



## New distribution record of Heterobranchs (Mollusca: Gastropoda) from Keelakarai coast, Gulf of Mannar, India

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An extensive survey was conducted from 2019 to 2020 in the sub-tidal regions of the Gulf of Mannar, Southeast coast of India. A total of 20 species of heterobranchs was recorded from the Keelakarai group of Islands in the Gulf of Mannar coast using SCUBA gears. Among these, eight species are reported for the first time from the Gulf of Mannar Marine Biosphere Reserve (*Aegires villosus*, *Doriprismatica atromarginata*, *Glossodoris pallida*, *Glossodoris rufomarginata*, *Goniobranchus trimarginatus*, *Gymnodoris citrina*, *Hypselodoris infucata*, and *Tubulophilinopsis gardineri*), and one species namely, *Aldisa andersoni* is a new record to the Indian water. The comprehensive description, morphometric characters and distribution are discussed herewith.

[**Keywords:** *Aegires*, *Aldisa*, East coast of India, Marine National Park, Molluscs, Nudibranchs, Opisthobranchs].

### Introduction

Nudibranchs are shell-less marine molluscs belonging to the subclass Heterobranchia, found in the intertidal to abyssal depths. They are fascinating molluscs commonly called sea slugs. Heterobranchia (Opisthobranchs) are distributed around the world in warm temperate to tropical environment<sup>1</sup> and more than 6000 species are described from marine ecosystems worldwide<sup>2</sup>. Of these, around 400 species of Heterobranch are reported from the Indian water<sup>3-5</sup>. Actual work on the Indian Heterobranchia taxonomy was initiated during 1880s by Kelaart<sup>6,7</sup> and Alder & Hancock<sup>8</sup>. Following these, Gardiner<sup>9</sup> reported Heterobranchs from the Maldives and Lakshadweep Islands; Eliot<sup>10-14</sup> from South India and Ceylon and subsequently from Maldives and Lakshadweep Islands, Okhamandal, Gujarat, Chilka, and Orissa coast. Farran<sup>15</sup> reported the Opisthobranchian molluscs from Pearl oyster bed, Gulf of Mannar. Similarly, Gravely<sup>16</sup> and Satyamurti<sup>17</sup> reported 30 species from the Krusadai Islands, Mandapam group, Gulf of Mannar. Further, 29 species were reported from the Southeast coast of India<sup>18-30</sup>. Based on the available literature, there are 47 species reported from the Gulf of Mannar region and recently, Kumar *et al.*<sup>4</sup> reported 20 species, among them 12 species were new records from the Thoothukudi group of islands, Gulf of Mannar, India.

### Materials and Methods

The present survey was conducted in and around the Keelakarai coast, Gulf of Mannar Marine National Park from 2019 to 2020 (Table 1). The Heterobranchia specimens were observed and collected by a direct search method with the help of SCUBA diving gears, and photographed through an underwater camera (Nikon cool pixel camera). The collected specimens were stored in 95 % ethanol for long term preservation and were identified on the basis of morphological characters<sup>31-33</sup>. Identified specimens are registered and deposited in the national zoological collections of Zoological Survey of India, Marine Aquarium & Regional Centre, Digha, West Bengal.

### Results

A total of 20 species of Heterobranchs were identified from the Keelakarai coast (Figs. 1A-U), among them, one species was new record to the Indian water and eight species were reported for the first time from the Gulf of Mannar Marine Biosphere Reserve, India. The morphological features of presently collected Heterobranchia are given below.

Phylum: Mollusca Linnaeus, 1758  
Class: Gastropoda Cuvier, 1795  
Subclass: Heterobranchia Gray, 1840

Table 1 — Detail of the study areas with GPS co-ordination

S.No	Date	Name of the place	GPS Coordinates	Habitat
1	29.01.2019	Off Chinna Erwadi	Lat. 08°58'18.9 N; Long 78°46'26.6 E	Reef bed
2	30.01.2019	Off Chinna Erwadi	Lat. 08°59'18.0 N; Long.78°50'34.7 E	Reef bed
3	31.01.2019	Off Anaipar Island	Lat. 09°00'16.8 N; Long. 78°48'42.6 E	Reef bed
4	01.02.2019	Off Chinna Erwadi	Lat. 09°00'16.8 N; Long. 78°48'42.6 E	Reef bed
5	02.02.2019	Appa Island	Lat. 09°09'39.3 N; Long. 78°48'58.6 E	Reef bed
6	03.02.2019	Off Palliyarmunai	Lat. 09°04'58.4 N; Long. 78°44'27.6 E	Reef bed
7	04.02.2019	Off Palliyarmunai	Lat. 09°04'46.7 N; Long. 78°44'13.4 E	Reef bed
8	05.02.2019	Anaipar Island	Lat. 09°07'32.8 N; Long. 78°43'13.3 E	Reef bed
9	06.02.2019	Off Chinna Erwadi	Lat. 09°05'45.0 N; Long. 78°47'32.4 E	Reef bed
10	09.09.2019	Chinna Erwadi	Lat. 09°11'40.7 N; Long. 78°43'23.0 E	Reef bed
11	29.01.2020	Valimunai Island	Lat. 09°06.26.0 N; Long. 78°44'15.9 E	Reef bed

Order: Nudibranchia Cuvier, 1817

Suborder: Doridina

### 1. *Aegires villosus* Farran, 1905

Family: Aegiridae P. Fischer, 1883

Genus: *Aegires* Loven, 1844

*Aegires villosus* Farran, 1905 (Fig. 1A)

**Material examined:** ZSI/MARC M6144; one specimen collected on 01.02.2019; size: 10 mm; Depth: 22 m.

**Location:** Off Chinna Erwadi, Keelakari group (Lat. 09°00'16.8 N; Long. 78°48'42.6 E).

**Diagnosis:** The collected specimen was yellowish-orange in colour on the dorsal side and some magenta spots and streaks present on the dorsum. Rhinophores smooth, pale purple base and orange central section and magenta apex. The Papillae are pale purple in colour with magenta spots (Fig. 1A).

**Habitat:** Hydrozoan associated species in reef ecosystem.

**Distribution:** Sri Lanka (Ceylon), Japan, New Caledonia, Dar es Salaam, Tanzania, Papua New Guinea, Bali, Philippines, Tonga, Thailand, Malaysia, American Samoa and Australia, India.

**Distribution in India:** Andaman and Nicobar Islands<sup>5</sup>.

**Remarks:** The species has been first described from Cheval Paar, Ceylon (Sri Lanka) and the present reporting is the first report from the Gulf of Mannar Marine Biosphere Reserve. The morphological features are matching with the type species.

**Taxonomic references:** Farran<sup>15</sup>, Baba<sup>34</sup>, Edmunds<sup>35</sup>, Rudman<sup>36</sup>.

### 2. *Aldisa andersoni* Gosliner & Behrens, 2004

Family: Cadlinidae Bergh, 1891

Genus: *Aldisa* Bergh, 1878

*Aldisa andersoni* Gosliner and Behrens, 2004 (Fig. 1B)

**Material examined:** ZSI/MARC M6145, two specimens collected on 01.02.2019; Size: 12 mm, 15 mm; Depth: 22 m.

**Location:** Off Chinna Erwadi, Keelakari group (Lat. 09°00'16.8 N; Long. 78°48'42.6 E).

**Diagnosis:** The background colour of the body is blue-grey with three black bands. The species is oval-shaped, low conical tubercles present on the surface, the bright yellow saddle is behind the rhinophores and across the notum upto the edge of the mantle. The sample rhinophores and gills are blue in colour (Fig. 1B).

**Habitat:** The species is observed from the live reef ecosystem.

**Distribution:** Sri Lanka, Pigeon Island, Trincomalee.

**Remarks:** The species is new record to the Indian water and was first described from Sri Lanka. The morphological characters of the specimen recorded in the present study are similar to the holotype specimen.

**Taxonomic references:** Gosliner & Behrens<sup>37</sup>.

### 3. *Doriprismatica atromarginata* (Cuvier, 1804)

Family: Chromodorididae Bergh, 1891

Genus: *Doriprismatica* d'Orbigny, 1839

*Doriprismatica atromarginata* (Cuvier, 1804) (Fig. 1C)

**Synonyms:** *Casella atromarginata* (Cuvier, 1804); *Goniodoris atromarginata* (Cuvier, 1804); *Doris atromarginata* Cuvier, 1804; *Glossodoris atromarginata* (Cuvier, 1804); *Glossodoris maccarthyi* (Kelaart, 1858); *Doris maccarthyi* Kelaart, 1859; *Casella maccarthyi* (Kelaart, 1859); *Casella philippinensis* Bergh, 1874; *Casella atromarginata var. pallida* Bergh, 1905.

**Material examined:** ZSI/MARC M6150, 2 specimens collected on 02.02.2019; Size: 40 to 60 mm; Depth: 5 m.

**Location:** Appa Island, Keelakari group (Lat. 09°09'39.3 N; Long. 78°48'58.6 E).

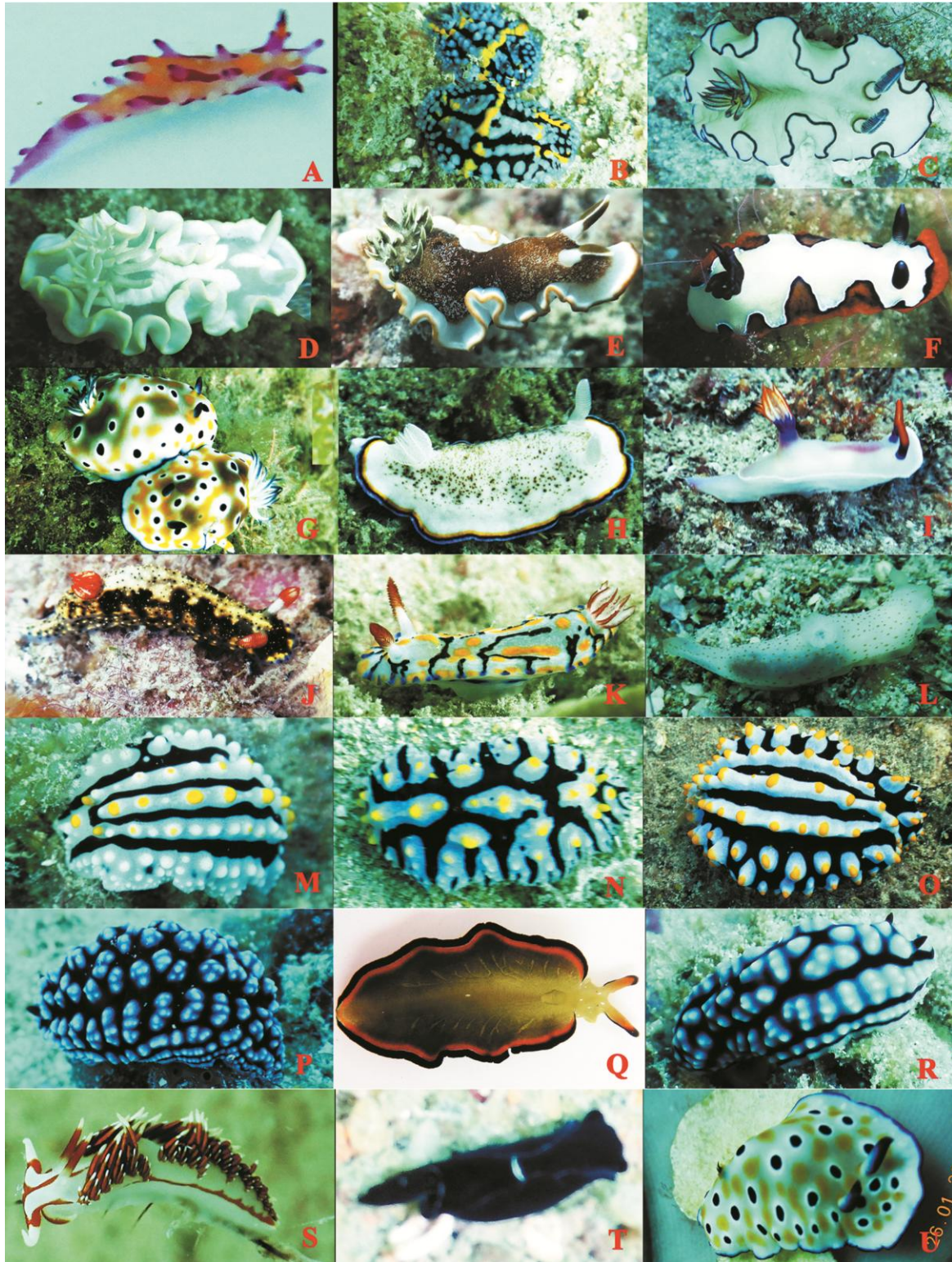


Fig. 1 — A: *Aegires villosus*, B: *Aldisa andersoni*, C: *Doriprismatica atromarginata*, D: *Glossodoris pallida*, E: *Glossodoris rufomarginata*, F: *Goniobranchus fidelis*, G: *Goniobranchus cavae*, H: *Goniobranchus trimarginatus*, I: *Hypselodoris bullockii*, J: *Hypselodoris infucata*, K: *Hypselodoris nigrostriata*, L: *Gymmodoris citrina*, M: *Phyllidia alyta*, N: *Phyllidia marindica*, O: *Phyllidia varicose*, P: *Phyllidiella pustulosa*, Q: *Elysia ornate*, R: *Phyllidiella zeylanica*, S: *Phidiana militaris*, T: *Tubulophilinopsis gardineri*, and U: *Goniobranchus cavae*

**Diagnosis:** The collected specimens were creamy-white to pale yellow in colour and the sinuous mantle edge is distinct in black band. The rhinophores and gills are smooth and black in colour.

**Habitat:** The species is mostly observed from the reef with algae ecosystem.

**Distribution:** Indo-Pacific coast.

**Distribution in India:** Tamil Nadu, Karaikal, Andaman and Nicobar Islands.

**Remarks:** The unique characters of the species are black line bordering the mantle edges and blue-black lamellae. The species is new record to the Gulf of Mannar Marine Biosphere Reserve.

**Taxonomic references:** Eliot<sup>10</sup>, Fontana *et al.*<sup>38</sup>, Ramakrishna *et al.*<sup>3</sup>, Apte & Desai<sup>5</sup>.

#### 4. *Glossodoris pallida* (Ruppell & Leuckart, 1828)

Family: Chromodorididea Bergh, 1891

Genus: *Glossodoris* Ehrenberg, 1831

*Glossodoris pallida* (Ruppell & Leuckart, 1828) (Fig. 1D)

**Synonyms:** *Chromodoris pallida* (Ruppell & Leuckart, 1830); *Doris pallida* Ruppell & Leuckart, 1830; *Doris xantholeuca* Ehrenberg, 1831; *Glossodoris xantholeuca* (Ehrenberg, 1831).

**Material examined:** ZSI/MARC M6151; one specimen collected on 03.02.2019; Size: 30 mm; Depth: 14 m.

**Location:** Off Palliyarmunai, Keelakari (Lat. 09°04'58.4 N; Long. 78°44'27.6 E).

**Diagnosis:** The specimen is translucent white in colour with a yellow line border. The gills and rhinophores are also white in colour with a tingle of the yellow border. The mantle is folded into a series of semi-permanent undulations.

**Habitat:** The species is very common in the live reef ecosystem.

**Distribution:** American Samoa, Vanuatu, Tanzania, Australia, Singapore, Mozambique, Reunion Island, South Korea, Papua New Guinea, Japan, Philippines, Indonesia, and India.

**Distribution in India:** Lakshadweep, Andaman and Nicobar Islands, Gujarat (Gulf of Kuchchh, Dwarka, Okha).

**Remarks:** The species is new record to the Gulf of Mannar Marine Biosphere Reserve and is reported from other reef ecosystems of India. The species is similar with *Glossodoris symmetricus* and the mantle border is orange-red in colour. The species *Glossodoris pallida* also bear a yellow mantle border and a similar foot border.

**Taxonomic references:** Sreeraj *et al.*<sup>39</sup>, Apte & Desai<sup>5</sup>.

#### 5. *Glossodoris rufomarginata* (Bergh, 1890) (Fig. 1E)

**Synonyms:** *Casella rufomarginata* Bergh, 1890; *Chromodoris rufomarginata* (Bergh, 1890); *Chromodoris youngbleuthi* Kay & Young, 1969; *Chromolaichma youngbleuthi* (Kay & Young, 1969); *Glossodoris youngbleuthi* (Kay & Young, 1969).

**Material examined:** ZSI/MARC M6152; one specimen collected on 03.02.2019; Size: 26 mm; Depth: 14 m.

**Location:** Off Palliyarmunai, Keelakari (Lat. 09°04'58.4 N; Long. 78°44'27.6 E).

**Diagnosis:** The collected sample was white in colour with an orange-brown speckled line pattern present on the mantle. The rhinophores and gills are also orange to orange-brown in colour and lined with white.

**Habitat:** The species is very common in the live reef ecosystem.

**Distribution:** Aldabra, Papua New Guinea, Hawaii, Korea, French Polynesia, Red sea, Australia, Solomon Islands, Japan, Myanmar, Taiwan, Philippines, Tanzania, Indonesia, Malaysia, and India.

**Distribution in India:** Andaman and Nicobar Islands.

**Remark:** The species is a new record to the Gulf of Mannar Marine Biosphere Reserve. The colour pattern varies with other species and similar to the Andaman specimen.

**Taxonomic references:** Sreeraj *et al.*<sup>40</sup>, Apte & Desai<sup>5</sup>.

#### 6. *Goniobranchus fidelis* (Kelaart, 1858)

Family: Chromodorididea Bergh, 1891

Genus: *Goniobranchus* Pease, 1866

*Goniobranchus fidelis* (Kelaart, 1858) (Fig. 1F)

**Synonyms:** *Chromodoris fidelis* (Kelaart, 1858); *Doris fidelis* Kelaart, 1858; *Glossodoris fidelis* (Kelaart, 1858); *Chromodoris lactea* Bergh, 1905; *Chromodoris flammulata* Bergh, 1905; *Chromodoris krishna* Rudman, 1973

**Material examined:** ZSI/MARC M6147; two specimens collected on 02.02.2019; Size: 22 to 25 mm; Depth: 5 m.

**Location:** Appa Island, Keelakari group (Lat. 09°09'39.3 N; Long. 78°48'58.6 E).

**Diagnosis:** The specimens are creamy white in colour and margin of the mantle is red in colour. The rhinophores are greyish with white tips and the gills are also of the same colour.

**Habitat:** The species is reported from reef with algae ecosystem.

*Distribution:* Sri Lanka, Tengan (Kombu), Hontou, Okinawa, Japan, India.

*Distribution in India:* Lakshadweep, Andaman and Nicobar Islands, Gujarat (Gulf of Kuchchh), Tamil Nadu.

*Remarks:* The species reported in Gulf of Mannar by Kumar *et al.*<sup>4</sup> and the present study extended its range into the Keelakarai group of Islands, Gulf of Mannar.

*Taxonomic references:* Eliot<sup>10</sup>, Ramakrishna *et al.*<sup>3</sup>, Kumar *et al.*<sup>4</sup>, Apte<sup>41</sup>, Apte & Desai<sup>5</sup>.

### 7. *Goniobranchus cavae* (Eliot, 1904) (Fig. 1G,U)

*Synonyms:* *Chromodoris cavae* Eliot, 1904; *Glossodoris cavae* (Eliot, 1904)

*Material examined:* ZSI/MARC M6148; two specimens collected on 02.02.2019; Size: 45 to 50 mm; Depth: 5 m.

*Location:* Appa Island Keelakarai group (Lat. 09°09'39.3 N; Long. 78°48'58.6 E).

*Diagnosis:* The specimens are creamy-white with a yellow background and purple spots with white ring. The margin of the mantle is purple in colour followed by white lines. Rhinophores are lamellated, white base with a purple top and the gills are also white with purple topped.

*Habitat:* The species is reported from reef with algae ecosystem.

*Distribution:* East Africa, Tanzania.

*Remarks:* The species was first reported in India by Kumar *et al.*<sup>4</sup> from Vembar coast, Thoothukudi and the present study extended its range into the Keelakarai coast, Gulf of Mannar.

*Taxonomic references:* Eliot<sup>10</sup>, Rudman<sup>42</sup>.

### 8. *Goniobranchus trimarginatus* (Winckworth, 1946) (Fig. 1H)

*Synonyms:* *Chromodoris trimarginata* (Winckworth, 1946); *Glossodoris trimarginata* Winckworth, 1946.

*Material examined:* ZSI/MARC M6153; one specimen collected on 03.02.2019; Size: 22 mm; Depth: 14 m.

*Location:* Off Palliyarmunai, Keelakarai (Lat. 09°04'58.4 N; Long. 78°44'27.6 E).

*Diagnosis:* The specimen is white in colour with small black and brown spots. The mantle edge is marked by a thin purple line followed by a black line and yellow line. The gill leaves and rhinophores are white in colour.

*Habitat:* Reef ecosystem.

*Distribution:* Malaysia, Thailand, India.

*Distribution in India:* Mumbai.

*Remarks:* The species is a new record to Gulf of Mannar Marine Biosphere Reserve. The characters three lines and colours (purple, black, yellow) on the mantle is similar with the earlier reported species in Mumbai coast.

*Taxonomic references:* Winckworth<sup>43</sup>, Valdes *et al.*<sup>30</sup>, Apte & Desai<sup>5</sup>.

### 9. *Hypselodoris bullockii* (Collingwood, 1881)

Family: Chromodorididea Bergh, 1891

Genus: *Hypselodoris* Stimpson, 1855

*Hypselodoris bullockii* (Collingwood, 1881) (Fig. 1I)

*Synonyms:* *Chromodoris bullockii* Collingwood, 1881; *Risbecia bullockii* (Collingwood, 1881)

*Material examined:* ZSI/MARC M6155; two specimens collected on 04.02.2019; Size: 25 mm; Depth: 14 m.

*Location:* Off Palliyarmunai, Keelakarai (Lat. 09°04'46.7 N; Long. 78°44'13.4 E).

*Diagnosis:* The specimens are pale purple in colour, the mantle has thin white line border in edge. The rhinophores base bears purple band and orange on top. The gill leaves also purple at base and whitish with orange border on the gill leaves.

*Habitat:* The species is mostly observed from the dead reef with algae ecosystem.

*Distribution:* Australia, Thailand, Malaysia, South China Sea, India.

*Distribution in India:* Andaman and Nicobar Islands, Tamil Nadu.

*Remarks:* The species is first reported from Katchaal, Nicobar Island followed by Thoothukudi coast. Present report the species is new record to the Keelakarai coast, Gulf of Mannar.

*Taxonomic references:* Ramakrishna *et al.*<sup>3</sup>; Kumar *et al.*<sup>4</sup>; Apte & Desai<sup>5</sup>.

### 10. *Hypselodoris infucata* (Rüppell & Leuckart, 1828) (Fig. 1J)

*Synonyms:* *Doris infucata* Ruppell & Leuckart, 1830; *Brachychlanis pantherina* Ehrenberg, 1831; *Chromodoris diardii* (Kelaart, 1859); *Chromodoris runcinata* Bergh, 1877; *Chromodoris semperi* Bergh, 1877; *Glossodoris runcinata* (Bergh, 1877).

*Material examined:* ZSI/MARC M6156; two specimens collected on 04.02.2019; Size: 28 mm; Depth: 14 m.

*Location:* Off Palliyarmunai, Keelakarai (Lat. 09°04'46.7 N; Long. 78°44'13.4 E).

**Diagnosis:** The specimens are translucent yellow, greenish background with pigment on the surface of grey-blue and with small black and yellow spots. The rhinophores are opaque white with red edges and gills white with red line along the internal and external edge.

**Habitat:** The species is mostly observed from the dead reef with algae ecosystem.

**Distribution:** Indo-West Pacific: Red Sea, Indonesia, Vietnam, New Caledonia, Israel, South Africa, Philippines.

**Distribution in India:** Lakshadweep, Andaman and Nicobar, Gujarat, Maharashtra, Tamil Nadu.

**Remarks:** The species is a new record to the Gulf of Mannar Marine Biosphere Reserve and is also reported from the other reef ecosystems of India. The present report confirmed by the different sized dark blue, black and yellow spots and lamellae being a bright orange with a white core of the rhinophores.

**Taxonomic references:** Eliot, 1906<sup>10</sup>, Apte<sup>41</sup>, Kumar *et al.*<sup>4</sup>, Apte & Desai<sup>5</sup>.

### 11. *Hypselodoris nigrostriata* (Eliot, 1904) (Fig. 1K)

**Synonyms:** *Chromodoris nigrostriata* Eliot, 1904.

**Material examined:** ZSI/MARC M6157; one specimen collected on 04.02.2019; Size: 17 mm; Depth: 14 m.

**Location:** Off Palliyarmunai, Keelakari (Lat. 09°04'46.7 N; Long. 78°44'13.4 E).

**Diagnosis:** The specimen is bluish in colour with yellow spots and black striated lines observed all over the body. Rhinophores and gill leaves are orange-red in colour.

**Habitat:** The species is mostly observed from the dead reef with sponge and algae ecosystem.

**Distribution:** Red Sea, Kenya, Mauritius, South Africa, Tanzania, Maldives, Hawaii, India.

**Distribution in India:** Andaman and Nicobar, Maharashtra (Mumbai), Andhra Pradesh (Visakhapatnam), Tamil Nadu.

**Remarks:** The specimen recorded in the present study has blackish line, diagonal and yellow spots in between similar with the South Andaman specimen. The species is new record to the Keelakarai coast, Gulf of Mannar.

**Taxonomic references:** Ramakrishna *et al.*<sup>3</sup>, Apte & Desai<sup>5</sup>.

### 12. *Gymnodoris citrina* (Bergh, 1877)

Family: Polyceridae Alder & Hancock, 1845

Genus: *Gymnodoris* Stimpson, 1855

*Gymnodoris citrina* (Bergh, 1877) (Fig. 1L)

**Synonyms:** *Trevelyana citrina* Bergh, 1877

**Material examined:** ZSI/MARC M6154; one specimen collected on 03.02.2019; Size: 20 mm; Depth: 14 m.

**Location:** Off Palliyarmunai, Keelakari (Lat. 09°04'58.4 N; Long. 78°44'27.6 E).

**Diagnosis:** The specimen is transparent or pale white in colour with orange-yellow spot all over and each spots raised on a short pointed papilla. The mantle is rounded with orange-yellow tubercles. The rhinophores and gill leaves are white in colour and orange-yellow spots absent.

**Habitat:** The species is observed very near to the reef ecosystem.

**Distribution:** Indo-West Pacific water.

**Distribution in India:** Lakshadweep, Andaman and Nicobar Island.

**Remarks:** The species is very similar with *Gymnodoris bicolor*. The species *Gymnodoris bicolor* have a genital opening immediately behind the branchia and in *Gymnodoris citrina* the opening is well forward of the branchia. Based on the available literature the species is a new record to Gulf of Mannar Marine Biosphere Reserve.

**Taxonomic references:** Ramakrishna *et al.*<sup>3</sup>.

### 13. *Phyllidia alyta* Yonow, 1996

Family: Phyllidiidae Rafinesque, 1814

Genus: *Phyllidia* Cuvier, 1797

*Phyllidia alyta* Yonow, 1996 (Fig. 1M)

**Material examined:** ZSI/MARC M6159; one specimen collected on 05.02.2019; Size: 20 mm; Depth: 4 m.

**Location:** Anaipar Island, Keelakari group (Lat. 09°07'32.8 N; Long. 78°43'13.3 E).

**Diagnosis:** The specimen was grey or white in colour with four longitudinal black bands. The inner black bands runs from behind the rhinophores to just front of the anal papilla and meet. The median row of tubercles are tipped with yellow and second row of tubercles on each side are rarely tipped with yellow. In the outside rows there are small irregularly scattered tubercles at the mantle border. The rhinophores are also yellow in colour.

**Habitat:** The specimen is observed from the reef ecosystem.

**Distribution:** Maldives, Mauritius, Reunion, Sri Lanka, India.

**Distribution in India:** Lakshadweep, Andaman and Nicobar, Tamil Nadu.

*Remarks:* The species has been earlier reported from the Thoothukudi group of Islands in which the inner pair of the longitudinal black bands were not met. But, in the specimen reported in present study the inner pair of black bands meet behind the rhinophores. The species is a new record to Keelakarai group of Islands, Gulf of Mannar.

*Taxonomic references:* Ramakrishna *et al.*<sup>3</sup>, Kumar *et al.*<sup>4</sup>, Apte<sup>41</sup>, Apte & Desai<sup>5</sup>.

**14. *Phyllidia marindica* (Yonow & Hayward, 1991)** (Fig. 1N)

*Synonyms:* *Fryeria marindica* (Yonow & Hayward, 1991); *Reyfriedia marindica* Yonow & Hayward, 1991.

*Material examined:* ZSI/MARC M6149; one specimen collected on 02.02.2019; Size: 18 mm; Depth: 5 m.

*Location:* Appa Island, Keelakarai group (Lat. 09°09'39.3 N; Long. 78°48'58.6 E).

*Diagnosis:* The specimen is blue-grey in colour with two black bands on the mantle and blue ridge on each side of the mantle. There are many black lines running on both sides of the mantle. The yellow colour spots in different size has a single row in median ridge and rhinophores are also yellow in colour.

*Habitat:* The species is collected from the reef with algae ecosystem.

*Distribution:* Western Australia, Eastern Africa, Maldives, Thailand, India.

*Distribution in India:* Lakshadweep, Andaman and Nicobar, Tamil Nadu.

*Remarks:* Since no previous works were carried out from the Keelakarai group of Islands, the present reporting is the new record to Keelakarai coast, Gulf of Mannar.

*Taxonomic references:* Ramakrishna *et al.*<sup>3</sup>, Apte<sup>41</sup>, Apte & Desai<sup>5</sup>.

**15. *Phyllidia varicosa* Lamarck, 1801** (Fig.1O)

*Synonyms:* *Phyllidia borbonica* Cuvier, 1804; *Phyllidia trilineata* Cuvier, 1804; *Phyllidia quinquelineata* Blainville, 1816; *Phyllidia Arabica* Ehrenberg, 1831; *Phyllidia honloni* Risbec, 1956; *Phyllidia fasciolata* Bergh, 1869.

*Material examined:* ZSI/MARC M6160; one specimen collected on 05.02.2019; Size: 32 mm; Depth: 4 m.

*Location:* Anaipar Island, Keelakarai group (Lat. 09°07'32.8 N; Long. 78°43'13.3 E).

*Diagnosis:* The specimen is blue-grey in colour with tubercles. The tubercles are capped with yellow colour and rhinophores possesses 27 to 30 lamellae.

*Habitat:* The species is collected from the reef with algae ecosystem.

*Distribution:* Australia, Papua New Guinea, Thailand, Malaysia, Mauritius, Seychelles, Red Sea, Sir Lanka to Hawaii, Africa, Japan, India.

*Distribution in India:* Andaman and Nicobar, Lakshadweep, Karnataka (Netrani), Tamil Nadu.

*Remark:* The species tubercles are yellow-tipped in the present study as well as in the Andaman specimens. The species is a new record to Keelakarai coast, Gulf of Mannar.

*Taxonomic references:* Rao, *et al.*<sup>29</sup>, Apte<sup>41</sup>, Ramakrishna *et al.*<sup>3</sup>, Kumar *et al.*<sup>4</sup>, Apte & Desai<sup>5</sup>.

**16. *Phyllidiella pustulosa* (Cuvier, 1804)**

Family: Phyllidiidae Rafinesque, 1814

Genus: *Phyllidiella* Bergh, 1869

*Phyllidiella pustulosa* (Cuvier, 1804) (Fig. 1P)

*Synonyms:* *Phyllidia pustulosa* Cuvier, 1804; *Phyllidia verrucosa* van Hasselt, 1824; *Phyllidia albonigra* Quoy & Gaimard, 1832; *Phyllidia nobilis* Bergh, 1869; *Phyllidiella nobilis* (Bergh, 1869; *Fryeria variabilis* Collingwood, 1881; *Phyllidia spectabilis* Collingwood, 1881; *Phyllidia melanocera* Yonow, 1986; *Phyllidia rotunda* Eliot, 1904).

*Material examined:* ZSI/MARC M6161; one specimen collected on 05.02.2019; Size: 28 mm; Depth: 4 m.

*Location:* Anaipar Island, Keelakarai group (Lat. 09°07'32.8 N; Long. 78°43'13.3 E).

*Diagnosis:* The specimen base colour is black with pink tubercles. Each tubercle is usually clustered in to three groups and a black colour line is present between the individual tubercles. Some tubercles are amalgamated together within these groups due to that the black line is not visible or poorly visible in between the tubercles. The mantle edges are pale pink and rhinophores claws have 22 to 26 lamellae.

*Habitat:* The species is collected from the reef ecosystem.

*Distribution:* Western Pacific, Micronesia, Papua New Guinea, Fiji, Australia, Red Sea to Hawaii, Japan, Malaysia, Thailand, Indonesia, India.

*Distribution in India:* Andaman and Nicobar, Lakshadweep, Tamil Nadu.

*Remarks:* The species is a new distribution record to the Keelakarai coast, Gulf of Mannar and share

similarity with the following species like *Phyllidiella annulata*, *Phyllidiella zeylanica*, *Phyllidiella granulate*, *Phyllidopsis bumi*, *Phyllidiella nigra* and *Phyllidiella cooraburrama*. Among these, three species (*Phyllidiella zeylanica*, *Phyllidiella granulate*, *Phyllidiella nigra*) are available in the Indian water; of which, *Phyllidiella granulate* and *Phyllidiella nigra* are reported from the Andaman and Nicobar Islands and *Phyllidiella zeylanica* is reported in all major reef ecosystems of India.

*Taxonomic references:* Ramakrishna *et al.*<sup>3</sup>, Kumar *et al.*<sup>4</sup>, Apte<sup>41</sup>, Apte & Desai<sup>5</sup>.

### 17. *Phyllidiella zeylanica* (Kelaart, 1859) (Fig. 1Q)

*Synonyms:* *Phyllidia zeylanica* Kelaart, 1859; *Phyllidia catena* Pruvot-Fol, 1956; *Phyllidia seriata* Pruvot-Fol, 1957.

*Material examined:* ZSI/MARC M6162; one specimen collected on 05.02.2019; Size: 4 mm; Depth: 4 m.

*Location:* Anaipar Island, Keelakari group (Lat. 09°07'32.8 N; Long. 78°43'13.3 E).

*Diagnosis:* The species surface is a blackish with irregularly tuberculated. The tubercles are pink in colour with black bands around. The adult species have nine longitudinal pink ridges and some time the ridges are broken or interrupted. The rhinophores are black in colour and have 23 lamellae on each rhinophore.

*Habitat:* The species is collected from the reef ecosystem.

*Distribution:* Western Pacific, Seychelles, Eastern Africa, Reunion, Thailand, India.

*Distribution in India:* Andaman and Nicobar, Lakshadweep, Gujarat (Gulf of Kuchchh), Karnataka (Netrani), Tamil Nadu.

*Remarks:* The species is similar with *Phyllidiella rosans* which was reported from the Gulf of Mannar, Lakshadweep, Andaman and Nicobar Islands. The maximum size of the *Phyllidiella zeylanica* is upto 60 mm and *Phyllidiella rosans* is 35 mm. The rhinophores are black in colour and clavus possesses 23 lamellae in *Phyllidiella zeylanica* and *Phyllidiella rosans* have 15 black lamellae. The species is already reported from the Thoothukudi group of Island and for the first time it is reported from the Keelakarai coast, Gulf of Mannar in the present study.

*Taxonomic references:* Rao, *et al.*<sup>29</sup>, Eliot<sup>10</sup>, Ramakrishna *et al.*<sup>3</sup>, Kumar *et al.*<sup>4</sup>, Apte<sup>41</sup>, Apte & Desai<sup>5</sup>.

### 18. *Elysia ornata* (Swainson, 1840)

Superorder: Sacoglossa

Family: Plakobrachidae Gray, 1840

Genus: *Elysia* Risso, 1818

*Elysia ornata* (Swainson, 1840) (Fig. 1R)

*Synonyms:* *Thallepus ornatus* Swainson, 1840.

*Material examined:* ZSI/MARC M6158; one specimen collected on 04.02.2019; Size: 30 mm; Depth: 14 m.

*Location:* Off Palliyarmunai, Keelakari (Lat. 09°04'46.7 N; Long. 78°44'13.4 E).

*Diagnosis:* The species is commonly called ornate Elysia or ornate leaf slugs and the species is translucent greenish-yellow in colour speckled with white and black. The edge of the animal is with orange band and a black margin. The rhinophores are of same colour like orange and dark tips.

*Habitat:* The species is collected from the reef ecosystem.

*Distribution:* Caribbean and Indo – West Pacific; New Caledonia, French Polynesia, Australia, Reunion Island, Dubai, Indonesia, South China Sea, Red Sea, Bahamas, Malaysia, Singapore, Japan, Taiwan, Saudi Arabia, Papua New Guinea, Philippines, Hawaii, American Samoa, India.

*Distribution in India:* Andaman and Nicobar, Lakshadweep, Gujarat, Maharashtra, Goa, Karnataka, Tamil Nadu.

*Remarks:* The species is a new record to the Keelakarai coast, Gulf of Mannar. The species characteristics are very similar to Andaman and Thoothukudi specimens.

*Taxonomic references:* Satyamurti<sup>17</sup>, Ramakrishna *et al.*<sup>3</sup>, Apte<sup>41</sup>, Apte & Desai<sup>5</sup>.

### 19. *Phidiana militaris* (Alder & Hancock, 1864)

Suborder: Cladobranchia

Family: Facelinidae Bergh, 1889

Genus: *Phidiana* Gray, 1850

*Phidiana militaris* (Alder & Hancock, 1864) (Fig. 1S)

*Synonyms:* *Caloria militaris* (Alder & Hancock, 1864); *Eolis militaris* Alder & Hancock, 1864.

*Material examined:* ZSI/MARC M6146; one specimen collected on 02.02.2019; Size: 20 mm; Depth: 5 m.

*Location:* Appa Island, Keelakari group (Lat. 09°09'39.3 N; Long. 78°48'58.6 E).

*Diagnosis:* The collected specimen was translucent white to pale pink in colour and the head has a prominent orange line. Y shaped mark present in between the oral tentacles of the dorsal surface. The



rhinophores, foot corners and oral tentacles are yellow in colour.

*Habitat:* The species is collected from the reef with algae ecosystem.

*Distribution:* Hong Kong, Singapore, Saudi Arabia, Oman, Philippines, Thailand, India.

*Distribution in India:* Gujarat, Maharashtra, Goa, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, Lakshadweep, Andaman and Nicobar Islands.

*Remarks:* The species is a new record to the Keelakarai coast, Gulf of Mannar. The species characteristics are very similar to Andaman specimen.

*Taxonomic references:* Alder and Hancock<sup>8</sup>, Eliot<sup>10</sup>, Satyamurti<sup>17</sup>, Rudman<sup>42</sup>, Ramakrishna *et al.*<sup>3</sup>, Kumar *et al.*<sup>4</sup>, Apte *et al.*<sup>41</sup>, Apte & Desai<sup>5</sup>.

## 20. *Tubulophilinopsis gardineri* (Eliot, 1903)

Order: Cephalaspidea P. Fischer, 1883

Family: Aglajidae Pilsbry, 1895

Genus: *Tubulophilinopsis* Zamora-Silva & Malaquias, 2017

*Tubulophilinopsis gardineri* (Eliot, 1903) (Fig. 1T)

*Synonyms:* *Doridium gardineri* Eliot, 1903; *Philinopsis gardineri* (Eliot, 1903); *Aglaja splendida* Marcus, 1965.

*Material examined:* ZSI/MARC M6573; one specimen collected on 05.02.2019; Size: 10 mm; Depth: 12 m.

*Location:* Off Anaipar Island, Keelakarai group (Lat. 09°00'16.8 N; Long. 78°48'42.6 E).

*Diagnosis:* The specimen is greenish-black in colour and margins of the parapodia and caudal lobes are distinctive with a deep blue band edge.

*Habitat:* The species is observed from the sandy bottom near the reef ecosystem.

*Distribution:* Western Pacific, Western Australia, Reunion Island and India.

*Distribution in India:* Lakshadweep, Andaman and Nicobar.

*Remarks:* The species is a new record to the Gulf of Mannar Marine Biosphere Reserve and the characteristics are very similar to the Andaman specimen.

*Taxonomic references:* Sreeraj *et al.*<sup>39</sup>, Apte & Desai<sup>5</sup>.

## Discussion

Gulf of Mannar is enriched with a variety of marine fauna and flora including endangered animals. Studies on the Heterobranchs fauna from Gulf of Mannar is inadequate. A number of species (47) were reported from the Mandapam group of Islands and from Palk

Bay regions<sup>10,15-17,21-23,25-30,38,44</sup>. Following these Kumar *et al.*<sup>4</sup>, reported 20 species with 12 new records from Thoothukudi and Vembar group of Islands. Recently (2019), Kumar *et al.*<sup>44</sup> added eight more species from the Gulf of Mannar Islands. Of these, six species were from the Vembar group of Islands and two species from the Mandapam group of Islands.

Since no previous works were carried for reporting the Heterobranch species from Keelakarai group of Islands in Gulf of Mannar, India, the present investigation was carried out. Keelakarai group of Islands consists of a total of seven Islands, of which, the present study covered only three Islands namely Valimunai Island (Palliyamunai), Anaipar Island, and Appa Island. In the present underwater study reports a total of 20 species from the Keelakarai coast including eight new records from the Gulf of Mannar Marine Biosphere Reserve. Further, the species *Aldisa andersoni* is reported for the first time from the Indian water. The species *Aldisa andersoni* was first described from the Sri Lanka coast which is very nearest to the present study sites in India<sup>34</sup>. The findings of the present study not only extends the distributional range but also indicate the significance of periodic survey and monitoring for a better understanding of the diversity of Heterobranchs, in general and in the Indian sub-continent.

## Conclusion

The Heterobranchs of India has not been sufficiently studied; it can be anticipated that Heterobranchs diversity is quite high in the Gulf of Mannar region. Regrettable, but there is also a scarcity of information on the distribution of Heterobranchs in the Indian reef associated regions. It is necessary that several extensive surveys and taxonomical studies are required to document the Heterobranch fauna to enhance the database of Gulf of Mannar Marine Biosphere Reserve as well as of other reef ecosystems of India.

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### Conflict of Interest

Authors don't have any conflict of interest.

### Author Contributions

JSY and CV collection, preservation, identification and manuscript preparation; and CR study coordination and manuscript preparation.

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