australia, S. Leys, damaged, 28 January 1991; WM (QM G210933), inshore, under boulder, Nagada Harbour, Madang, Papua New Guinea, Leslie Newman & Andrew Flowers, 3 June 1992; WM (QM G210856), low tide, in tidal pool, north Pig Island, Madang, Papua New Guinea, Leslie Newman & Andrew Flowers, 7 June 1992; WM (QM G210857), inshore, under rocks, Nagada Harbour, Madang, Papua New Guinea, Leslie Newman & Andrew Flowers 2 July 1992; WM (QM G210858), same data, 26 April 1994; S (QM G210988) same data, 30 April, 1994; S (QM G210987), same data, May 1994; S 2 specimens (QM G211100), 1 — 2 m, on mangrove roots, west Weno Island, Chuuk Lagoon, Micronesia, P. Schupp, Nov. 1994; S 2 specimens (QM G211137), same data; S 2 specimens, (QM G211139), same data; LS(QM G210934), inshore, under rocks on pink ascidian, north Palfrey Island, Lizard Island lagoon, northern Great Barrier Reef, Australia, Hugh & Carolyn Peterken, 1 April 1995; S, (QM G210985) under coral rubble, Mud Is., Moreton Bay, southeast Queensland, Australia, P. Fernside, 1 October 1995; S (QM G210986), under rubble, inshore, under oyster rubble, Dunwich, Stradbroke Island, Moreton Bay, southeast Queensland, Australia, Leslie Newman & Andrew Flowers, 27 October 1995: S (QM G211136), inshore, under rocks, Maudís Bay, north Coral Bay, Ningaloo Reef, Western Australia, Leslie Newman & Andrew Flowers, 9 May 1996. Record: Photograph only, Trincomalee, Sri Lanka, Charles Anderson, March 1995.

Diagnosis. Cream colored with blue or dark purple distinct spots along the margin.

Description. Body elongate, oval and leaf-like in shape. Background mottled cream and opaque white with well defined, separate, royal blue or dark purple spots along margin, spots uneven in size and spacing (Figs. 1-3). Spots continue over the pseudotentacles. Ventrally cream with tinge of pink (maybe due to prey), margin with blue or dark purple spots. Cerebral eyespot with about 40 eyes in a horseshoe shaped cluster. Size range: 6 x 3 mm (immature) to 40 x 29 mm (mature) with an average size of 23 x 8 mm (N = 44, STD = 1.4 mm and 0.3 mm respectively) (Schupp et al. 1999).

Vas deferens unbranched (Fig. 4). Seminal vesicle rounded oblong (985 µm long); ejaculatory duct short, coiled; prostatic vesicle round (340 µm wide); stylet long and narrow (360 µm long and 50 µm wide); stylet length: width ratio = 1: 7.2 (Fig. 5). Male antrum moderately deep and voluminous, female antrum shallow.

Etymology. Named from the Latin (masculine), *indicus* = blue ink, for the color of its distinctive spots.

Remarks. Confusion has arisen over two similarly patterned *Pseudoceros* species. *Pseudoceros gamblei* Laidlaw 1902 (p. 297, fig. 69a,b) was originally described from the Laccadives, Indian Ocean as “milk white or transparent flesh coloured with purple or dark blue rims”. However, Marcus (1950) placed

this species in the genus *Dicteros* Jacubowa, 1906 since it lacks a true prostate gland. This is surprising since Laidlaw (1902 pl. XV fig. 18) clearly illustrates a prostate gland for this species. Subsequently Faubel (1984) placed *P. gamblei* in the genus *Pseudoceros* although the type material (if it exists) at all was not re-examined. In comparison, *P. indicus* possesses distinct blue or dark purple spots along the margin rather than a continuous purple rim.

Further confusion has arisen over *P. concinnus* (Collingwood 1876: 90, pl. 17, fig. 4) which was clearly described as "cream-colored, approaching yellow,

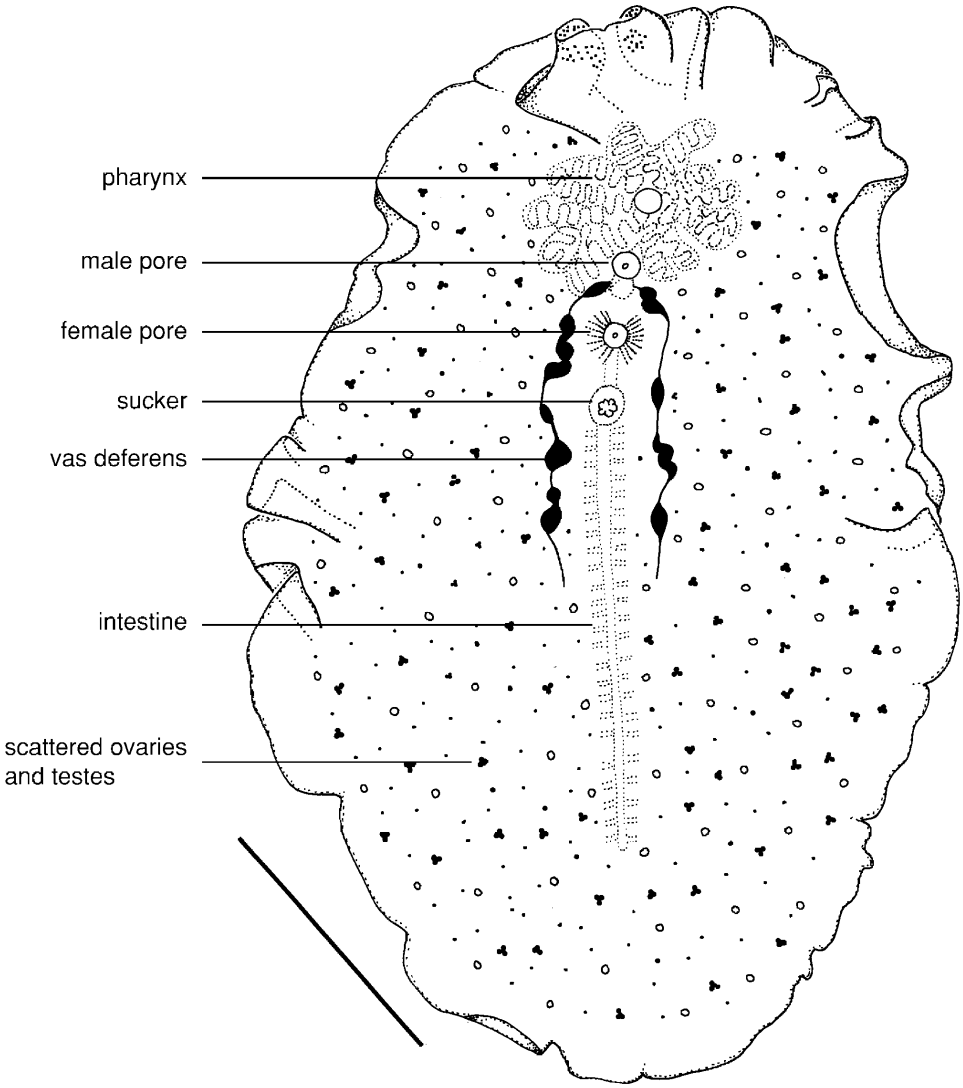

Fig. 4 *Pseudoceros indicus* nov. sp., wholemount of the holotype from the ventral side. Bar = 5 mm.

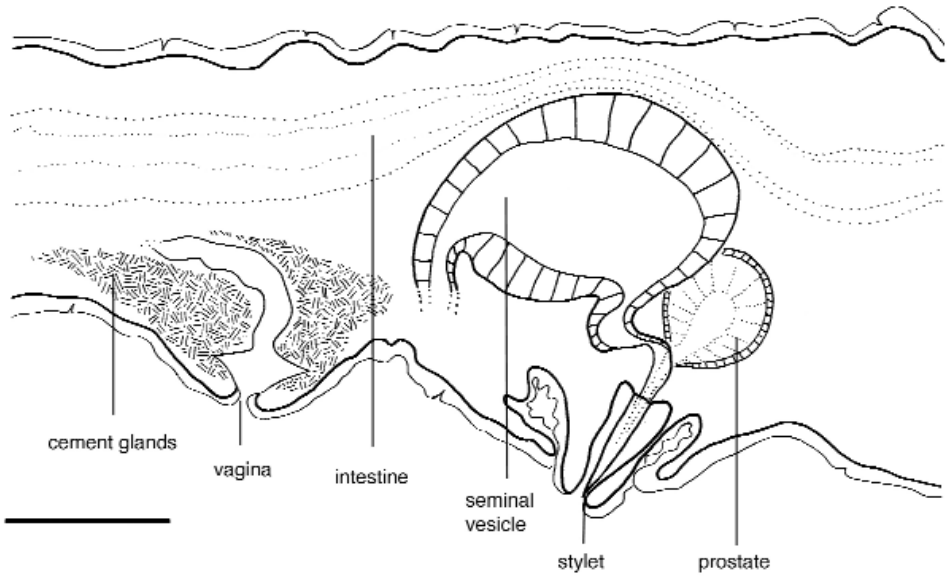

Fig. 5 *Pseudoceros indicus* nov. sp., reconstruction of the reproductive anatomy of the paratype. Bar = 500 µm.

with an edging of blue all around, composed of small and larger spots running into one another. A similar blue streak runs along the median line from a little behind the head to some distance from the posterior extremity…". Furthermore, Collingwood stated that this animal possessed an "arbusculiform alimentary tube". According to Newman & Cannon (1994, 1996a, b) several genera possess an arbusculiform or ruffled pharynx. However, it is unclear if this animal belongs to *Pseudoceros* sensu strictu since morphological details of the pseudotentacles, pharynx or reproductive system are not given. We believe this species must be now considered incertae sedis. Furthermore, *Pseudoceros indicus* clearly lacks a blue median stripe.

Prudhoe (1989:79 fig. 21a) clearly illustrated this species from Mozambique but incorrectly named it *P. concinnus* (Collingwood 1876). He described his specimens from a watercolor painting as only having blue spots at regular intervals along the margin.

Habitat, Distribution and Ecology. Abundant on mangrove roots, 1 – 2 m depth, feeding on the white colonial ascidian, *Eudistoma toealensis* Monniot and Monniot 1996 and the yellowish, colonial ascidian, *E. viride* Monniot and Monniot 1996, from Moen, Chuuk Lagoon, Micronesia (Schupp et al. 1999). Also common under rocks covered with live and dead oysters from mud flats at low tide from Moreton Bay, southeast Queensland and rare from under coral rubble, inshore at Lizard Island Lagoon, northern Great Barrier Reef Australia; Ningaloo Reef, Western Australia and Madang, Papua New Guinea. Recorded from Mozambique (Prudhoe 1989) and Sri Lanka, India Ocean.

According to Schupp et al. (1999), analysis of secondary metabolite composition in *P. indicus* revealed that it incorporated and accumulated the secondary metabolites from the ascidians. Specimens collected from *E. viride* contained only compounds from *E. viride* and likewise specimens found on *E. toealensis* had only *E. toealensis* secondary metabolites. Whether this represents a very selective feeding mode, specializing on one ascidian species only, or very short retention or fast excretion times of the incorporated secondary metabolites remains to be determined. Both ascidian crude extracts demonstrated potent feeding deterrent properties against common reef fishes. Thus *P. indicus* might use the incorporated and accumulated ascidian compounds as a defense against possible fish predators (Schupp et al. 1999).

Discussion

It is apparent that *P. indicus* is well distributed throughout the Indo-Pacific as it was found in the Indian Ocean from Mozambique, Sri Lanka, and Western Australia, and in the Pacific Ocean from Papua New Guinea, eastern Australia and Micronesia. The abundance of this species, especially in Micronesia, is clearly related to the abundance of its ascidian prey (Schupp et al. 1999).

There has been much confusion in the literature over the color pattern of this and similarly patterned species. Obviously another species with a blue margin and blue median stripe exists (Newman unpubl data) and has been confused in the past with *P. indicus*.

Furthermore, within the Pseudocerotidae, species have been recognised solely on the basis of their color patterns (Newman & Cannon 1994, 1995a, 1998). Reliability of the use these color patterns for species diagnosis has been confirmed with molecular data (Goggin & Newman 1996; Litvaitis & Newman in press). It is therefore imperative that species are examined live, preferably in situ, and their color patterns accurately recorded. As well, samples should be collected for molecular studies. The biodiversity of polyclads from Micronesian waters is only just being understood. Further studies are needed especially regarding the biology and ecology of these marine predators.

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