



<http://dx.doi.org/10.11646/zootaxa.3802.4.5>

<http://zoobank.org/urn:lsid:zoobank.org:pub:4095CA09-8EA4-4941-8286-32E95F0206AE>

Review of *Baeolidia*, the largest genus of Aeolidiidae (Mollusca: Nudibranchia), with the description of five new species

LEILA CARMONA^{1,4}, MARTA POLA², TERRENCE M. GOSLINER³ & JUAN LUCAS CERVERA¹

¹Departamento de Biología, Facultad de Ciencias del Mar y Ambientales, Campus de Excelencia Internacional del Mar (CEI-MAR), Universidad de Cádiz. Polígono Río San Pedro, s/n, Ap.40. 11510 Puerto Real (Cádiz), SPAIN.

²Laboratorio de Biología Marina, Departamento de Biología, Edificio de Biología, Campus de Excelencia Internacional UAM+CSIC, Universidad Autónoma de Madrid, C/ Darwin, 2, 28049 Madrid, SPAIN.

³Department of Invertebrate Zoology, California Academy of Sciences, 55 Music Concourse Drive, Golden Gate Park, San Francisco, CA 94118, USA.

⁴Corresponding author. E-mail: leila.carmona@uca.es; phone: +34 956016012

Abstract

This paper discusses the systematics of the aeolid genus *Baeolidia* Bergh, 1888. To date, this monophyletic genus is the most diverse within Aeolidiidae with sixteen valid species. Excluding *Baeolidia cryoporos* Bouchet, 1977, the genus is restricted to the Indo-Pacific and Eastern Pacific. Species of *Baeolidia* show a huge intrageneric variability in several morphological characters. Only oral glands, if present, may distinguish *Baeolidia* from other aeolidiids genera. *Aeolidiella occidentalis* Bergh, 1875, *Aeolidiella faustina* Bergh, 1900 and *Spurilla orientalis* Bergh, 1905 are transferred to *Baeolidia* but they are considered *nomina dubia*. Five new species, *Baeolidia rieae* sp. nov., *Baeolidia variabilis* sp. nov., *Baeolidia lunaris* sp. nov., *Baeolidia gracilis* sp. nov. and *Baeolidia scottjohnsoni* sp. nov. are described.

Key words: Cladobranchia, molluscan diversity, morphology, new species, systematics

Introduction

The aeolidiid genus *Baeolidia* was introduced by Bergh (1888) based on a single preserved specimen of *Baeolidia moebii* from Mauritius. The original description has contradictory information about the cerata arrangement, which has been considered as one of the most important diagnostic characters in Aeolidiidae. Bergh (1888) originally described the cerata in rows and then in arches (page 779 of that contribution). This lack of clarity has produced a great deal of confusion in the literature about the morphological characteristics of this genus. While some authors characterized *Baeolidia* by having the cerata in arches (Miller 2001) others ascribed or transferred species that have rows instead of arches to this genus (Gosliner 1985). Additionally, *Baeolidia* has been considered as a junior synonym of *Spurilla* Bergh, 1864 (Rudman 1982), whereas some authors that have considered *Baeolidia* as a valid genus rejected the validity of *Limenandra* (Gosliner 1980, 1985; Valdés *et al.* 2006; Gosliner *et al.* 2008). Some species have been assigned to *Baeolidia*: *Baeolidia moebii* Bergh, 1888; *Baeolidia major* Eliot, 1903; *Baeolidia japonica* Baba, 1933; *Baeolidia fusiformis* Baba, 1949; *Baeolidia benteva* Er. Marcus, 1958; *Baeolidia cryoporos* Bouchet, 1977 and *Baeolidia palythoae* Gosliner, 1985. Furthermore, *Limenandra nodosa* Haefelfinger & Stamm, 1958; *Aeolidiopsis harrietae* Rudman, 1982 and *Spurilla australis* Rudman, 1982 were also transferred to *Baeolidia* because of their ceratal arrangement or/and the ornamentation of the rhinophores (Gosliner 1985; Miller 2001).

The first comprehensive study on Aeolidiidae (Carmona *et al.* 2013) rendered *Baeolidia* as a monophyletic genus once *Spurilla salaamica* Rudman, 1982 and *Aeolidiopsis ransoni* Rudman, 1982 were transferred to *Baeolidia*. The latter contribution also showed that not only the ceratal arrangement but also the rhinophoral ornamentation and the position of the anus lacked of any phylogenetic significance within *Baeolidia*. Additionally, Carmona *et al.* (2013) pointed out the existence of, at least, three undescribed species (Fig. 1). The molecular

Acknowledgments

We are deeply grateful to all individuals who helped to collect and provided specimens and images for this study, including C. Pittman, R. Nakano, S. Johnson and Y. Tibiriça. This work was supported by several research grants (CGL2006-05182/BOS and CGL2010-17187, Spanish Ministry of Economy and Competitiveness (includes the early Ministry of Sciences and Innovation) to J. L. Cervera; California Academy of Sciences, National Science Foundation (DEB 0329054 PEET) to T. M. Gosliner; and a Research Grant of the Malacological Society of London to L. Carmona. This is CEI-MAR journal publication 56.

References

- Adams, J.A. (1960) A contribution to the biology and postlarval development of the Sargassum Fish, *Histrio histrio* (Linnaeus), with a discussion of the *Sargassum* complex. *Bulletin of Marine Science of the Gulf & Caribbean*, 10, 55–82.
- Angas, G.F. (1864) Description d'espèces nouvelles appartenant à plusieurs genres de Mollusques Nudibranches des environs de Port-Jackson (Nouvelle-Galles du Sud), accompagnée de dessins faits d'après nature. *Journal de Conchyliologie*, 12, 43–70.
- Baba, K. (1933a) Supplementary note on the Nudibranchia collected in the vicinity of the Amakusa Marine Biological Laboratory. *Annotationes Zoologicae Japonenses*, 14, 273–283.
- Baba, K. (1933b) Preliminary account on the Nudibranchia collected in the vicinity of Amakusa Marine Biological Laboratory. *Annotationes Zoologicae Japonenses*, 14, 165–179.
- Baba, K. (1937) Opisthobranchia of Japan (II). *Journal of the Department of Agriculture, Kyushu Imperial University*, 5, 289–344.
- Baba, K. (1949) *Opisthobranchia of Sagami Bay collected by His Majesty The Emperor of Japan*. Iwanami Shoten, Tokyo, 149 pp.
- Baba, K. (1955) *Opisthobranchia of Sagami Bay. Suppl.* Iwanami Shoten, Tokyo, 59 pp.
- Bergh, L.S.R. (1864) Anatomiske bidrag til kundskab om Aeolidierne. *Det Kongelige Videnskabernes Selskabs Skrifter, Naturvidenskabelige og Matematiske Afdeling* 7, 139–316.
- Bergh, L.S.R. (1874) Malacologische Untersuchungen. In: Semper, C. (Ed.), *Reisen im Archipel der Philippinen*. Zweiter Theil, Wissenschaftliche Resultate. Band 2, Heft 6, pp. 247–285.
- Bergh, L.S.R. (1878) Malacologische Untersuchungen. In: Semper, C. (Ed.), *Reisen im Archipel der Philippinen*. Zweiter Theil, Wissenschaftliche Resultate. Band 2, Heft 14, pp. 603–645.
- Bergh, L.S.R. (1888) Malacologische Untersuchungen. In: Semper, C. (Ed.), *Reisen im Archipel der Philippinen*. Zweiter Theil, Wissenschaftliche Resultate. Band 2, Heft 16, pp. 755–814.
- Bergh, L.S.R. (1900) Ergebnisse einer Reise nach dem Pacific (Schauinsland 1896-1897). *Die Opisthobranchier. Zoologische Jahrbücher*, 13, 207–246.
- Bergh, L.S.R. (1905) Die Opisthobranchiata der Siboga-Expedition. *Siboga Expedition Monographs*, 50, 1–248.
- Bidgrain, P. (2013) *Spurilla major* (Eliot, 1903). [Message in] *South-west Indian Ocean Seaslugs site*. Available from: http://seaslugs.free.fr/nudibranche/a_intro.htm. (accessed 1 January 2013)
- Bouchet, P. (1977) Opisthobranches de profondeur de l'océan atlantique: II. Notaspidea et Nudibranchiata. *Journal of Molluscan Studies*, 43, 28–66.
- Burn, R. (1962) Descriptions of Victorian nudibranchiate Mollusca, with a comprehensive review of the Eolidacea. *Memoirs of the National Museum, Melbourne*, 25, 95–128.
- Burn, R. (1969) A memorial report on the Tom Crawford collection of Victorian Opisthobranchia. *Journal of the Malacological Society of Australia*, 12, 64–106.
- Burn, R. (2006) A checklist and bibliography of the Opisthobranchia (Mollusca: Gastropoda) of Victoria and the Bass Strait area, south-eastern Australia. *Museum Victoria Science Reports*, 10, 1–42.
- Carmona, L., Pola, M., Gosliner, T.M. & Cervera, L. (2013) A tale that morphology fails to tell: a molecular phylogeny of Aeolidiidae (Aeolidida, Nudibranchia, Gastropoda). *PloS One*, 8, 5. <http://dx.doi.org/10.1371/journal.pone.0063000>
- Carmona, L., Lei, B.R., Pola, M., Gosliner, T.M., Valdés, Á. & Cervera, J.L. (2014a) Untangling the *Spurilla neapolitana* (Delle Chiaje, 1841) species complex: a review of the genus *Spurilla* Bergh, 1864 (Mollusca: Nudibranchia: Aeolidiidae). *Zoological Journal of the Linnean Society*, 17, 132–154. <http://dx.doi.org/10.1111/zoj.12098>
- Carmona, L., Pola, M., Gosliner, T.M., Cervera, J.L. (2014b) The Atlantic-Mediterranean genus *Berghia* (Mollusca, Nudibranchia, Aeolidiidae). Taxonomic review and phylogenetic analysis. *Journal of Molluscan Studies*. [in press]
- Carmona, L., Pola, M., Gosliner, T.M. & Cervera, L. (2014c) The end of a long controversy: systematics of the genus *Limenandra* (Mollusca: Nudibranchia: Aeolidiidae). *Helgoland Marine Research*, 68, 37–48. <http://dx.doi.org/10.1007/s10152-013-0367-y>

- Cobb, G. & Mullins, D. (2013) *Baeolidia major* [Message in] *Nudibranchs Sunshine Coast Australia*. Available at: <http://www.nudibranch.com.au/pages/b2879WPw.htm> (accessed 1 January 2013)
- Coleman, N. (2001) *1001 Nudibranchs - Catalogue of Indo-Pacific Sea Slugs*. Neville Coleman's Underwater Geographic Pty. Ltd., Springwood, Queensland, 144 pp.
- Edmunds, M. (1969) Opisthobranchiate Mollusca from Tanzania. I. Eolidacea (Eubranchidae and Aeolidiidae). *Proceedings of the Malacological Society of London*, 38, 451–469.
- Edmunds, M. (1970) Opisthobranchiate Mollusca from Tanzania. II. Eolidacea (Eubranchidae and Aeolidiidae). *Proceedings of the Malacological Society of London*, 39, 15–57.
- Eliot, C.N.E. (1903) On some nudibranchs from east Africa and Zanzibar, part II. *Proceedings of the Zoological Society of London*, 1, 250–257.
- Franc, A. (1968) Sous-classe des opisthobranches. In: Grassé, P.P. (Ed.), *Traite de Zoologie*. Masson, Paris, pp. 608–893.
- Farmer, W. (1966) Range extension of *Berghia amakusana* (Baba) to the East Pacific. *The Veliger*, 9, 251.
- García-Gómez, J.C. (2002) *Paradigmas de una fauna insólita: los moluscos opistobranquios del Estrecho de Gibraltar*. Instituto de Estudios Campogibraltareños, 397 pp.
- Gosliner, T.M. (1980) The systematics of the Aeolidacea (Nudibranchia: Mollusca) of the Hawaiian Islands, with description of two new species. *Pacific Science*, 33, 37–77.
- Gosliner, T.M. (1985) The aeolid nudibranchs family Aeolidiidae (Gastropoda, Opisthobranchia) from tropical southern *Annals of the South African Museum*, 95, 233–267.
- Gosliner, T.M., Behrens, D.W. & Valdés, Á. (2008) *Indo-Pacific nudibranchs and sea slugs*. Sea Challengers/California Academy of Sciences Gig, Harbor/San Francisco, CA, 426 pp.
- Haefelfinger, H.R. & Stamm, R.A. (1958) *Limenandra nodosa* gen. et spec. nov. (Nudibranch., Aeolidiidae propr.), un opisthobranch nouveau de la Méditerranée. *Vie et milieu*, 9, 418–423.
- Kay, E.A. (1979) *Hawaiian marine shells, reef and shore fauna of Hawaii, section 4: Mollusca*. Bishop Museum Press, Honolulu, 653 pp.
- Koh, D.B. (2006) *Sea Slugs of Korea*. Pungdeung Publishing, Korea, 250 pp.
- Labbé, A. (1930) Remarques sur les genres *Aeolidiella* Bergh, *Spurilla* Bergh, et *Berghia* Trinchese. *Bulletin de la Société Zoologique de France*, 54, 619–630.
- Marcus, Er. (1958) On western Atlantic opisthobranchiate gastropods. *American Museum Novitates*, 1906, 1–82.
- Marcus, Er. (1961) Opisthobranch Mollusks from California. *The Veliger*, 3 (Supplement), 1–85.
- Marcus, Er. & Marcus, Ev. (1960) Opisthobranchia aus dem Roten Meer und von den Malediven. *Akademie der Wissenschaften und der Literature, Abhandlungen der Mathematisch-Naturwissenschaftlichen Klasse*, 12, 873–934.
- Miller, M.C. (2001) Aeolid nudibranchs (Gastropoda: Opisthobranchia) of the family Aeolidiidae from New Zealand waters. *Journal of Natural History*, 35, 629–662.
<http://dx.doi.org/10.1080/00222930152023081>
- Morton, J. & Miller, M. (1968) *The New Zealand sea shore*. Collins, Auckland & London, 653 pp.
- Nakano, R. (2004) *Opisthobranchs of Japan Islands*. Rutles, Inc, Tokyo, 304 pp.
- Odhner, N.H. (1939) Opisthobranchiate Mollusca from the western and northern coasts of Norway. *Det Kgl Norske Vidensk Selsk Skrift*, 1, 1–93.
- Ono, A. (1999) *Opisthobranchs of Kerama Islands*. TBS-Britannica Co., Ltd, Tokyo, 184 pp.
- Ono, A. (2004) *Opisthobranchs of Ryukyu Islands*. Rutles, Inc, Tokyo, 304 pp.
- Pittman, C. & Fiene, P. (2012a) *Aeolidiopsis ransoni*. [Message in] *Sea Slugs of Hawaii*. Available from: <http://seaslugsofhawaii.com/species/Aeolidiopsis-ransoni-a.html> (accessed 1 November 2012)
- Pittman, C. & Fiene, P. (2012b) *Berghia salaamica*. [Message in] *Sea Slugs of Hawaii*. Available from: <http://seaslugsofhawaii.com/species/Berghia-salaamica-a.html> (accessed 1 November 2012)
- Pola, M., Cervera, J.L. & Gosliner, T.M. (2007) Phylogenetic relationships of Nembrothinae (Mollusca: Doridacea: Polyceridae) inferred from morphology and mitochondrial DNA. *Molecular Phylogenetics and Evolution*, 43, 726–742.
<http://dx.doi.org/10.1016/j.ympev.2007.02.003>
- Pola, M., Cervera, J.L. & Gosliner, T.M. (2008) Description of the first *Roboastra* species (Nudibranchia, Polyceridae, Nembrothinae) from the western Atlantic. *Bulletin of Marine Science*, 83, 391–399.
- Powell, A.W.B. (1976) *Shells of New Zealand, An illustrated Handbook*, Fifth revised edition. Whitcoulls Publishers, Christchurch, 154 pp.
- Powell, A.W.B. (1979) *New Zealand Mollusca, Marine, Land and Freshwater Shells*. Collins Publishers Ltd, Auckland, 500 pp.
- Pruvot-Fol, A. (1956) Un Aeolidien nouveau des mers tropicales: *Aeolidiopsis ransoni* n. g., n. sp. *Bulletin du Muséum National d'Histoire Naturelle*, 28, 228–231.
- Rudman, W.B. (1982) The taxonomy and biology of further aeolidacean and arminacean nudibranch molluscs with symbiotic zooxanthellae. *Zoological Journal of the Linnean Society*, 74, 147–196.
<http://dx.doi.org/10.1111/j.1096-3642.1982.tb01146.x>
- Rudman, W.B. (2002) Comment on *Baeolidia japonica* from Japan. by Jun Imamoto. [Message in] *Sea Slug Forum*. Australian Museum, Sydney. Available from: <http://www.seaslugforum.net/find/7665> (accessed 1 November 2012)
- Rudman, W.B. (20027a) Comment on *Spurilla macleayi* from northeastern New Zealand by Ian Skipworth. [Message in] *Sea*

- Slug Forum*. Australian Museum, Sydney. Available from: <http://www.seaslugforum.net/find/19188> (accessed 1 November 2012)
- Rudman, W.B. (20027b) Comment on *Spurilla australis* from Lembeh Straits, Sulawesi by Matt Oldfield. [Message in] *Sea Slug Forum*. Australian Museum, Sydney. Available from: <http://www.seaslugforum.net/find/19744> (accessed 1 November 2012)
- Schmekel, L. (1970) Anatomie der Genitalorgane von Nudibranchiern (Gastropoda Euthyneura). *Pubblicazioni della Stazione Zoologica di Napoli*, 38, 120–217.
- Thiel, M. & Gutow, L. (2005) The ecology of rafting in the marine environment. II. The rafting organisms and community. *Oceanography & Marine Biology Annual Review*, 43, 279–418.
<http://dx.doi.org/10.1201/9781420037449.ch7>
- Trinchese, S. (1877) Notes II. Descrizione del genere *Berghia*, Trinchese. *Rendiconto delle Sessioni dell'Accademia delle Scienze dell'Istituto di Bologna*, anno accademico 1876-77, pp. 151–153.
- Turk, T. & Furlan, B. (2011) New records of Indo-Pacific and Atlantic mollusc species (Opisthobranchia) in the Eastern Mediterranean and Adriatic Sea. *Annales Series Historia Naturalis*, 21, 5–10.
- Valdés, Á., Hamann, J., Behrens, D.W. & DuPont, A. (2006) *Caribbean Sea Slugs. A field guide to the opisthobranch mollusks from the tropical northwestern Atlantic*. Sea Challengers Natural History Books, Gig Harbor/Washington, 289 pp.
- Willan, R.C. & Morton, J.M. (1984) *Marine Molluscs Part II. Opisthobranchia*. University of Auckland Leigh Marine Laboratory, Auckland, New Zealand, 106pp.