

# The BEAGLE

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### TWO NEW GENERA OF DIDEMNID ASCIDIANS FROM TROPICAL AUSTRALIAN WATERS

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#### ABSTRACT

*Atriolum* has characters that suggest affinities with *Leptoclinides* and *Didemnum* respectively. Its large zooids and functional rather than vestigial oviduct are primitive characters previously not known in the Didemnidae. A thoracic brood pouch is probably convergent with similar structure in the Holozoidae and does not reflect phylogeny. Type material of this monotypic genus is from Murray I. and Raine I., northern Queensland. *Polysoma* resembles certain *Diplosoma* spp. in the absence of spicules, and the form of the colony and zooids. It is distinguished by its arc of numerous scattered testis follicles and straight vas deferens. Type material of this monotypic genus is from Port Essington, Northern Territory.

#### INTRODUCTION

The family Didemnidae is diverse in tropical coralline waters and there is a vast array of species in currently recognized genera. The two species described below represent genera that are new to science, and demonstrate a further degree of diversity than that formerly recognized in the family.

The family is characterised by marked development of colonial systems in which there are numerous and very small and simplified zooids, extensive cloacal spaces,

and a limited number of cloacal apertures. In previously known genera the embryos are fertilised in the abdomen, possibly by way of a vestigial oviduct. As each egg develops it ruptures from the abdomen into the test, and the embryo incubates in the basal test. The gonads are contained in the abdomen and vegetative reproduction is by oesophageal budding. The larvae usually have three adhesive organs with long slender stalks and shallow epidermal cups; and four pairs of club-shaped ectodermal ampullae.

## Family DIDEMNIDAE

Genus *Atriolum* gen. nov.

Zooids with 4 rows of stigmata; greatly extended atrial siphon and 5 lobes bordering the aperture; a coiled vas deferens; a single undivided male follicle; embryos developing in a brood pouch constricted from the postero-dorsal aspect of the thorax.

In this genus, the colonial system is well developed as in other genera of the Didemnidae, and the vas deferens is coiled as in several other genera of the family. The large central cloaca is similar to that known for the genus *Askonides* Kott, 1962 (< *Leptoclinides*). The long posteriorly oriented atrial siphon giving each zooid direct access to a central or posterior-abdominal cloacal cavity is also present in *Leptoclinides* spp.

The zooids of the present species are not reduced to the same extent as in other genera of the family, however, and although the embryos are probably released into the common test as is usual in the family, the existence of a functional oviduct through which ova move anteriorly into the brood pouch is unusual and suggests that the large zooids in this genus represent a phylogenetically primitive condition rather than a secondary enlargement of the small and simplified zooids that characterise other didemnid genera. Fertilisation of eggs in the brood pouch rather than at the vase of the oviduct is also unusual in the family Didemnidae.

A similar brood pouch in which fertilisation occurs is present in the family Holozoidae, in which cloacal systems are also well developed. In most holozoid genera, however, the atrial opening is greatly modified and there is no siphon. Further, species of the Holozoidae reproduce vegetatively from posterior abdominal vascular stolons. Although the exact mechanism of budding in the present species is not known, no posterior abdominal stolon can be demonstrated.

*Sigillina deerata* (Sluiter, 1895) and *S. fantasiana* (Kott, 1957), species of problematical affinities (see Kott 1967), have a brood pouch and posteriorly directed, lobed atrial siphons that open into cloacal spaces as in *Atriolum*. Kott (1967) suggested their affinity with holozoid genera on the basis of their posterior abdominal stolon and brood pouch. The true phylogeny of these species of *Sigillina* may be reflected by the presence of the posterior abdominal stolon together with their mechanism of budding and this is enough to preclude any close relationship with *Atriolum* despite the similarity of their atrial siphons, brood pouches and zooid size.

It is most probable that in *Atriolum* and in *Sigillina* and the Holozoidae the well developed cloacal systems, the length of atrial siphons and the presence of brood pouches are all secondary and sometimes convergent characters related to one another and to the size of the zooids.

Larvae of *Atriolum* are characteristically didemnid, with four pairs of ectodermal ampullae, and narrow stalked adhesive organs arranged in a straight median row. Accordingly, although *Atriolum* appears to represent a fairly primitive condition in the Didemnidae, as evidenced by certain primary characters that it shares with other aplousobranch families, it does not supply any evidence regarding the phylogenetic relationships of the Didemnidae. Its intra-familial relationships are with the genus *Didemnum*, on account of the spirally coiled vas deferens around an undivided male follicle. The genus *Leptoclinides* with a similarly directed and sometimes lobed atrial aperture and a coiled vas deferens is distinguished by its multiple-lobed testis that is very probably a secondary condition. The separation of both *Didemnum* and *Leptoclinides* from an *Atriolum*-like ancestor seems the most likely reconstruction of the phylogeny of these three genera.

*Atriolum robustum* sp. nov.

(Figs. 1-4)

*Material examined* — *Holotype*: Murray I., South Channel Reef between Maer and Dewar Is., 20 m, coll. E. Lovell, QM GH285.

*Paratypes*: Raine, I., NW face, 10-20 m, coll. E. Lovell, QM GH286, NTM E18; Swain Reefs, 10-20 m, fast current, coll. J. E. Watson, QM GH1410.

*Description* — *Colony*: Colonies are smooth, robust, firm, rounded and upright, sometimes cylindrical but often laterally flattened. They are often irregularly lobed, massive and tuberous. Undivided colonies (from 0.5 to 2 cm in diameter), may narrow abruptly to a narrow basal stalk or there may be several prop-like stalks produced from different places around the base of the colony. A large common cloacal aperture is present on the free end of each lobe, and occasionally these apertures are more numerous.

The test is firm, gelatinous and translucent. There is a layer of spicules immediately beneath the superficial layer of test and bladder cells. Spicules are sparse throughout the remainder of the colony, although they extend in five lines along the lobes that border the atrial apertures where they open to the cloacal cavity. Spicules also line the branchial lobes forming white points where each branchial aperture opens to the surface.

There is a cloacal chamber in the centre of each lobe. The zooids open directly into this chamber and there are no secondary cloacal canals. The zooid bearing layer of test surrounding the cloacal cavity is up to 1 cm thick. The spicules are stellate, 0.02 to 0.04 mm in diameter with about 15 to 17 short conical points in optical section.

*Zooids*: The thoraxes are suspended almost vertically between the outer surface and the cloacal cavity, but the abdomen lies at right angles to the thorax. The thoraxes are up to 3 mm in length (excluding the atrial siphon) and the abdomen is slightly shorter. The branchial siphon is long and muscular with a distinct circular sphincter

musele at its base. There are distinct longitudinal thoracic museles extending from the branchial siphon down each side of the thoracic body wall. There are four rows each of 20 long, narrow stigmata. The atrial siphon is generally longer than the thorax and extends backwards from the posterodorsal corner of the thorax to the cloacal cavity. It has outer circular muscle bands that coalesce with one another along the length of the siphon to form a regular mesh. There are also inner longitudinal bands. Near the distal end of the siphon there is a short expansion caused by a band of larger epithelial cells. The anal border has 5 small lobes. A single developing embryo is present in a brood pouch that is constricted off from the under side of the proximal end of the atrial siphon. The oviduct passes into the brood pouch through the narrow constriction and its distal end is curved around within the pouch. This can be observed in stained preparations.

The oesophagus is of medium length. It opens into an almost spherical stomach that has about nine internal, sometimes irregular glandular ridges. There is a duodenal area and an oval mid-stomach. The distal end of the gut loop is flexed upwards. The rectum curves into the atrial siphon and terminates in a 2-lipped anus just distal to the opening of the brood pouch.

The gonads are in the usual position for the Didemnidae. There is a large hemispherical male follicle beneath the gut loop and a two egg ovary just anterior to the testis. The vas deferens coils  $7\frac{1}{2}$  times around the outer surface of the male follicle. However, it coils in a clockwise direction, rather than anti-clockwise as in other genera of this family. The distal end of the duct curves over into the atrial siphon and opens near the anus, just beyond the opening of the brood pouch. Only a single ovum develops at one time, and passes up the oviduct into the brood pouch. As the embryo develops, the brood pouch moves toward the cloacal chamber and the narrow

neck attaching it to the atrial siphon lengthens. The most mature embryos are found in the test adjacent to the cloacal chamber, and although none were found actually in that chamber, it is probable that they are released into it (as in other didemnid genera) by rupture of the brood pouch.

The larval trunk is large (1.2 mm long) and the strong tail is wound half way around it. There are four club-shaped ectodermal ampullae each side of the three median adhesive organs. There are also four accessory ampullae at the base of the primary row on the left side. The adhesive organs are on long narrow stalks and have shallow saucer-like ectodermal cups from the base of which the narrow stalked cone of adhesive cells arise. There is a large ocellus and an otolith.

Remarks: The clockwise spiral of the vas deferens may be characteristic of this species or it may be a generic characteristic. Otherwise the form of the colonies and colonial systems, the stellate spicules in a layer beneath the surface test, the large zooids with numerous long stigmata, the long atrial siphon, the brood pouch with single incubating embryos and the undivided testis follicle characterise this monotypic genus. Unfortunately, no colonies have yet been observed in the vegetative phase to determine the site and mechanism of budding.

Genus *Polysoma* gen. nov.

Small zooids with four rows of stigmata; a wide atrial aperture that exposes most of the branchial sac; a male gonad of up to 16 follicles joined by short vasa efferentia to a straight vas deferens; no spicules.

The genus is distinguished from other genera of the family by its rather diffuse male gonad consisting of numerous follicles loosely grouped around the proximal end of the straight vas deferens. Both *Polysyncraton* and *Leptoclinides* have numerous male follicles but in each case

they are tightly grouped and are surrounded by the spiral coils of the vas deferens. *Diplosoma* also lacks spicules and, with *Lissoclinium*, further resembles the present genus in the absence of a coiled vas deferens. However in both *Diplosoma* and *Lissoclinium* the male follicles are never more numerous than the two that appear to have resulted from the subdivision of a single follicle; they remain closely associated and the vas deferens hooks around between them rather than extending straight from a central point.

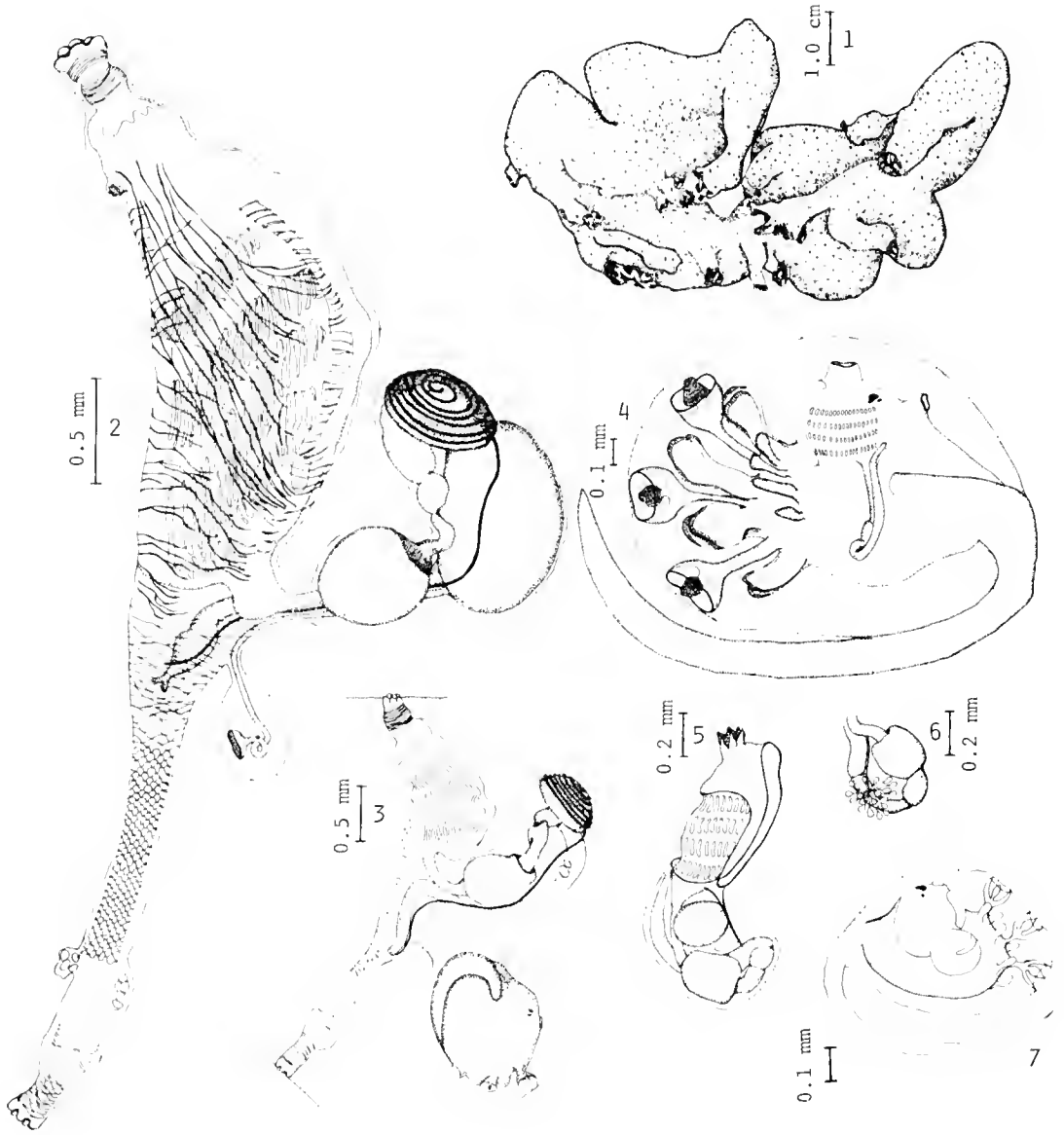
In other respects, however, the genus is characteristically didemnid. Its colonies are thin and investing sheets with extensive cloacal spaces; the zooids are small and simplified, and there is a retractor muscle. The larva has three pairs of diplosomid-like ectodermal ampullae; and there is a single precocious blastozooid. Proliferation of male follicles and straightening of the vas deferens in *Polysoma* distinguish it from *Diplosoma*, which has similar colonies, wide atrial apertures, often precocious buds in the larva, and a reduction in the number of ectodermal ampullae as in the present genus.

*Polysoma testiculata* sp. nov.

(Figs. 5-7)

*Material examined* — Coral Bay, Port Essington, Northern Territory, 3m, on coral, coll. A. J. Bruce, Station CP/6 23/6/82. Holotype, NTM E 11; Paratypes, OM GH802.

*Description* — Colonies: The colonies form extensive but thin irregular investing sheets not more than 3 mm thick and up to 3 mm in maximum extent. A few large common cloacal apertures are present on the surface. Large cloacal cavities are present beneath the apertures and deep, narrow canals, with a row of zooids along each side, radiate from these cavities. The cloacal canals occupy the whole length of the zooids but do not extend posterior to them. The test is soft and translucent. There



*Atriolum robustum* (holotype OM GH285): Fig. 1, whole colony showing basal props with foreign particles adhering to them; Fig. 2, zooid with mature gonads and incipient brood pouch, showing body musculature; Fig. 3, zooid with embryo incubating in the brood pouch; Fig. 4, larva.

*Polysoma testiculata* (holotype NTM E 11): Fig. 5, zooid; Fig. 6, abdomen showing vas deferens, testis and gut loop; Fig. 7, larva.

are no spicules but there are morula bodies similar to those found in *Diplosoma* (see Eldredge 1967) scattered through the test.

**Zooids:** The zooids are about 1 mm long, although the abdomen is generally bent at right angles to the thorax. There are 7 to 8 long, rectangular stigmata in each of the four rows. The atrial aperture is wide, exposing a great part of the branchial sac. There is a short, fine retractor muscle from the posterior end of the thorax.

The oesophagus is moderately long, and bends ventrally. There is a large almost spherical stomach, a duodenal area, and an oval posterior stomach in the loop of the gut. The gut loop is flexed upwards. Oesophageal buds are present in these specimens. Ovaries were not observed. The testis, in the usual position beneath the gut loop, consists of up to 16 pyriform follicles

arranged in a deep arc. Short vasa efferentia radiate inwards to join the proximal end of the vas deferens that extends anteriorly to open alongside the anus.

Only a single embryo was present in the type material. The larval trunk is 0.6 mm long, and the tail is wound half way around it. There is an otolith and an ocellus, three pairs of ectodermal ampullae, and a single blastozooid. The adhesive organs have deep ectodermal cups and elongate cones of adhesive cells.

**Remarks** — The condition of the male gonad is unusual and justifies the erection of a new genus to accommodate the species. Apart from that character, neither the colony nor the zooids and larvae display any novel morphology and generally resemble *Diplosoma perspicuum* Hartmeyer, 1919.

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#### RESUMÉ

Deux nouvelles espèces de didemnidés ascidiennes australiennes appartenant à deux nouveaux genres, sont décrites et illustrées. *Atriolum robustum* gen. nov., sp. nov., a des caractères qui suggèrent des affinités avec le genre *Leptoclinides* et le genre *Didemnum*. Les zooides grandes et le tuyot ovipare fonctionnel sont peut être des caractéristiques primitifs, mais la chambre incubatoire est probablement convergente, ayant la même structure que les Holozoidae. Le *Polysoma testiculata* gen. nov., sp. nov., ressemble au *Diplosoma*, mais *Polysoma* se distingue par un cercle de nombreuses follicules mâles et par un vas deferens direct.

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