



New Record of a Marine Heterobranch, *Dendrodoris krusensternii* (J. E. Gray, 1850), from the Odisha Coast, India

S. Rajendra*, Tamal Mondal and C. Raghunathan

¹Zoological Survey of India, M-Block, New Alipore, Kolkata – 700 053, West Bengal

Abstract

The present study documents the marine heterobranch mollusca, *Dendrodoris krusensternii* (J. E. Gray, 1850), for the first time from the Odisha Coast, India. The specimen was collected from the Nuanai river within the Balukhand-Konark Wildlife Sanctuary, Odisha. Detailed illustrations and descriptions of the species characteristic features are provided, along with distributional information. Additionally, a list of marine heterobranch faunal species along the Odisha coast is included. Furthermore, a comprehensive list of Indian Dendrodorididae species is also provided.

Keywords: Backwaters, Fishing, Konark, Mollusca, Nuanai river, Puri, Balukhand-Konark Wildlife Sanctuary

Introduction

Marine heterobranchs, a diverse group of gastropod molluscs, encompass a wide array of species found in marine habitats worldwide (Sreeraj *et al.*, 2013). They display bright colors, patterns, obvious shapes and distributed from intertidal to subtidal, shallow water coral reef regions to cold and deeper waters (Gosliner *et al.*, 2008). They mainly feed on other benthic metazoans such as sponges, cnidarians (sea anemones), ascidians and bryozoans (Papu *et al.*, 2020). Hence as they provide nutrition with high food specificity on the species level some species are indicating for the diversity of other metazoans in coral reef environment (Wells and Bryce, 1993).

Members of the Dendrodorididae family are nocturnal, distinguished by elongate-ovate, smooth bodies that range in size from moderately to highly elongate. Their mantle has a broad skirt that is usually smooth but may include pustules or tubercles on the surface. The lamellate rhinophores terminate in a unique club and can be constricted into individual pockets. These dorids lack a radula and jaws (Wägele *et al.* 2003). They eat sponges by secreting glandular chemicals that dissolve the sponge tissues, which they subsequently ingest by sucking up the remains (Young, 2003). There are only three genera documented viz., *Cariopsilla* Ortea & Espinosa, 2006, *Doriopsilla* Bergh, 1880, and *Dendrodoris* Ehrenberg, 1831 comprising a total of 72 species (MolluscaBase, 2024a). Of these, only 14 species belonging to two genera have been

recorded in Indian waters.

Ehrenberg (1831) described the genus *Dendrodoris* with the specimen of *Doris lugubris* Ehrenberg, 1828 currently accepted as *Dendrodoris limbata* (Cuvier, 1804), which is type by subsequent designation (MolluscaBase eds. 2024b). Species of the genus *Dendrodoris* are characterized by soft body with or without spicules, with some species having large tubercles on the notum. Their dorsal coloration is variable, with a wide, wavy mantle edge with radiating striations. Tripinnate gills form a circle around the anus, while rhinophores have a cylindrical stalk and lamellate club. Oral tentacles are either nonexistent or tiny ventrally (Valdés *et al.*, 1996). There is a total of 45 valid species under the genus *Dendrodoris* (MolluscaBase, 2024b). Of these, 12 species are documented along the Indian coast. The present study reports, *Dendrodoris krusensternii* (J. E. Gray, 1850) from Nuanai river of Balukhand-Konark Wildlife Sanctuary, Odisha coast for the first time.

Material and Methods

As a part of the assessment of faunal diversity of Balukhand-Konark Wildlife Sanctuary, a specimen of marine heterobranch was collected from the Nuanai River within the Balukhand-Konark Wildlife Sanctuary. A live specimen was manually collected by hand-picking method from the study area. The specimen was narcotized by using

a solution containing 72g/L of MgCl₂. Subsequently, the specimen was fixed in a solution of 5% formaldehyde and seawater, followed by transfer to 95% ethanol for long-term preservation. Species identification was conducted solely based on external morphology, utilizing standard literature sources such as Alder and Hancock (1864), Apte and Desai (2017), Chandran *et al.* (2017a,b) and the online portal <http://www.seaslugforum.net/>. Identified species was registered in National Zoological Collections of Zoological Survey of India, Kolkata, India.

A checklist of marine heterobranch fauna of Odisha coast compiled by available information from published literature, available data, and reports, including the findings of this study (Table 1). As well the checklist of Indian Dendrodorididae species distribution in Indian waters also provided in Table 2. The taxonomic status of species listed in the checklist was validated using the WoRMS (World Register of Marine Species, 2024) database, ensuring accuracy and consistency. Any corrected taxonomy or nomenclature discrepancies were promptly updated accordingly.

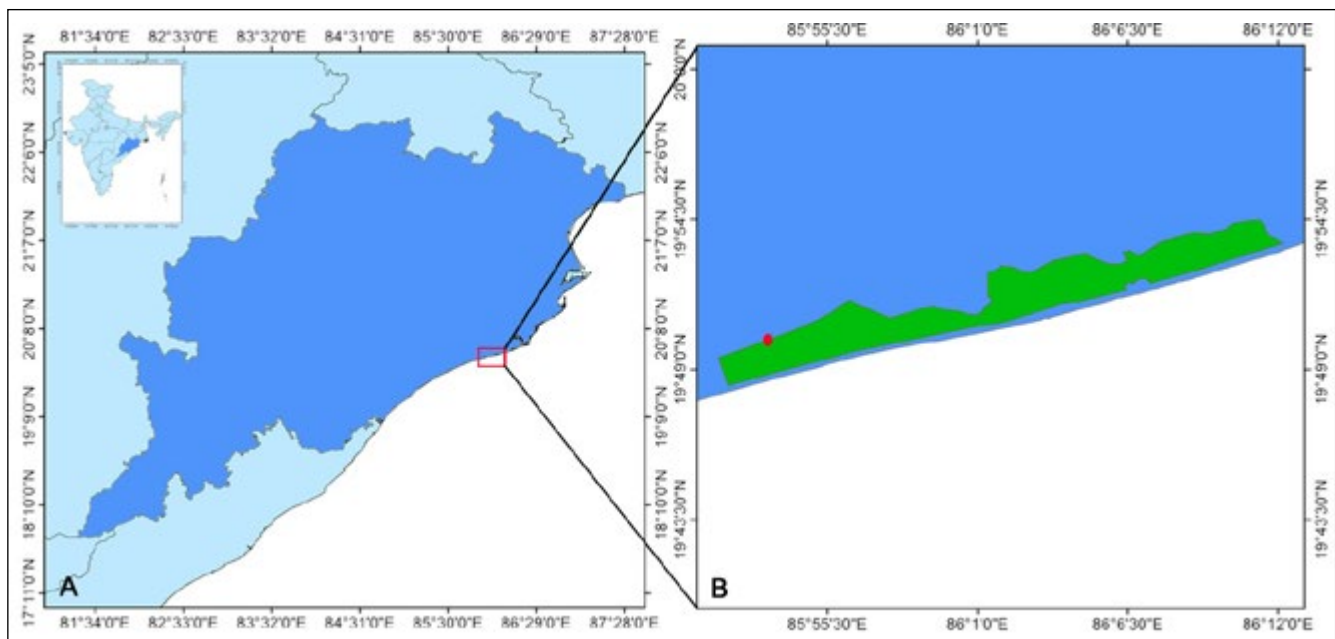


Figure 1: A. Map showing the survey state, Odisha; B. study area of Balukhand-Konark Wildlife Sanctuary (Red point is where specimen was found)

Result

Systematics

Phylum Mollusca
 Class Gastropoda
 Subclass Heterobranchia Burmeister, 1837
 Order Nudibranchia Cuvier, 1817
 Family Dendrodorididae O'Donoghue, 1924 (1864)
 Genus *Dendrodoris* Ehrenberg, 1831
 Species *Dendrodoris krusensternii* (J. E. Gray, 1850)

Common name

Blue-spot nudibranch

Synonyms

Actinodoris krusensternii J. E. Gray, 1850
Dendrodoris clavulata (Alder & Hancock, 1864)
Dendrodoris denisoni (Angas, 1864)
Dendrodoris gemmacea (Alder & Hancock, 1864)
Dendrodoris gunnamatta J. K. Allan, 1932
Doridopsis clavulata Alder & Hancock, 1864
Doridopsis gemmacea Alder & Hancock, 1864
Doris denisoni Angas, 1864

Material examined

One live specimen, Puri, Balukhand-Konark WLS, Nuanai river (Lat: 19°50'19.31"N; Long: 85°53'48.24"E) on 29th February 2024 (ZSI-M37463/10) (Figure 1).

Description

Body brown, large, broad, soft body and presence of numerous yellowish brown and white fleshy tubercles scattered on the dorsum. These tubercle shapes are varying in sizes. Body covered with distinctive iridescent blue spots on both the surface of the body and tubercles. Mantle edge also covered with blue or dark spots. Thick club-like rhinophores are brown with white tips and brown stalks while the large feathery gills are translucent cream with dark brown edges. Foot is light brownish colour with few purple spots (Figure 2).

After preservation specimen changed into brown colour and blue spots become dark color appearance as black or dark brownish spots or ring or circle shaped.

Size: 65 cm

Type locality: M.E. Gray did not specify the locality where *A. krusensternii* was collected; however, according to Krusenstern (1810-14), the specimen was collected in Japan (Valdés and Fahey, 2006).

Geographical Distribution: *India:* Odisha (present study), Goa (Apte and Desai, 2017); Kerala (Chandran *et al.*, 2017b); Andhra Pradesh (Alder and Hancock, 1864); Lakshadweep (Chandran *et al.*, 2017a) and Andaman and Nicobar Islands (Venkataraman *et al.*, 2015; Apte and Desai, 2017); Elsewhere: This species wide spread in the Indo-Pacific region (Valdés and Fahey, 2006). Hawaii (Gosliner, 1987), Midway Atoll (Gosliner *et al.*, 2008), Japan (Baba, 1949), Australia (Angas, 1864), Korea, Papua New Guinea, New Caledonia, New Zealand, Philippines, Indonesia, Singapore, Thailand, Réunion Island (Gosliner *et al.*, 2008), South Africa (Gosliner, 1987) and Mozambique (Macnae and Kalk, 1958; King and Fraser, 2014) (Tibirica, 2017) (Figure 3).

Season of occurrence: December to May

Habitat: The present specimen found from the backwaters of Nuanai river which is approximately 3.2 km from Nuanai Beach, Odisha coast during hightide time.

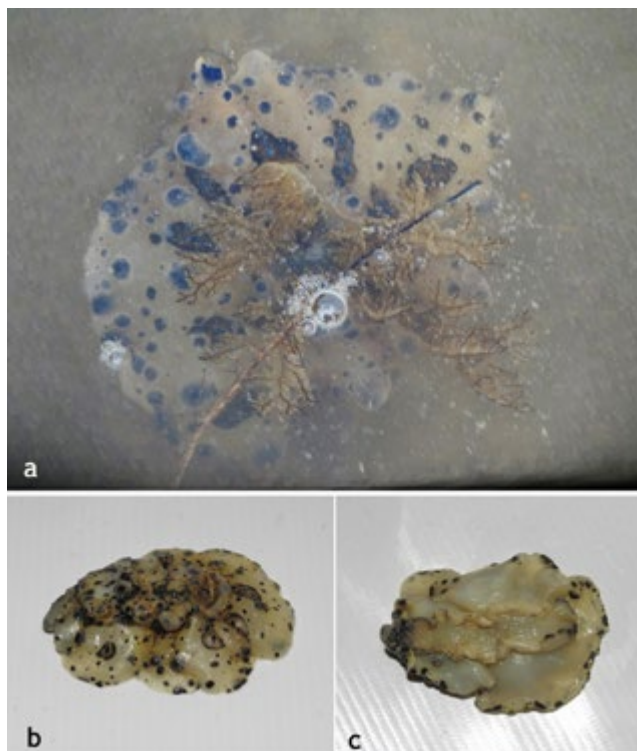


Figure 2: *Dendrodoris krusensternii* (J. E. Gray, 1850) a, *In-situ* photograph showing the morphological features of species; b, dorsal view of specimen, after preservation; c, foot region of specimen

Remarks: The species status is uncommon and usually exhibits significant color variation throughout the Indo-Pacific region (Rudman, 2003). The blue spots are distinguished feature in this species. There is no previous reports of this species from backwater ecosystems. The Nuanai River mouth is located 3.2 kilometers from the site where the specimen was found. It is plausible that the specimen was transported into the backwaters due to high tide or wave action events. The water's physiochemical characteristics, which are similar to those typically found in estuarine environments, played a crucial role in the specimen's survival. Specifically, the salinity level was measured at 37 parts per thousand (ppt), the temperature at 26°C, and the pH level at 8.2. These conditions seems to be provided a suitable habitat, enabling the specimen to survive.

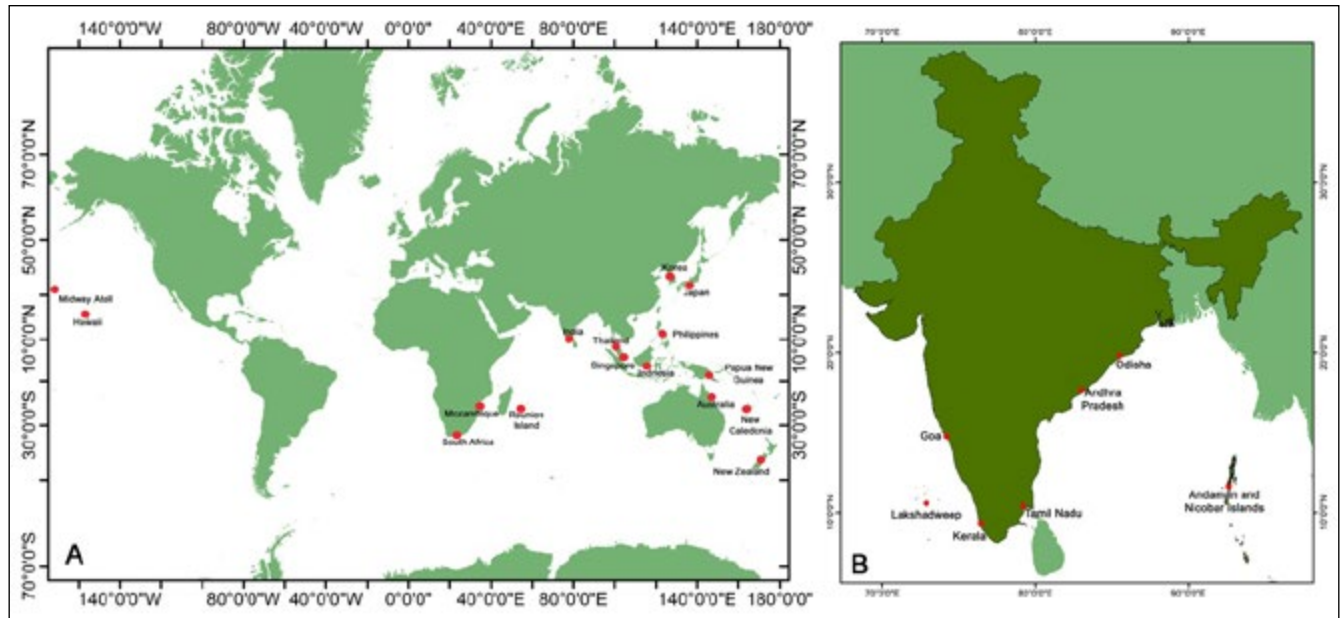


Figure 3: Geographical distribution of *Dendrodoris krusensternii* (J. E. Gray, 1850). A. Indo-Pacific distribution; B. Distribution in India

Discussion

Odisha have extensive coastline along the Bay of Bengal to its numerous estuaries, mangroves, and coral reefs. Odisha's marine habitats harbor a remarkable diversity of species, making it a hotspot for marine biodiversity (Pati *et al.*, 2018). Molluscan diversity well documented in Odisha coastal region (Tudu *et al.*, 2018). Studies conducted in Odisha have documented the presence of various heterobranch species, including both common and rare taxa. The present recorded species was collected from the Nuanai river for the study of assessing the faunal diversity in Balukhand-Konark Wildlife Sanctuary. The Nuanai is one of the small river tributary branches of the Mahanadi river system which flows east and drains into Bay of Bengal. A small river branch originated from another tributary river Kushabhadra also joined the Nuanai river. The estuarine part of the Nuanai is located near Beldala village about 9 km from Puri District (Rao and Rath, 2013).

Recently, two new species of sea slugs *viz.*, *Melanochlamys bengalensis* Tudu, Sajan & Mukhapadhyay, 2022 and *Melanochlamys droupadi* Tudu & Sajan, 2024 discovered

from the Odisha coast (Tudu *et al.*, 2022; Tudu and Sajan, 2024). These findings contribute to our understanding of the distribution, abundance, and ecological interactions of heterobranchs in the region. A comprehensive checklist of marine heterobranch species along the Odisha coast, has recorded a total of 12 species under 11 genera and 11 families (see Table 1 for details). Among them only one species of *Dendrodoris* species are recorded from Odisha coast. There are about 14 species belonging to 2 genera of Dendrodorididae species were reported from India (Table 2). Member of the family Dendrodorididae species are well recorded from the both mainland India as well in Island ecosystem. The identification and classification of heterobranch species in Odisha are essential for conservation efforts and ecosystem management. Through studying these organisms, stake holders can assess the health of marine environments, monitor changes over time, and identify potential threats to biodiversity.

Table 1: Checklist of marine heterobranchs recorded from Odisha

Sl. No	Systematics	Odisha
	Phylum Mollusca	
	Class Gastropoda	
	Subclass Heteobranhia	
	Superorder Sacoglossa	
	Superfamily Plakobranchoidea	
	Family Limapontiidae Gray, 1847	
	Genus <i>Ercolania</i> Trinchese, 1872	
1.	<i>Ercolania pica</i> (Annandale & Prashad, 1922)	•
	Family Plakobranhidae Gray, 1840	
	Genus <i>Elysia</i> Risso, 1818	
2.	<i>Elysia chilkensis</i> Eliot, 1916	•
	Superorder Ringiculimorpha	
	Superfamily Ringiculoidea	
	Family Ringiculidae R. A. Philippi, 1853	
	Genus <i>Ringicula</i> Deshayes, 1838	
3.	<i>Ringicula propinquans</i>	•
	Order Cephalaspidea	
	Family Bullidae Gray, 1827	
	Genus <i>Bulla</i> Linnaeus, 1758	
4.	<i>Bulla ampulla</i> Linnaeus, 1758	•
	Family Tornatinidae P. Fischer, 1883	
	Genus <i>Acteocina</i> J. E. Gray, 1847	
5.	<i>Acteocina estriata</i> (Preston, 1914)	•
	Family Haminoeidae Pilsbry, 1895	
	Genus <i>Haloa</i> Pilsbry, 1921	
6.	<i>Haloa crocata</i> (Pease, 1860)	•
	Family Aglajidae Pilsbry, 1895 (1847)	
	Genus <i>Melanochlamys</i> Cheeseman, 1881	
7.	<i>Melanochlamys bengalensis</i> Tudu, Sajan & Mukhapadhyay, 2022	•
8.	<i>Melanochlamys droupadi</i> Tudu & Sajan, 2024	•

Sl. No	Systematics	Odisha
	Order Nudibranchia	
	Family Dendrodorididae O'Donoghue, 1924 (1864)	
	Genus <i>Dendrodoris</i> Ehrenberg, 1831	
9.	<i>Dendrodoris krusensternii</i> (J. E. Gray, 1850) *	•
	Family Arminidae Iredale & O'Donoghue, 1923 (1841)	
	Genus <i>Armina</i> Rafinesque, 1814	
10.	<i>Armina babai</i> (S. Tchang, 1934)	•
	Family Tethydidae Rafinesque, 1815	
	Genus <i>Melibe</i> Rang, 1829	
11.	<i>Melibe viridis</i> (Kelaart, 1858)	•
	Family Cuthonidae Odhner, 1934	
	Genus <i>Cuthona</i> Alder & Hancock, 1855	
12.	<i>Cuthona henrici</i> Eliot, 1916	•

(*new record for Odisha coast)

Table 2: Distribution of Dendrodorididae family in India

Sl. No	Species name	Distribution in India
	Genus <i>Doriopsilla</i> Bergh, 1880	
1.	<i>Doriopsilla miniata</i> (Alder & Hancock, 1864)	Gujarat, Maharashtra
2.	<i>Doriopsilla</i> sp.	Gujarat
	Genus <i>Dendrodoris</i> Ehrenberg, 1831	
3.	<i>Dendrodoris atromaculata</i> (Alder & Hancock, 1864)	Gujarat, Andhra Pradesh
4.	<i>Dendrodoris coronata</i> Kay & D. K. Young, 1969	Lakshadweep
5.	<i>Dendrodoris elongata</i> Baba, 1936	Nicobar Islands
6.	<i>Dendrodoris fumata</i> (Rüppell & Leuckart, 1830)	Gujarat, Maharashtra, Goa, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, Andaman and Nicobar Islands
7.	<i>Dendrodoris fusca</i> (Alder & Hancock, 1864)	Andhra Pradesh
8.	<i>Dendrodoris goani</i> K. V. Rao & Kumary, 1973	Goa
9.	<i>Dendrodoris grisea</i> (Kelaart, 1858)	Andhra Pradesh
10.	<i>Dendrodoris guttata</i> (Odhner, 1917)	Andaman Islands
11.	<i>Dendrodoris krusensternii</i> (J. E. Gray, 1850)	Goa, Kerala, Lakshadweep, Andhra Pradesh, Odisha (present study) and Andaman and Nicobar Islands

Sl. No	Species name	Distribution in India
12.	<i>Dendrodoris nigra</i> (W. Stimpson, 1855)	Gujarat, Kerala, Lakshadweep Tamil Nadu, Andhra Pradesh, Andaman and Nicobar Islands
13.	<i>Dendrodoris pustulosa</i> (Alder & Hancock, 1864)	Andhra Pradesh
14.	<i>Dendrodoris tuberculosa</i> (Quoy & Gaimard, 1832)	Lakshadweep, Andhra Pradesh, Andaman Islands

Acknowledgements

Authors are thankful to the Director, Zoological Survey of India for providing support and facilities during the period. Thanks are also extended to the forest department of

Balukhand-Konark Wildlife Sanctuary for permission. First author is grateful to Dr. C.R. Sreeraj, Scientist-D, Andaman and Nicobar Regional Centre, Zoological Survey of India for confirmation of species.

References

- Alder, J. and Hancock, A. 1864. Notice of a collection of nudibranchiate Mollusca made in India by Walter Elliot Esq. with descriptions of several new genera and species. *Transactions of the Zoological Society of London*, 5(3-4):113–147.
- 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*, 3(12): 43–70.
- Apte, D. and Desai, D. 2017. Field Guide to sea slugs of India. Bombay Natural History Society, Mumbai, 459 p.
- Baba, K. 1949. Opisthobranchia of Sagami Bay. Iwanami Shoten, Tokyo, 149 pp.
- Chandran, B.K.S., Ravinesh, R. and Kumar, A.B. 2017a. Additions to the sea snail fauna (Mollusca: Gastropoda: Opisthobranchia) of Lakshadweep Islands, India. *Journal of Threatened Taxa*, 9(12):11045–11053. <http://doi.org/10.11609/jott.2342.9.12.11045-11053>
- Chandran, B.S., Shrinivaasu, S., Ravinesh, R., Robert, P., Aneesha, A.B. and Kumar, A.B. 2017b. Opisthobranch (Mollusca: Gastropoda) fauna of Kerala, India: A citizen science initiative. *Journal of the Marine Biological Association of India*, 59(1):1–50.
- Ehrenberg, C. G. 1828-1831. Animalia evertebrata exclusis Insectis. Series prima. In: F. G. Hemprich & C. G. Ehrenberg, *Symbolae physicae, seu icones et descriptiones Mammalium, Avium, Insectorum et animalia evertebra, quae ex itinere per Africam borealem et Asiam occidentalem studio nova aut illustrata redierunt*. 126 pp. (1831), 10 pls (1828).
- Gosliner, T.M. 1987. Nudibranchs of southern Africa: a guide to opisthobranch molluscs of southern Africa. Sea Challengers, California Academy of Sciences, San Francisco, 136 pp.
- Gosliner, T.M., Behrens, D.W. and Valdés, Á. 2008. Indo-Pacific nudibranchs and sea slugs: a field guide to the world's most diverse fauna. Sea Challengers Natural History Books, California Academy of Sciences, San Francisco, 426 pp.
- Gosliner, T.M., Behrens, D.W. and Valdes, A. 2008. *Indo Pacific Nudibranchs and Sea Slugs: A Field Guide to the World's Most Diverse Fauna*. San Francisco, CA: Sea Challengers Natural History Books & The California Academy of Sciences, 425 p.
- King, D. and Fraser, V. 2014. The Reef Guide. Fishes, corals, nudibranchs & other invertebrates. East & South Coasts of Southern Africa. Struik Nature, Cape Town, 360 pp.
- Macnae, W. and Kalk, M. 1958. A natural history of Inhaca Island, Mozambique. Witwatersrand Univ. Press, Johannesburg, 163 pp.
- MolluscaBase eds. 2024a. MolluscaBase. Dendrodorididae O'Donoghue, 1924 (1864). Accessed through: World Register of Marine Species at: <https://www.marinespecies.org/aphia.php?p=taxdetails&id=23026> accessed on 2024-05-10

- MolluscaBase eds. 2024b. MolluscaBase. *Dendrodoris* Ehrenberg, 1831. Accessed through: World Register of Marine Species at: <https://www.marinespecies.org/aphia.php?p=taxdetails&id=137883> on 2024-05-15
- Papu, A., Undap, N., Martinez, N.A., Segre, M.R., Datang, I.G., Kuada, R.R., Perin, M., Yonow, N. and Wägele, H. 2020. First Study on Marine Heterobranchia (Gastropoda, Mollusca) in Bangka Archipelago, North Sulawesi, Indonesia. *Diversity*, **12**(2):1–52.
- Pati, S.K., Swain, D., Sahu, K.C., Sharma, R.M. and Mohapatra, A. 2018. Marine fauna of Odisha, east coast of India: an annotated checklist of historical data of 135 years. *Journal of Aquatic Biology and Fisheries*, **6**:1–115.
- Rao D. V. and Rath, S. 2013. Ichthyofauna and Decapod Crustacean Fauna of the Nuanai Estuary, Odisha, Estuarine Ecosystem Series, **5**:1–64 (Published by the Director, Zool. Surv. India, Kolkata)
- Rudman, W.B. 2003. Comment on *Dendrodoris denisoni* from New Zealand by Mark Burnett. [Message in] Sea Slug Forum. Australian Museum, Sydney. Available from <http://www.seaslugforum.net/find/9212>
- Sreeraj, C. R., Sivaperuman, C. and Raghunathan, C. 2013. Species diversity and abundance of opisthobranch molluscs (Gastropoda: Opisthobranchia) in the coral reef environments of Andaman and Nicobar Islands, India. In: *Ecology and Conservation of Tropical Marine Faunal Communities* (pp. 81-106). Springer, Berlin, Heidelberg.
- Tibirica, Y., Pola, M. and Cervera, J.L. 2017. Astonishing diversity revealed: an annotated and illustrated inventory of Nudipleura (Gastropoda: Heterobranchia) from Mozambique. *Zootaxa*, **4359**(1): 1-133.
- Tudu, P.C., Sajan, S., Acharya, S. and Mohapatra, A. 2024. A new species of head-shield sea slug, *Melanochlamys droupadi* (Heterobranchia: Aglajidae) from the north-western Bay of Bengal, India. *Molluscan Research*, pp.1–8.
- Tudu, P.C., Sajan, S., Roy, S., Mukhapadhyay, A., Tripathy, B. and Mohapatra, A. 2022. A new species of cephalaspidean sea slug of the genus *Melanochlamys* Cheeseman, 1881 (Heterobranchia: Aglajidae) from the Bay of Bengal, India. *Molluscan Research*, **42**(4):328–337.
- Tudu, P.C., Yennawar, P., Ghorai, N., Tripathy, B. and Mohapatra, A. 2018. An updated checklist of marine and estuarine mollusc of Odisha coast. *Indian Journal of Geo-Marine Sciences*, **47**(8):1537–1560.
- Valdés, A. and Fahey, J. 2006. Dorid nudibranchs described by JE Gray in ME Gray, 1842-1857 (Mollusca: Opisthobranchia). *Records of the Western Australian Museum*, **69**:95–102.
- Valdés, A., Ortea, J., Àvila, C. and Ballesteros, M. 1996. Review of the genus *Dendrodoris* Ehrenberg, 1831 (Gastropoda: Nudibranchia) in the Atlantic Ocean. *Journal of Molluscan Studies*, **62**(1):1–31.
- Venkataraman, K., Raghunathan, C., Raghuraman, R. and Dixit, S. 2015. Fascinating Seaslugs & Flatworms of Indian Seas. Zoological Survey of India. 1-149. (Published by the Director, Zool. Surv. India, Kolkata)
- Wägele, H., Vonnemann, V. and Wägele, J.W. 2003. Towards a phylogeny of the Opisthobranchia. In: Lydeard C, Lindberg D (eds) *Molecular systematics and phylogeography of mollusks*. Smithsonian Institution Press, Washington, DC, pp 185–228
- Wells, F.E. and Bryce, C.W. 1993. Sea Slugs and Their Relatives of Western Australia; Western Australian Museum: Perth, Australia, p. 184.
- Young, D.K. 1969. The functional morphology of the feeding apparatus of some Indo-west-Pacific dorid nudibranchs. *Malacologia*, **9**:421–445.