

A new subfamily, new genus and new species of terrestrial flatworm (Platyhelminthes: Tricladida: Geoplanidae) from Stewart Island, New Zealand

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ABSTRACT: Within the context of ongoing taxonomic revisions of terrestrial flatworms from the Australia–New Zealand region: the new genus *Eudoxiatopoplana* is erected; the new species *Eudoxiatopoplana bilaticlavia* is described from Stewart Island; and the new subfamily Eudoxiatopoplaninae is erected within the family Geoplanidae.

KEYWORDS: Taxonomy, Eudoxiatopoplaninae, new subfamily, *Eudoxiatopoplana bilaticlavia*, new genus, new species, resorptive bursa.

Introduction

To date, only three species of terrestrial flatworms are known from Stewart Island, New Zealand, all of which were found in modified habitat: *Arthurdendyus australis* (Dendy, 1894), from nurseries and agricultural land; and *A. testaceus* (Hutton, 1880) and *A. triangulatus* (Dendy, 1894), from nurseries (Johns & Boag 2003). In the Museum of New Zealand Te Papa Tongarewa collection of terrestrial flatworms from the Subantarctic and other islands presently being studied by the author (Winsor 2006), there is a single specimen from Stewart Island. This paper concerns the description of this specimen, considered here to be an endemic new genus and new species of terrestrial flatworm accommodated in a new subfamily of the Geoplanidae.

Materials and methods

The specimen selected for histology was processed to paraffin wax, longitudinally sagittally (LSS) and transversely sectioned (TS) at 8 µm, and stained using the MSB (Martius scarlet blue) method (Winsor 1998a,b). Nomenclature of

the stripe pattern follows the scheme of Graff (1899: 25). Determination of the cutaneous and parenchymal muscular indices (CMI, PMI) follows Winsor (1983). Nomenclature and type of adenodactyl follows Winsor (1998b). The specimen is held in the collections of the Museum of New Zealand Te Papa Tongarewa, Wellington (MONZ).

Abbreviations used in figures

ad	adenodactyl
bd	bursal duct
cm	cutaneous musculature
cod	common ovovitelline duct
cs	creeping sole
dsv	distal seminal vesicle
ed	ejaculatory duct
fa	female antrum
fg	female genital canal
gp	gonopore
ip	inverted penis
in	intestine
ma	male antrum
mo	mouth

nc	nerve cord
ovd	ovovitelline duct
ph	pharynx
php	pharyngeal pouch
pm	parenchymal musculature (ring zone)
psv	proximal seminal vesicle
rb	resorptive bursa
rh	rhammites
sd	sperm duct
sdv	spermiducal vesicle
sg	shell glands
te	testis
vd	vas deferens

Systematics

Family Geoplanidae Stimpson, 1857

Eudoxiatopoplana new genus

DIAGNOSIS: Geoplanid with a small, robust body, lanceolate, broader posteriorly than anteriorly, sub-cylindrical in cross section. Mouth situated just behind mid-body, gonopore closer to mouth than to posterior end. Eyes in multiple rows around anterior tip and dorso-anteriorly, extending the length of the body. Sensorial margin passes antero-ventrally around the anterior tip. Sensory papillae absent. Anterior adhesive cup, sucker absent. Creeping sole non-ciliated, 31% of body width. Cutaneous musculature tripartite, with circular, helical and longitudinal muscles; longitudinal muscles in well-defined bundles; dorsal cutaneous musculature almost double of that ventrally, CMI 4.4–6.5%. Parenchymal longitudinal muscles present as a massive ring zone, PMI 38.5%, stronger ventrally than dorsally and intersected by a closely woven meshwork of oblique-transverse and dorso-ventral muscles fibres. Testes dorsal, extending from behind ovaries to posterior end. Efferent ducts ventral. Penis inverted type. Ovaries in anterior body third. Ovitelline ducts unite then enter female genital canal ventro-posteriorly (postflex condition). Female genital canal enters antrum horizontally. Resorptive bursa present. Adenodactyl present. Viscid gland absent.

TYPE SPECIES: *Eudoxiatopoplana bilaticlavata* new species.

ETYMOLOGY: The name *Eudoxiatopoplana* is composed of *Eudoxia* (Greek = honoured), *atopos* (Greek = out of place, strange) and *plana* (Latin = flat, planarian). Gender: feminine. It honours Emeritus Professor Eudoxia Maria Froehlich (Departamento de Zoologia, Universidade de São Paulo, Brazil) for her outstanding contribution to the study of

terrestrial flatworms for over 55 years and for her friendship with the author for the past 35 years. It also alludes to generic characters – particularly the dorsal testes, eye pattern and musculature that are usually associated with taxa from the Neotropical and Oriental zoogeographic regions – that, until now, had not been reported from the Australia–New Zealand region. Suggested vernacular name: *Eudoxia*'s strange flatworm.

DISTRIBUTION: Stewart Island, New Zealand.

Systematic discussion

Until recently, the suborder Tricladida (Platyhelminthes) was divided taxonomically into four ecologically based infraorders: *Maricola* (marine planarians); *Paludicola* (fresh-water planarians); *Cavernicola* (cave-dwelling planarians); and the *Terricola* (terrestrial planarians). However, molecular analyses of planarian flatworms have caused rethinking of these infraorders; whilst the *Maricola* are clearly monophyletic, it has been demonstrated that the *Paludicola* are paraphyletic, the *Terricola* being the sister group to one of the three paludicolan families, the *Dugesiiidae* (Álvarez-Presas *et al.* 2008). As a consequence of these analyses a new higher classification of the paludicolan and terricolan flatworms is urgently required, and will be proposed in the near future (Ronald Sluys, pers. comm. 2008). Pending the publication of a new classification of planarian flatworms, the following systematic discussion reflects the current traditional taxonomy of the *Terricola*.

The Geoplanidae, to which all native terrestrial flatworms of New Zealand and its Subantarctic Islands belong, is defined as 'Terricola with numerous small eyes concentrated around the anterior, and along the sides, sometimes located dorsally, or without eyes; without auricular or tentacular organs, or semilunar headplate' (Ogren & Kawakatsu 1990). This family presently comprises four sub-families: the Geoplaninae (Ogren & Kawakatsu 1990: 83), which occur largely in South and Central America; the Caenoplaninae (Ogren & Kawakatsu 1991: 28, emended by Winsor 2006), centred mainly in the Australo-Pacific region; the Pelmatoplaninae (Ogren & Kawakatsu 1991: 33) in the Southeast Asia–Indo-Pacific region; and the Anzoplaninae (Winsor 2006) from Australia, New Zealand and the Subantarctic Islands.

With multiple eyes concentrated around the anterior end, dorsally and along the sides, and without auricular or tentacular organs or a semilunar headplate, *Eudoxiatopoplana* clearly belongs in the Geoplanidae. However, assignment

of *Eudoxiatopoplana* to one of the four subfamilies in the Geoplanidae is problematic as the new genus has a mix of mutually exclusive taxonomic characters.

The eye pattern in *Eudoxiatopoplana*, with lateral clustering and eyes extending the length of the body, is similar to that found in some taxa of the Caenoplaninae, Anzoplaninae and Geoplaninae, but differs from these in that *multiple* rows of eyes, instead of a *single* row of eyes, pass around the anterior tip. In the Pelmatoplaninae, the eyes do not extend around the anterior tip, are crowded antero-laterally and rarely extend beyond the mouth. The eye pattern of the anterior end in *Eudoxiatopoplana* is not dissimilar to that observed in species in the Bipaliidae, though an expanded headplate is absent in *Eudoxiatopoplana*.

The presence of dorsal testes excludes *Eudoxiatopoplana* from the Caenoplaninae and Pelmatoplaninae, which have ventral testes, and from the Anzoplaninae, which have dorso-ventral testes. The presence of dorsal testes, regarded as an apomorphy, characterises the Geoplaninae whose distribution is confined to the Neotropical zoogeographic region. The presence of this character state in a species from the Australian region is unique. However, *Eudoxiatopoplana* is potentially precluded from the Geoplaninae by the absence of a ciliated creeping sole and presence of strong parenchymal musculature in a ring zone.

With regard to body musculature, especially the presence of strong parenchymal muscles in a ring zone, and in elements of the copulatory organs, *Eudoxiatopoplana* approaches the Pelmatoplaninae. However, in *Eudoxiatopoplana* the cutaneous longitudinal muscles are in well-defined bundles, whereas in Pelmatoplaninae species the cutaneous longitudinal muscles are not bundled.

The inverted penis type present in *Eudoxiatopoplana* is also present in some taxa of the Anzoplaninae, Caenoplaninae and Geoplaninae, as well as in other 'turbellaria'. Setting aside the penis type, there are similarities between the austral taxa and those of the Pelmatoplaninae described from Vietnam by Beauchamp (1939) with regard to the general anatomy and form of the male copulatory organs. Glandulo-muscular organs have not yet been described in the Pelmatoplaninae.

To date, resorptive bursae, all of which arise from the female genital organs, have been found only in Australo-Pacific geoplanid taxa. These resorptive bursae have a similar internal structure, comprising thin, irregular, arborising folds that may fuse to appear like honeycomb. Lysocytes or glands with lysocytic secretions and phagocytes are present,

and sperm are digested intraluminally. Four types of resorptive bursae are now identified: the posterior-medial resorptive bursa present in *Eudoxiatopoplana*; and three types of lateral bursae present in other taxa.

The three types of lateral bursae are all only lightly muscularised: atrial lateral bursae embedded in the atrial musculature, the short bursal stalks of which arise at the entrance of the female genital canal in *Australopacifica willeyi* (Busson, 1903) (Caenoplaninae), which has anterior-facing, inequi-bilobed, bilateral bursae; parapharyngeal lateral bursae situated on either side of the pharynx, where the short bursal stalks arise from the ovovitelline ducts, present in *Anzoplana trilineata* Winsor, 2006 (Anzoplaninae); and ovarian lateral bursae, previously termed 'parovarian tissue' and at that time of unknown function (Fyfe 1937, 1953), situated at the proximal end of the oviducts and ventro-lateral to the ovaries, now recognised as resorptive bursae (Winsor & Stevens 2005). These bursae are present in the caenoplanines *Arthurdendyus triangulatus* (Dendy, 1895), *A. vegrandis* Winsor & Stevens, 2005, and the subantarctic taxa *Kontikia marrineri* (Dendy, 1911), *Kontikia ashleyi* (Fyfe, 1953) and *Fyfea carnleyi* (Fyfe, 1953).

The unique resorptive bursa present in *Eudoxiatopoplana bilaticlavata* differs chiefly from the lateral bursae in its posterior-medial situation in the copulatory organs, being strongly muscularised, and being supplied directly from the common ovovitelline duct via the bursal canal.

Given the present uncertainties in terricolan systematics, it is tempting to resort to the simple expedient of emending the diagnosis of one of the current subfamilies, such as the Anzoplaninae, to accommodate *Eudoxiatopoplana*. However, this would create an unnatural group and further complicate analyses of terrestrial flatworm taxa. Therefore, it is proposed that this genus be accommodated within a new subfamily.

Eudoxiatopoplaninae new subfamily

DIAGNOSIS: Geoplanidae with dorsal testes and ventral efferent ducts. With tripartite cutaneous musculature, with cutaneous longitudinal muscles in well-defined bundles, with parenchymal longitudinal muscles present in a strong ring zone. With a non-ciliated creeping sole. Eyes pigment cup-type, in multiple rows around the anterior tip, continuing to the posterior end and dorsally.

A comparison of key taxonomic characters and states present in the subfamilies of the Geoplanidae, including the Eudoxiatopoplaninae, is provided in Table 1.

Table 1 A comparison between some key taxonomic characters and states present in the new subfamily Eudoxiatopoplaninae and those present in most of the taxa included in the other subfamilies of the Geoplanidae. (Data for cutaneous muscular index (CMI) and parenchymal muscular index (PMI) were calculated by the author from various sources.)

Character	Eudoxiatopoplaninae	Geoplaninae	Anzoplaninae	Caenoplaninae	Pelmatoplaninae
Rows of eyes around anterior tip	Multiple	Single	Single	Single	None
Testes	Dorsal	Dorsal	Dorso-ventral	Ventral	Ventral
Type of creeping sole	Non-ciliated	Ciliated	Both ciliated and non-ciliated	Both ciliated and non-ciliated	Very reduced, ciliated creeping sole
Cutaneous longitudinal musculature and cutaneous muscular index (CMI)	Weak; in bundles. CMI: 4.5–6.5%	Weak to strong; in bundles. CMI: 2–18%	Weak to strong; in bundles. CMI: 6–22%	Weak to strong; in bundles. CMI: 2.7–24%	Weak; not in bundles. CMI: no data
Parenchymal longitudinal musculature and parenchymal muscular index (PMI)	Very strong; present in ring zone. PMI: 38.5%	—	Strong; present in ventral plate or ring zone. PMI: 9–10.8%	Weak to strong; present as isolated bundles, in ventral plate or ring zone. PMI: 1.2–28.5%	Very strong; present in ring zone. PMI: 15.6–21.3%

Eudoxiatopoplana bilaticlavia
new species (Fig 1–5)

Material examined

HOLOTYPE: MONZ–ZW 1397. Stewart Island, New Zealand, 47° 00'S 167° 50'E. Collected on a dead rat by D. Cunningham in June 1984. Sectioned at 8 µm, a series of 72 slides stained with the MSB method: anterior TS, mid-anterior TS and pre-pharyngeal TS and posterior LSS together, sectioned from the left side.

External features

A geoplanid with a small, robust body slightly tapered anteriorly to a blunt anterior end, the tip of which is rounded and contracted to show some of the anterior ventral surface. The body gradually broadens, reaching maximum width in the third body quarter, after which it tapers more acutely to a rounded posterior (Fig. 1). Body oval in cross section. Mouth ventrally situated in the first body third, with the gonopore almost mid-body. Creeping sole indistinct. Dorsal

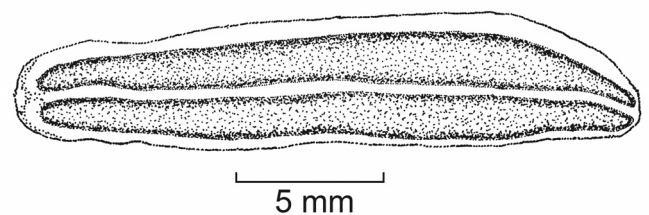


Fig. 1 *Eudoxiatopoplana bilaticlavia*: whole specimen, dorsal aspect.

ground colour cream, with paired broad medio-lateral stripes of dark brown-grey that extend from the median region to the outer marginal zone, from which it is separated by a narrow interval of ground colour; the paired stripes are broad and cover both the median and lateral dorsal regions of Graff (1899). The colour of the median stripes is darkest along their median and lateral edges. The cream dorsal ground colour extends to the margins, with the suggestion of a diffuse submarginal brownish stripe (not shown in Fig. 1,

as this is essentially a dorsal, not lateral, view). Submarginal zone, extending to and including the ventral surface, white. With multiple eyes (Fig. 2), crowded around the anterior tip margin, extending dorsally to form two loose patches, and laterally in a loose submarginal band to the posterior. Dimensions of the single specimen are provided in Table 2.

Internal anatomy

HEAD: Adhesive suckers with associated musculature absent. Gut extends to within approximately 340 µm of tip, overlies ganglion. Eyes pigment-cup 37–39 µm in diameter; the number of retinal clubs could not be determined. Sensorial zone 85 µm wide, rhabdoid free, extends around antero-ventral margin. Ciliated pits simple invaginations, 11–14 µm in diameter, 42–56 µm deep, lined by ciliated anucleate epithelium.

PRE-PHARYNGEAL REGION: A schematic representation of the transverse pre-pharyngeal region is provided in Fig. 3. Dorsal epithelium 20 µm thick, slightly thinner than the ventral epithelium, 25 µm thick, nucleate. Creeping sole composed of non-ciliated nucleate columnar epithelium. Sinuous rhammites approximately the same height as the dorsal epithelium, derived from rhabditogen cells underlying cutaneous musculature, extend dorso-laterally to outer margins of creeping sole, abundant laterally. Epitheliosomes secreted from creeping sole. Finely granular xanthophil secretions from mesenchymal glands present over entire body, abundant marginally to form a marginal adhesive zone. Amorphous cyanophil secretions from mesenchymal glands discharged from the ventral surface.

Finely granular yellowish-brown pigment sparse, present below basement membrane, between fibres of cutaneous musculature and extending into ectal two-thirds of parenchymal musculature, corresponding in approximate position to the paired dark dorsal stripes. Body 3.6 mm wide. Creeping sole flat, 1.1 mm wide, 31% of body width. Body height 2.1 mm. Body width to height ratio 1.7:1. Cutaneous musculature tripartite, with circular and helical muscles, longitudinal muscles in distinct bundles, not in-sunk. Dorsal cutaneous musculature thicker (59–84 µm thick) than ventral musculature (34–50 µm thick). CMI = 4.4–6.5%.

Parenchymal longitudinal muscles in bundles of varying size, present as a massive ring zone, PMI 38.5%, stronger ventrally (480 µm thick) than dorsally (320 µm), intersected by a closely decussate meshwork of oblique-transverse and dorso-ventral muscle fibres in diamond-pattern corseting. Strong supraintestinal transverse, infraintestinal transverse

Table 2 *Eudoxiatopoplana bilaticlavia*: dimensions of specimen examined. Positions of body apertures are measured from the anterior tip.

Specimen MONZ-ZW 1397	
Length (mm)	21.0
Width (mm)	3.6
Distance of mouth from anterior end (mm)	7.1
Mouth–anterior end distance as % of body length	33.8
Distance of gonopore from anterior end (mm)	10.3
Gonopore–anterior end distance as % of body length	49.0
Distance from mouth to gonopore (mm)	3.2
Mouth–gonopore distance as % of body length	15.2
Width of creeping sole (mm)	1.1
Creeping sole width as % of body width	31
Height of body (mm)	2.1
Length of pharynx (mm)	2.8
Pharynx length as % of body length	13.3
Length of pharyngeal pouch (mm)	1.7
Pharyngeal pouch length as % of body length	8.1

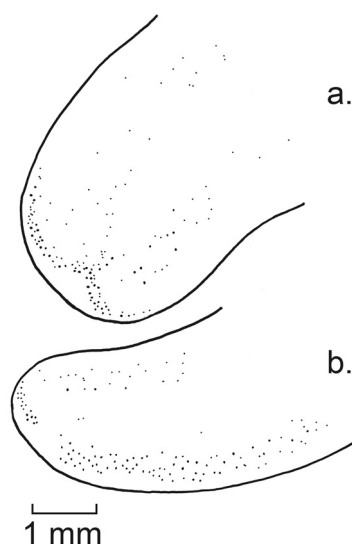


Fig. 2 *Eudoxiatopoplana bilaticlavia*: anterior tip showing distribution of eyes in (a) anterodorsal aspect, and (b) anterolateral aspect.

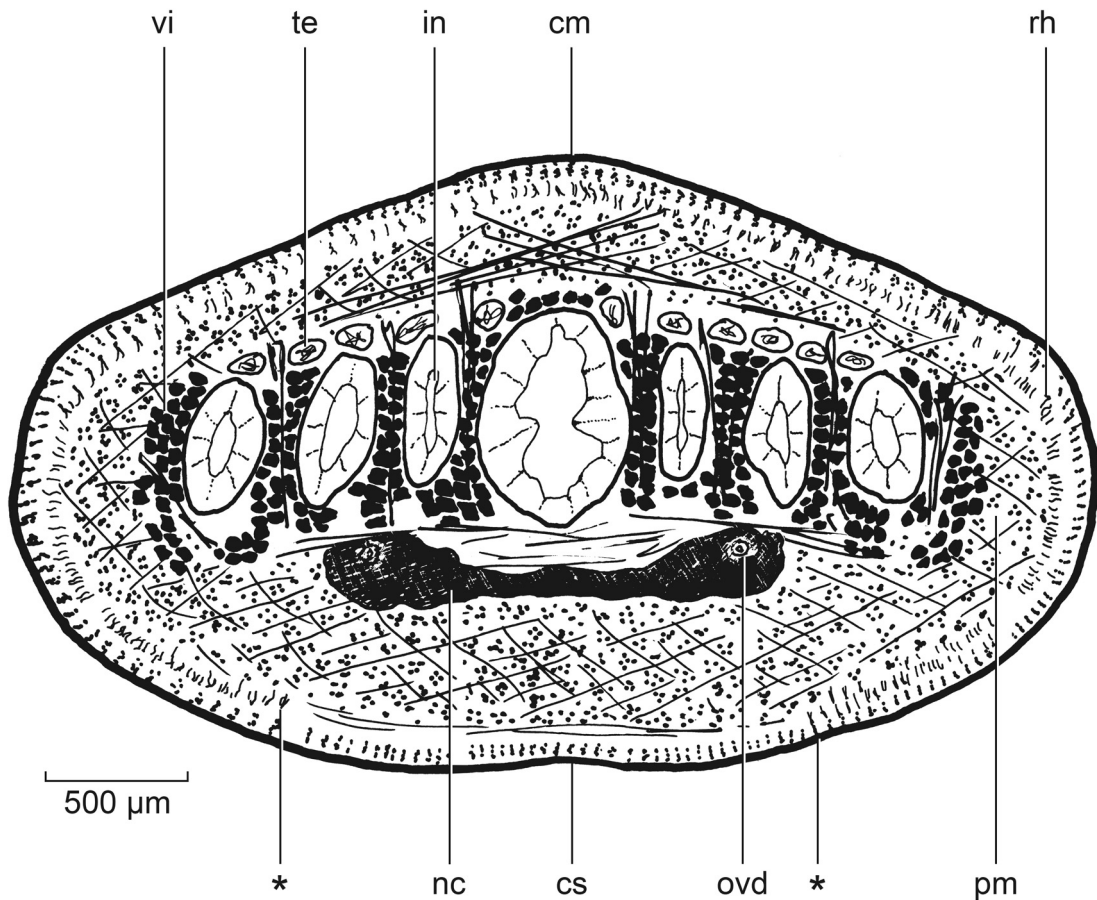


Fig. 3 *Eudoxiatopoplana bilaticlavata*: pre-pharyngeal region, transverse section (* indicates the ventral extent of the rhammites).

and dorso-ventral muscles present. Nephridial elements inconspicuous.

ALIMENTARY TRACT: Gut empty. Pharynx (Fig. 4) cylindrical, folded (contracted), 2.8 mm long, 13.3% of body length, with dorsal insertion posterior to ventral insertion. Inner pharyngeal musculature with subepithelial mixed longitudinal–circular muscles; outer pharyngeal musculature comprises subepithelial longitudinal, then mixed circular–longitudinal muscles. Oesophagus absent. Pharyngeal pouch 1.7 mm long, 8.1% body length. Mouth opens in the mid-pouch. Diverticulum absent.

REPRODUCTIVE ORGANS: Copulatory organs complex, situated immediately behind the pharyngeal pouch, with inverted penis, resorptive bursa and adenodactyl (Fig. 5). Testes mature, ellipsoidal in shape, 80–112 μm \times 40–70 μm in diameter, follicular, dorsal, lying just below the parenchymal muscle ring zone immediately above the gut (Fig. 3). Testes extend posteriorly from behind the ovaries to the

hind end. Sperm ductules from testes pass ventrally in the mesenchymal tissues between intestinal diverticula. The vasa deferentia are prominent close to the copulatory organs; anterior to the pharynx they are thin-walled, tortuous and difficult to trace. Just behind the pharyngeal pouch the efferent ducts form capacious spermiducal vesicles that ascend steeply and penetrate the bulb separately. From each, a short sperm duct enters the proximal end of the seminal vesicle separately.

Seminal vesicle musculature comprises inner circular-oblique muscles that merge ectally with the longitudinal muscles of the penis bulb. Glands supplying the seminal vesicle are located in the mesenchyme outside the penis bulb. The seminal vesicle is divided into two distinct parts, proximal and distal. Proximal part spheroid in shape, some 200 μm in diameter, slightly bicornuate where sperm ducts enter, with fimbriate vacuolate nucleate columnar erythrophil epithelium, through which necks of glands situated

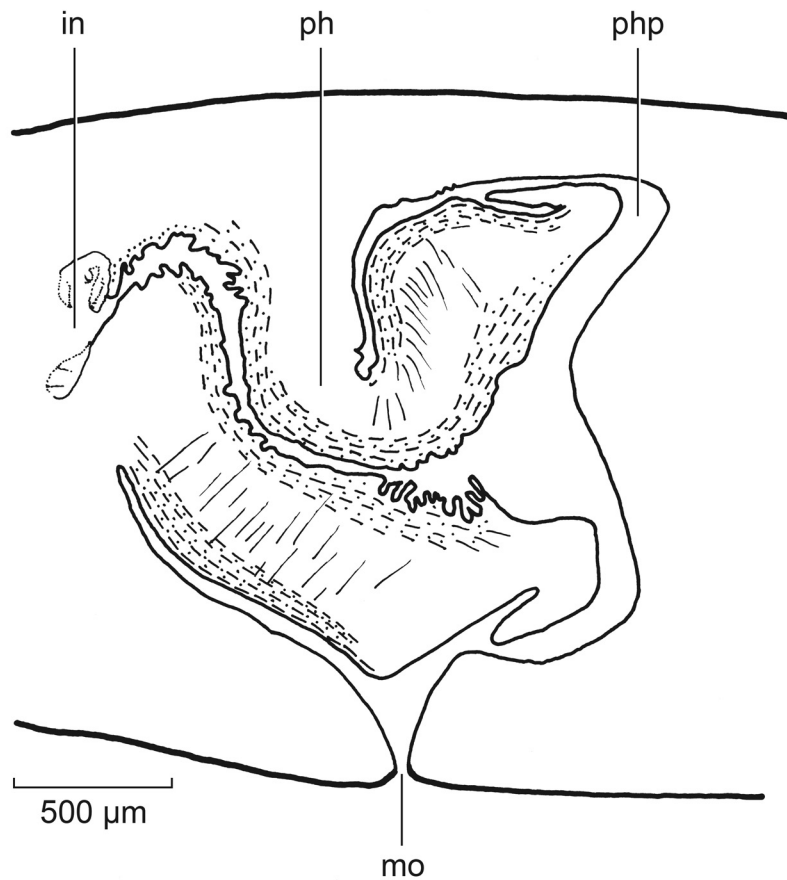


Fig. 4 *Eudoxiatopoplana bilaticlavata*: pharynx, longitudinal sagittal section.

external to the penis bulb discharge a coarse-grained secretion into the lumen. Proximal vesicle communicates with distal seminal vesicle via a narrow opening. Distal seminal vesicle lined by villiform epithelium, which is penetrated by gland ducts that are heavily charged with both coarse granular xanthophil secretions and fine granular erythrophil secretions in the dorsad end, and fine granular erythrophil secretions intermixed with fine black granules and granular cyanophil secretions in the ventrad end. Because of the dense secretory elements, it is difficult to ascertain the exact type of the lining epithelium.

Seminal vesicle floor occupied by almost horizontal inverted penis, inverted part with flattened cuboidal facing epithelium. Ejaculatory duct tortuous, lined by rugose nucleate cuboidal epithelium, underlain by strong circular muscles. Fine xanthophil secretion, derived from glands external to the penis bulb, pass through penial musculature into lumen of ejaculatory duct. Penis bulb with strong mixed

musculature, longitudinal muscles prominent around seminal vesicle, muscles on dorsal half of bulb particularly strong. Inverted penis with predominantly strong longitudinal muscles. Loose stroma ('compression tissue') is present between ectal epithelium and musculature, extending one-third length of penis.

Ovaries situated approximately halfway between the brain and root of the pharynx; spheroid, approximately the same size, but differ slightly in shape, 170–190 μm in diameter, dorso-ventral axis 178–248 μm long, embedded in lateral nerve cords. Ovovitelline ducts arise from lateral walls of ovaries. Proximal end of each duct slightly expanded, without sphincter muscle at point of contact with ovary. Resorptive cells absent. A small secondary ovary, 40 μm diameter, is present under the left ovary but is not served by an ovovitelline duct.

Ovovitelline ducts lined by ciliated nucleate low-columnar epithelium, with inner longitudinal and ectal

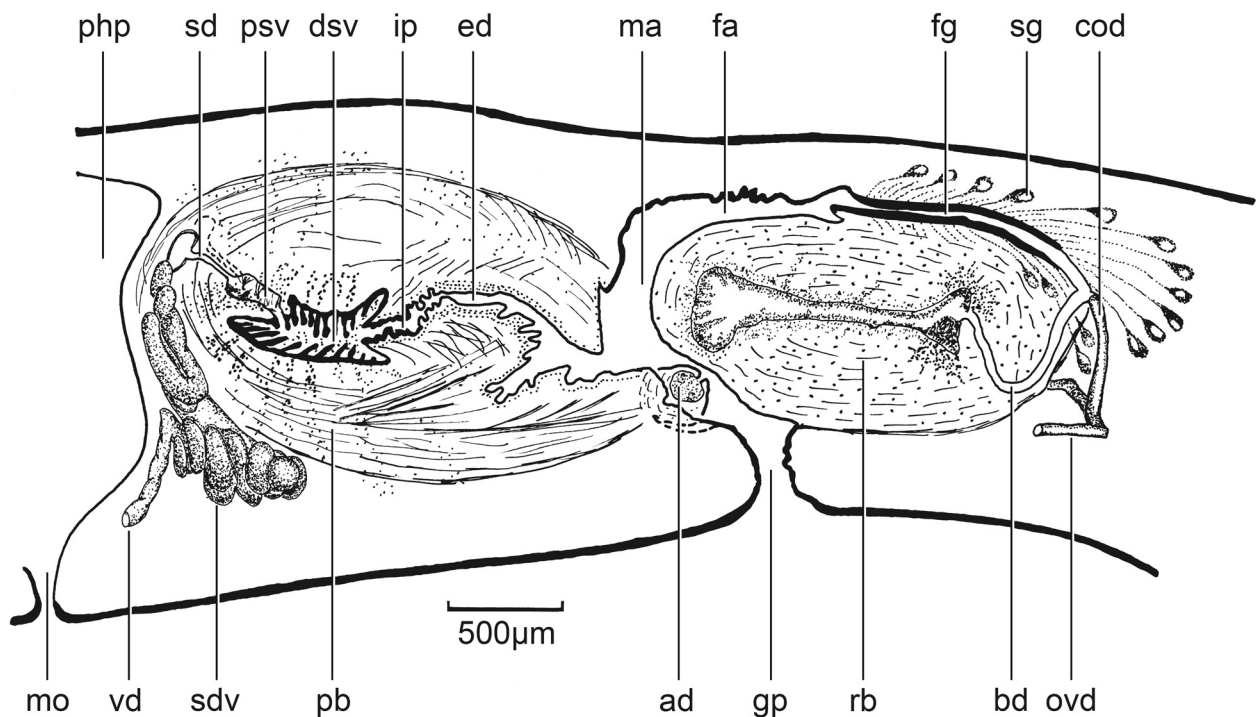


Fig. 5 *Eudoxiatopoplana bilaticlavia*: copulatory organs (holotype), composite longitudinal sagittal section.

circular musculature, pass ventrally, continue posteriorly along nerve cords and just behind the copulatory organ bulb bend medially then unite to form a common ovovitelline duct. Common oviduct epithelium and musculature same as ovovitelline duct, rises 450 μm and divides like an inverted Y, with one branch forming the bursal canal passing antero-ventrally into a resorptive bursa and the other limb curving antero-dorsally to communicate with the female genital canal (postflex posterior approach). Genitointestinal duct absent. Female genital canal rises gently, curves over the bursa, enters the dorsal rear wall of female antrum. Genital duct lined by columnar epithelium with cyanophil cytoplasm, receives coarse xanthophil, and fine granular cyanophil, granules secreted into lumen as strands; both secretions derived from glands in surrounding mesenchyme; with inner longitudinal and outer circular musculature. Female antrum narrowly flask-shaped, with expanded proximal end, elongate distal neck. Antral roof lined by strand cells with basal nuclei with cytoplasm containing coarse granular xanthophil secretion. Finer cyanophil strand-like secretions derived from glands situated within the bulb musculature pass between cells into antrum. This epithelium

continues along anterior (male) half of antrum to gonopore. Posterior antral wall (projecting wall of bursa) covered by flattened epithelium with sparse, coarse xanthophil granules. Antrum with subepithelial circular muscularis surrounded by loosely interwoven mixed muscle fibres.

Bursa massive, posterior-medial, horizontal, projecting into the antrum, with bulb composed of strong mixed circular and longitudinal muscles. Lumen long, narrow, expanded at the blind anterior end, and at the posterior end into which the U-shaped bursal canal opens. Lumen epithelium cyanophil, longitudinally closely folded, heavily charged with fine erythrophil granules and amorphous cyanophil secretion derived from glands lying within the bursal musculature; lumen contains some small masses of sperm. Phagocytes are present. Bursal canal lined by a ciliated nucleate low-columnar epithelium, with inner longitudinal and outer circular musculature.

Adenodactyl present, spheroidal shape, Type VI, situated just inside the gonopore projecting from the right antero-ventral wall of the antrum. Adenodactyl reservoir with flattened epithelium, filled with coarse granular cyanophil (mid-blue) secretions, through which occur skeins of fine

erythrophil granules derived from adjacent mesenchymal glands.

Vitellaria extensive, well developed, situated between gut diverticula; empty into the ovovitelline ducts via short, narrow vitelline funnels.

PATHOLOGY: Protozoan (?Ciliophoran), 2–4 µm in diameter, present in some testes and mesenchyme.

ETYMOLOGY: The specific epithet *bilaticlavia* alludes to the two broad dorsal stripes present on this species, and is derived from the Latin *bis* = two, and *laticlavus* = having a broad stripe.

Systematic discussion

Eudoxiatoplana bilaticlavia is differentiated anatomically from other austral terrestrial flatworm taxa by the characters of the genus. Details of the fixative and original treatment of the specimen are not known. An oesophagus was not identified in the pharynx, though there is the possibility that this structure might have been obscured in the contracted pharynx. In austral taxa, the presence of an oesophagus appears to be confined to Caenoplaninae and is not as common as in Neotropical Geoplaninae, although this may simply be due to the fact that less is known anatomically of the members of the former subfamily. In general topography, the copulatory organs of *E. bilaticlavia* are similar to those of the anzoplanine *Fyfea carnleyi* (Fyfe, 1953) in that both have an inverted penis and small Type VI adenodactyl, but differ in that the former species has a large resorptive bursa and more differentiated seminal vesicle.

The presence of dorsal testes in an austral geoplanid is unique. In the specimen of *Eudoxiatoplana bilaticlavia*, the testes are mature and show gonial cells, spermatids and spermatozoa to varying degrees, and could reasonably account for the large volume of sperm present in the spermiducal vesicles. There is no evidence of resorption of testes as might occur in an individual specimen that changed from male-mature to female-mature. No example of such resorption has been encountered previously with austral flatworms. Sperm ductules arising from the testes are difficult to discern throughout the body, and the efferent ducts are extremely difficult to locate anterior of the pharynx, though this difficulty has been experienced by the author with other austral taxa. Examination of mature specimens collected at a different time of the year may clarify the situation.

Another unique feature of *Eudoxiatoplana bilaticlavia* is the presence of the muscular resorptive bursa not previously reported from terrestrial flatworms, discussed previously.

With its two broad brown dorsal stripes on a cream ground colour, *Eudoxiatoplana bilaticlavia* bears a superficial resemblance to the terrestrial nemertean *Antiponemertes pantini* (Southgate, 1954), which has a similar stripe and colour pattern (Gibson 1972: Plate 1); the latter was also recorded from Stewart Island (Moore 1973; Moore & Gibson 1981) and may possibly occur in the same habitat. However, the two worms can be readily distinguished in the field by examination of their anterior tips with a hand lens: *Antiponemertes* has only four eyes whereas *Eudoxiatoplana* has multiple eyes anteriorly.

Comments

Unfortunately, there are no data available on the fixative or method of fixation used on the *Eudoxiatoplana bilaticlavia* holotype, and no details are available on the specific location and habitat where the specimen was found on Stewart Island, other than that it was found on a dead kiore (*Rattus exulans* (Peale, 1848)), also known as Polynesian rat, Māori rat and Pacific rat). Presumably the flatworm was found during a survey of rodents on the island. This native rodent was widespread prior to European settlement and is now confined to Fiordland and many offshore islands, including Stewart Island (Cunningham & Meers 1996). Although some terrestrial flatworms are necrophagic (Winsor 1977), there is no evidence in the flatworm pharynx or gut that this specimen was eating the rat.

The three species of terrestrial flatworms previously reported from Stewart Island were all found in disturbed habitat and are considered to be outside their native habitats on the South Island of New Zealand (Johns & Boag 2003). Johns (1998) refers to a New Zealand taxon 'new genus 3', with three probable new species he terms 'multieyes'. This multi-eyed genus may be congeneric with *Eudoxiatoplana* and if so, one of the three probable new species may be conspecific with *E. bilaticlavia*. However, there are no additional published data on Johns' (1998) probable new taxa. At present, *E. bilaticlavia* is known only from Stewart Island, and no comment can be made as to whether this occurrence is natural or adventive.

Eudoxiatoplana exhibits an unusual combination of taxonomic features that underline the constraints of the present taxonomy of terrestrial flatworms and the need to reassess the characters and states that define terricolan genera and higher ranks. The characters present in *Eudoxiatoplana* could be examples of character divergence, convergence,

or re-emergence, for which free-living flatworms are notorious. *Eudoxiatopoplana* is most probably a Gondwanan relic and may occupy a basal position in the lineage of the family.

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