Identification Key to the Genus Phyllodesmium Ehrenberg, 1831

Classification: Nudibranchia, Aeolidida, Myrrhinidae

Number of species: 27 accepted species according to WoRMS (WoRMS list). P. xeniae is a synonym of P. hyalinum.

Genus diagnosis

- **Diet:** Feeds on octocorals (soft corals and gorgonians).
- **No cnidosacs:** Unlike most aeolids, there are no cnidosacs at the tips of the cerata.
- **Camouflage and defence:** The cerata provide camouflage by mimicking the polyps of the host coral. They can also be shed (autotomy).
- **Symbiosis:** Many species host zooxanthellae (Symbiodiniaceae). These are kept in branches of the digestive gland that run through the cerata.
- **Distribution:** Indo-Pacific. The genus is absent from the Mediterranean. Two species occur in the Red Sea: P. hyalinum and P. fastuosum (the type species).

Characters to check in a photo

1. **Rhinophores:** smooth or spiny.
2. **Zooxanthellae:** whether brown spots, streaks or "gardens" show in the cerata, and whether the digestive-gland ducts are branched.
3. **Ceratal shape:** cylindrical, flattened (paddles), inflated or club-shaped, or ornamented with tubercles, undulate margins or side branches.
4. **Colour pattern:** dorsal white line, and the bands at the ceratal tips.
5. **Host and region:** the host coral and the geographic area.

> **Legend:** † marks a character taken from general knowledge or from the species name, and not checked against the original description. Verify these characters before using them in research.

Dichotomous key

1a. Rhinophores spiny or papillate → **P. acanthorhinum** †

1b. Rhinophores smooth → 2

2a. No zooxanthellae. No brown spots in the cerata, and the digestive-gland duct is usually unbranched → 3 (non-symbiotic group)

2b. Zooxanthellae present. Brown spots, streaks or "gardens" are visible in the cerata, and the digestive-gland ducts are branched → 8 (symbiotic group)

Non-symbiotic group

3a. South Africa. Body translucent cream to orange, with a broad opaque white dorsal band. Each ceras has a bluish-white band on its upper side. Host: Melitodes → **P. horridum** † (symbiosis status)

3b. Other regions → 4

4a. Ceratal digestive-gland ducts deep pink. Host: Carijoa → **P. poindimiei**

4b. Ducts not pink → 5

5a. Cerata, rhinophores and oral tentacles capped with white or cream-yellow. The cerata are bluish near their tips → **P. opalescens**

5b. No such caps → 6

6a. Body light brown to orange-brown, with an irregular white dorsal stripe. Upper half of the cerata white or yellowish. Upper half of the rhinophores white → **P. kabiranum** † (symbiosis status)

6b. Other pattern → 7

7a. Colour varies with diet, with a white mid-dorsal line. Hosts: Clavularia, Carijoa, Junceella and Stereonephthya → **P. serratum**

7b. Digestive-gland ducts unbranched and teeth of unusual shape (identification by anatomy only). Philippines → **P. karenae**

Symbiotic group

8a. Very large (often more than 10 cm). Cerata broad, flat and paddle-shaped, with white ducts that branch out to zooxanthellae "gardens". Host: Sarcophyton → **P. longicirrum**

8b. Cerata not broad paddles, or animal smaller → 9

9a. Large (up to 13 cm). Cerata long and somewhat flattened. Zooxanthellae patches concentrated on the upper, sunlit side. Host: Sinularia → **P. magnum**

9b. Smaller than 6 cm → 10

10a. Cerata inflated and full of zooxanthellae. The animal resembles Sinularia. Guam → **P. guamense**

10b. Cerata not inflated in this way → 11

11a. Cerata ornamented with tubercles, side branches or undulate margins → 12

11b. Cerata smooth → 16

12a. Cerata club-shaped: narrow base, expanded upper part, with large pointed lateral tubercles. Body transparent. Host: Lemnalia or Paralemnalia → **P. koehleri**

12b. Other shape → 13

13a. Cerata flattened, with a nodulose upper part dusted in white. Zooxanthellae visible in the nodules. Host: xeniids. Lembeh Strait → **P. lembehense**

13b. Other shape → 14

14a. Cerata with lateral side branches, giving a feather-like shape → **P. pinnatum** †

14b. No side branches → 15

15a. Cerata covered in tubercles → **P. tuberculatum** †

15b. Ceratal margins undulate → **P. undulatum** †. P. crypticum also has flattened cerata with crenulate margins † (host: Xenia).

16a. Host: organ-pipe coral (Tubipora musica). Cerata somewhat flattened, with the edges meeting at the tip. Colour greenish brown, with greenish-white edges and tips → **P. colemani**

16b. Other host → 17

17a. Host: Briareum. Cerata cylindrical and resembling the host's polyps, with rows of brown specks and yellow tips → **P. briareum**

17b. Host Xenia, or unknown → 18

18a. Small (up to 15 mm). Body translucent with brown patches, sometimes with a bluish-purple sheen. Ceratal tips white, with a yellow band and a bluish band below it. Australia, south to Tasmania → **P. macphersonae**

18b. Other pattern → 19

19a. Body translucent white to milky yellow, up to 20 mm → **P. parangatum**

19b. Cerata white with translucent patches, through which a cream-brown digestive gland shows. Rhinophores smooth. Tanzania → **P. pecten** † (symbiosis status)

19c. Cerata cylindrical, smooth and translucent. Red Sea and Indo-Pacific → **P. hyalinum** †

19d. Cerata resemble closed Xenia polyps, length up to 45 mm → **P. rudmani**. P. jakobsenae (up to 30 mm) is similar and needs anatomical examination to identify.

Species not included in the key

These species should be identified from their original descriptions. P. fastuosum (Red Sea, the type species) has no photographic record. P. iriomotense (Ryukyu Islands), P. lizardense (Lizard Island, Australia) and P. jakobsenae (Sulawesi and the Philippines) are known mainly from their original descriptions.

Caveats

- Many species mimic their host, so their colour depends on their diet. Identify by host and ceratal shape rather than by colour.
- Firm identification requires examining the radula and the branching pattern of the digestive gland, or sequencing COI and 16S.
- According to Moore & Gosliner (2011), symbiosis evolved only once in the genus, and was later lost in P. poindimiei and P. karenae. Being non-symbiotic therefore does not by itself show close relationship.

Species gallery and sources

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Phyllodesmium acanthorhinum



(c) Ewout Knoester, some rights reserved (CC BY-SA), uploaded by Ewout Knoester

- Original description: Moore & Gosliner 2014, The Veliger 51: 237–251
- WoRMS
- iNaturalist (9 observations)

Phyllodesmium briareum



(c) Steve Childs, some rights reserved (CC BY)

- Original description: Bergh 1896
- WoRMS
- iNaturalist (573 observations)
- Sea Slug Forum

Phyllodesmium colemani



(c) Robin Gwen Agarwal, some rights reserved (CC BY-NC), uploaded by Robin Gwen Agarwal

- Original description: Rudman 1991, J. Molluscan Stud. 57: 167–203
- WoRMS
- iNaturalist (116 observations)
- Sea Slug Forum

Phyllodesmium crypticum



(c) Steve Childs, some rights reserved (CC BY)

- Original description: Rudman 1981, Zool. J. Linn. Soc. 72: 219–262
- WoRMS
- iNaturalist (360 observations)
- Sea Slug Forum

Phyllodesmium fastuosum

No photo available on iNaturalist.

- Original description: Ehrenberg 1831
- WoRMS
- iNaturalist (0 observations)

Phyllodesmium guamense

No photo available on iNaturalist.

- Original description: Ávila et al. 1998, J. Molluscan Stud.
- WoRMS
- iNaturalist (0 observations)

Phyllodesmium horridum



(c) Terry Gosliner, all rights reserved, uploaded by Terry Gosliner

- Original description: Macnae 1954
- WoRMS
- iNaturalist (256 observations)
- Sea Slug Forum

Phyllodesmium hyalinum



(c) Rafi Amar, some rights reserved (CC BY-NC), uploaded by Rafi Amar

- Original description: Ehrenberg 1831
- WoRMS
- iNaturalist (39 observations)
- Sea Slug Forum

Phyllodesmium iriomotense



(c) yannickvm, some rights reserved (CC BY-NC)

- Original description: Baba 1991
- WoRMS
- iNaturalist (111 observations)
- Sea Slug Forum

Phyllodesmium jakobsenae



(c) Mike Krampf, some rights reserved (CC BY-NC), uploaded by Mike Krampf

- Original description: Burghardt & Wägele 2004, Zootaxa 596: 1–18
- WoRMS
- iNaturalist (132 observations)

Phyllodesmium kabiranum



(c) Hiroki Shudo, some rights reserved (CC BY-NC), uploaded by Hiroki Shudo

- Original description: Baba 1991
- WoRMS
- iNaturalist (48 observations)
- Sea Slug Forum

Phyllodesmium karenae



(c) Terry Gosliner, all rights reserved, uploaded by Terry Gosliner

- Original description: Moore & Gosliner 2009, Zootaxa 2201: 30–48
- WoRMS
- iNaturalist (12 observations)

Phyllodesmium koehleri



(c) Erwin Koehler, some rights reserved (CC BY-NC), uploaded by Erwin Koehler

- Original description: Burghardt, Schrödl & Wägele 2008, J. Molluscan Stud. 74: 277–292
- WoRMS
- iNaturalist (167 observations)
- Sea Slug Forum

Phyllodesmium lembehense



(c) Isla Elliott-Walker, all rights reserved, uploaded by Isla Elliott-Walker

- Original description: Burghardt, Schrödl & Wägele 2008, J. Molluscan Stud. 74: 277–292
- WoRMS
- iNaturalist (8 observations)
- Sea Slug Forum

Phyllodesmium lizardense



(c) Jim Greenfield, some rights reserved (CC BY-NC), uploaded by Jim Greenfield

- Original description: Burghardt, Schrödl & Wägele 2008, J. Molluscan Stud. 74: 277–292
- WoRMS
- iNaturalist (74 observations)

Phyllodesmium longicirrum



(c) Tsu Soo Tan, some rights reserved (CC BY-NC), uploaded by Tsu Soo Tan

- Original description: Bergh 1905
- WoRMS
- iNaturalist (166 observations)
- Sea Slug Forum

Phyllodesmium macphersonae



(c) lillianclementine, some rights reserved (CC BY-ND)

- Original description: Burn 1962
- WoRMS
- iNaturalist (503 observations)
- Sea Slug Forum

Phyllodesmium magnum



(c) Mark Rosenstein, some rights reserved (CC BY-NC)

- Original description: Rudman 1991, J. Molluscan Stud. 57: 167–203
- WoRMS
- iNaturalist (227 observations)
- Sea Slug Forum

Phyllodesmium opalescens



(c) Terry Gosliner, some rights reserved (CC BY-NC-SA), uploaded by Terry Gosliner

- Original description: Rudman 1991, J. Molluscan Stud. 57: 167–203
- WoRMS
- iNaturalist (262 observations)
- Sea Slug Forum

Phyllodesmium parangatum



(c) Terry Gosliner, all rights reserved, uploaded by Terry Gosliner

- Original description: Ortiz & Gosliner 2003, Proc. Calif. Acad. Sci. 54(9): 161–168
- WoRMS
- iNaturalist (44 observations)

Phyllodesmium pecten



(c) Dave and Janet Morgan, all rights reserved, uploaded by Dave and Janet Morgan

- Original description: Rudman 1981, Zool. J. Linn. Soc. 72: 219–262
- WoRMS
- iNaturalist (14 observations)
- Sea Slug Forum

Phyllodesmium pinnatum



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- Original description: Moore & Gosliner 2009, Zootaxa 2201: 30–48
- WoRMS
- iNaturalist (65 observations)

Phyllodesmium poindimiei



(c) Johan Bas, some rights reserved (CC BY-NC), uploaded by Johan Bas

- Original description: Risbec 1928
- WoRMS
- iNaturalist (819 observations)
- Sea Slug Forum

Phyllodesmium rudmani



(c) terence zahner, some rights reserved (CC BY-NC), uploaded by terence zahner

- Original description: Burghardt & Gosliner 2006, Proc. Calif. Acad. Sci.
- WoRMS
- iNaturalist (115 observations)

Phyllodesmium serratum



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- Original description: Baba 1949
- WoRMS
- iNaturalist (877 observations)
- Sea Slug Forum

Phyllodesmium tuberculatum



(c) Jim Greenfield, all rights reserved, uploaded by Jim Greenfield

- Original description: Moore & Gosliner 2009, Zootaxa 2201: 30–48
- WoRMS
- iNaturalist (93 observations)

Phyllodesmium undulatum



(c) uwkwaj, some rights reserved (CC BY-NC), uploaded by uwkwaj

- Original description: Moore & Gosliner 2014, The Veliger 51: 237–251
- WoRMS
- iNaturalist (42 observations)

Key references

- Rudman, W.B. (1981). The anatomy and biology of alcyonarian-feeding aeolid opisthobranch molluscs and their development of symbiosis with zooxanthellae. Zoological Journal of the Linnean Society 72: 219–262. DOI
- Rudman, W.B. (1991). Further studies on the taxonomy and biology of the octocoral-feeding genus Phyllodesmium Ehrenberg, 1831. Journal of Molluscan Studies 57(2): 167–203. Link
- Burghardt, I. & Wägele, H. (2004). Zootaxa 596: 1–18. DOI
- Burghardt, I., Schrödl, M. & Wägele, H. (2008). Three new solar-powered species of the genus Phyllodesmium. Journal of Molluscan Studies 74(3): 277–292. DOI
- Moore, E. & Gosliner, T. (2009). Three new species of Phyllodesmium Ehrenberg, and a revised phylogenetic analysis. Zootaxa 2201: 30–48. DOI
- Moore, E.J. & Gosliner, T.M. (2011). Molecular phylogeny and evolution of symbiosis in a clade of Indopacific nudibranchs. Molecular Phylogenetics and Evolution 58(1): 116–123. DOI
- Moore, E. & Gosliner, T. (2014). Additions to the genus Phyllodesmium, with a phylogenetic analysis and its implications to the evolution of symbiosis. The Veliger 51(4): 237–251. BioStor
- WoRMS – genus Phyllodesmium
- Sea Slug Forum (Rudman)