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Report on Ten Newly Recorded Opisthobranchs (Opisthobranchia, Gastropoda) from Andaman and Nicobar Islands, India

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ABSTRACT

Opisthobranchs are marine gastropod mollusks, which are noted for their often extraordinary colors and striking forms. Opisthobranchs are the least studied group of mollusks from Andaman and Nicobar Islands and also in Indian waters. The taxonomy and ecology of these animals of these Islands recently received attention after about a century. The present study deals with 10 species of opisthobranchs, belonging to 8 families. Of these six species such as, *Chelidonura pallida*, *Odontoglyphis guamensis*, *Elysia leucolegnote*, *Thuridilla albopustulosa*, *Costasiella paweli* and *Bornella anguilla* are reported for the first time from Indian waters.

Key words: Opisthobranch, Nudibranch, gastropod mollusks, taxonomy, Andaman and Nicobar Islands

INTRODUCTION

The Andaman and Nicobar group of Islands consists of 572 islands, islets and rocky out crops and have an aggregate coastline of 1, 912 km, which is about a fourth of the coastline of India (ANDFISH, 2006). The continental shelf area is very limited with an estimated area of 16,000 km² and the sea is very deep within a few kilometers from the shore. This provides a great opportunity to explore the vast diversity of the seas around these Islands. The coral reef biodiversity of Andaman and Nicobar Islands available at present are sporadic. As per the available literature so far 5, 440 marine species reported from this Archipelago, of which 138 are endemic (ZSI, 2009).

The work carried on opisthobranchs in India is meager and the earlier works date back to 1880s (Kelaart, 1858, 1859; Alder and Hancock, 1864; Gardiner, 1903). The molluscan studies of Andaman and Nicobar Islands were started in the late 19th century. The literature review reveals that the earliest molluscan study was made by Smith (1878). The first report on nudibranch from these Islands was published by Eliot (1910), which deals with a collection of nudibranchs made by Annandale. Opisthobranchiate taxonomy and ecology in these Islands recently received attention (Raghunathan *et al.*, 2010; Ramakrishna *et al.*, 2010; Sreeraj *et al.*, 2010) including many new records to the Indian Subcontinent.

MATERIALS AND METHODS

An intensive and extensive survey of opisthobranchs was carried out during 2010-11 in various Islands of Andaman and Nicobar Islands (Fig. 1). SCUBA gears were used for surveying the

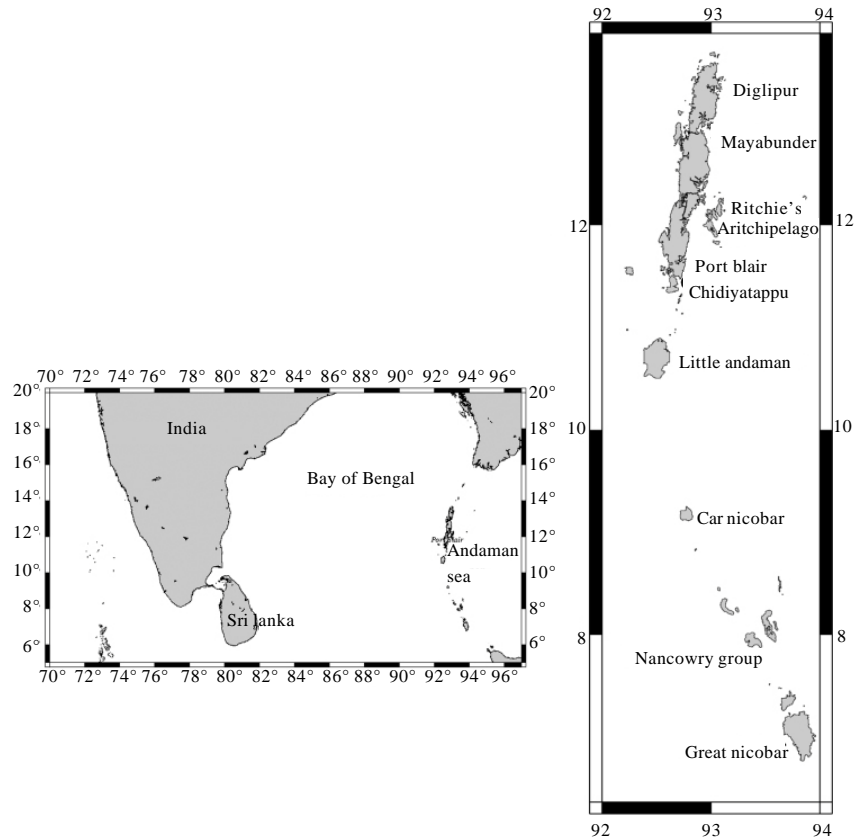


Fig. 1: Map showing the areas surveyed in Andaman and Nicobar islands

animals and collection of the specimens at sub-tidal regions. Animals were observed, photographed in the field and samples were collected for identification. Live specimens brought to the laboratory were subjected to detail observation to reveal their morphological characters and measurements. Most of the specimens were measured and photographed in their natural habitat and placed in a flat bottom plastic jar before brought to the laboratory for examination. Animals were fixed in a solution of 5% formaldehyde and seawater. Before placement in the fixative solution the animals were narcotized with a solution consisting of 72 g L^{-1} of MgCl_2 . The formaldehyde fixed animals were transferred to 95% ethanol for long term preservation. All the animals are deposited in the National Zoological Collections of Zoological Survey of India Andaman and Nicobar Regional Centre for reference.

Identification was carried out based on morphological characters and available literatures (Jensen, 1990a; Gosliner, 1995; Gosliner *et al.*, 2008; <http://www.seaslugforum.net/>, <http://www.nudipixel.net> and Jensen (Personal communication).

RESULTS

The taxonomic hierarchy followed in this work is by Bouchet and Rocroi (2005). Systematic accounting of the species recorded is given below:



Fig. 2(a-f): (a) *Haminoea cymbalum*, (b) *Chelidonura pallida*, (c) *Odontoglossa guamensis*, (d) *Aplysia parvula*, (e) *Volvatella vigourouxi* and (f) *Elysia leucolegnote*

- Informal group: Opisthobranchia
- Clade: Cephalaspidea
- Superfamily: Haminoeioidea Pilsbry, 1895
- Family: Haminoeidae Pilsbry, 1895
- Subfamily: Haminoeinae Pilsbry, 1895

***Haminoea cymbalum* (Quoy and Gaimard, 1835)**

Material examined: ZSI/ANRC 6407, two sexually matured individuals, intertidal area, 0.3 m depth, Kalapathar, little Andaman Island, 02.06.2011, collected by Sreeraj, C.R.

Diagnosis: The body color is greenish with grey, brown and white mottling (Fig. 2a).

Size: 10 to 15 mm.

Natural history: The animal was found in intertidal sandy mud area with lots of green algae.

Distribution: Widespread in the Indo-Pacific from the western Indian ocean of Mozambique and Madagascar to Australia, Indonesia, Guam, Okinawa and eastwards to Hawaii. There are only three records of this species in India; Gulf of Mannar (Fontana *et al.*, 2001), Lakshadweep (Apte, 2009) and Andaman and Nicobar Islands, a new record from the present study:

- Superfamily: Philinoidea Gray, 1850 (1815)
- Family: Aglajidae Pilsbry, 1895 (1847)

***Chelidonura pallida* (Risbec, 1951)**

Material examined: ZSI/ANRC 6291, one sexually matured individual, coral reef, 10 m depth, sound island, Mayabunder, North Andaman, 19.04.2011, collected by Raghuraman, R.

Diagnosis: Body is white with yellow and black lines around the edges (Fig. 2b).

Size: 35 mm.

Natural history: Found in shallow reef flat area with high density of small flatworms.

Distribution: Malaysia, Western Australia, Fiji, Papua New Guinea, Indonesia, Philippines, New Caledonia, Japan and India (First record from Indian waters).

***Odontoglaja guamensis* (Rudman, 1978)**

Material examined: ZSI/ANRC 6384, one sexually matured individual, coral reef, 3 m depth, Lohabarack Crocodile Sanctuary, South Andaman, 19.05.2011, Collected by Sreeraj, C.R.; ZSI/ANRC 6424, two sexually matured individuals, coral reef, 13 m depth, Rutland Island, Mahatma Gandhi Marine National Park, South Andaman, 15.07.2011, collected by Sreeraj, C.R.

Diagnosis: The species has a white body with brown patches and a series of reddish brown spots with larger round tubercles. The green spots in the brown patches are also distinctive in this species. This aglajid is known to retain a vestigial radula (Fig. 2c).

Size: 10 to 15 mm.

Natural history: Found in shallow reefs with algae and rocky or coral rubble patches.

Distribution: Western Pacific of New Caledonia, Papua New Guinea, Indonesia, Malaysia, Philippines, Vanuatu, Guam, Palau, Japan and India (First record from the Indian ocean):

- Clade: Anaspidea
- Superfamily: Aplysioidea Lamarck, 1809
- Family: Aplysiidae Lamarck, 1809
- Subfamily: Aplysiinae Lamarck, 1809

***Aplysia parvula* Guilding (Morch, 1863)**

Material examined: ZSI/ANRC 6423, four sexually matured individuals and two juveniles, coral reef, 10-13 m depth, Rutland island, Mahatma Gandhi Marine National Park, South Andaman, 15.07.2011, collected by Sreeraj, C.R.

Diagnosis: The body is variable in color from light brown with spots to uniformly dark brown. The large round opening in the mantle through which the shell is visible is distinctive (Fig. 2d).

Size: 15 to 40 mm.

Natural history: Found on rocky substratum where it feeds on red algae.

Distribution: Indo-Pacific tropics from the western Indian ocean to the central Pacific to the Hawaiian Islands. There are only two reports of this species from India; Lakshadweep (Apte, 2009) and Andaman and Nicobar Islands, a new record from the present study:

- Clade: Sacoglossa
- Superfamily: Oxynoidea Stoliczka, 1868 (1847)
- Family: Volvatellidae Pilsbry, 1895

***Volvatella vigourouxi* (Montrouzier in Souverbie, 1861)**

Material examined: ZSI/ANRC 6406, one sexually matured individual, Intertidal area, 0.3 m depth, Kalapathar, little Andaman Island, 02.06.2011, collected by Sreeraj, C.R.

Diagnosis: Yellow orange body and posteriorly swollen shell are characteristic of this species (Fig. 2e).

Size: 20 mm.

Natural history: Found in intertidal area in association with green algae *Caulerpa taxifolia*.

Distribution: New Caledonia, Hawaii and India (Lakshadweep (Apte, 2009) and Andaman and Nicobar Islands, a new record from the present study):

- Subclade: Placobranchacea
- Superfamily: Placobranchoidea Gray, 1840
- Family: Placobranchidae Gray, 1840

***Elysia leucolegnote* (Jensen, 1990b)**

Material examined: ZSI/ANRC 5501, group of 16 individuals including both sexually matured and juveniles, mangrove swamp, 0.1 m depth, Yerratta, Rangat, Middle Andaman, 10.01.2011, collected by Sreeraj, C.R.

Diagnosis: Narrow white line along parapodial borders, often locally widened. White triangle on head connected with white line over dorsal sides of rhinophores. Tips of rhinophores and often also posterior side of renocardial prominence lack tubules of digestive gland. Individuals with digestive gland yellowish starting in the central parts have not fed for some weeks as confirmed in captivity as suggested by Swennen in personal communication (Fig. 2f).

Size: 3 to 14 mm

Natural history: This species is reported to feed on siphonal green alga *Boodleopsis c.f. pusilla* that grows in high mud between mangrove roots (Swennen, 2011).

Distribution: Hong Kong, Thailand and India (Andaman and Nicobar Islands, a new record from the present study which extends its range to Indian ocean).

***Thuridilla albopustulosa* (Gosliner, 1995)**

Material examined: ZSI/ANRC 6405, one sexually matured individual, coral reef, 8 m depth, behind Butler Bay, little Andaman, 01.06.2011, collected by Sreeraj, C.R.

Diagnosis: The body is bluish with white pustules and black and orange pigment. The posterior half of the rhinophore reddish orange in color (Fig. 3a).

Size: 12 mm.

Natural history: Found on flat reef with algae and sponges.

Distribution: South Africa, Albarda Atoll, New Guinea, Philippines, Japan, Indonesia and India (First record from the Indian waters):

- Superfamily: Limapontioidea Gray, 1847
- Family: Limapontiidae Gray, 1847

***Costasiella paweli* (Ichikawa, 1993)**

Material examined: ZSI/ANRC 5471, six sexually matured individuals, sandy area with algae, 0.5 m depth, North Wandoor, South Andaman, 01.01.2011, collected by Sreeraj, C.R.

Diagnosis: Animal green in color. There is a spot of rust colored and black dots behind the eyes, extending up the front of the pericardium. The cerata appear dark green from the digestive glands; the tips have sub-terminal band of white and pale red and the tips are transparent. The animals collected from Andaman waters differ from the original description in having all black rhinophore and orange tips to the cerata. The same characters are reported in the animals collected from Singapore by Jensen (1990a) (Fig. 3b).

Size: 3 to 8 mm.



Fig. 3(a-d): (a) *Thuridilla albopustulosa*, (b) *Costasiella paweli*, (c) *Dendrodoris fumata* and (d) *Bornella anguilla*

Natural history: The animals were found exclusively on green algae *Avrainvillea*. The animals used to feed and lay eggs on the same algae.

Distribution: Japan, Singapore and India (First report from Indian Ocean, although there are reports in www.seaslugforum.net , they are not confirmed to be *C. Paweli*);

- Clade: Nudipleura
- Subclade: Doridacea
- Superfamily: Phyllidioidea Rafinesque, 1814
- Family: Dendrodorididae O'Donoghue, 1924

***Dendrodoris fumata* (Ruppell and Leuckart, 1828)**

Material examined: ZSI/ANRC 6402, one juvenile, intertidal area, 0.2 m depth, Gandhi Nagar, Great Nicobar Biosphere Reserve, Great Nicobar Island, 19.02.2011, collected by Raghunathan, C.

Diagnosis: Color variable from pink to reddish orange in juveniles, turning black in adults. It has five large gill branches which spread and extend to the edge of the mantle (Fig. 3c).

Size: 55 mm.

Natural history: Found under rocks and coral rubbles in the shallow water areas.

Distribution: South Africa, Madagascar, Tanzania, Christmas Island (Indian Ocean), India (Gujarat (Apte *et al.*, 2010) and Andaman and Nicobar Islands; first report from this work), Malaysia, Australia, New Caledonia, Vanuatu, Singapore, Korea, Japan, Palau and eastern Pacific of North and South America:

- Subclade: Dendronotida
- Superfamily: Tritonioidea Lamarck, 1809
- Family: Bornellidae Bergh, 1874

***Bornella anguilla* (Johnson, 1984)**

Material examined: ZSI/ANRC 5472, five sexually matured individuals, coral reef, 3 m depth, Company Basthi, long Island, Middle Andaman, 22.01.2011, collected by Sreeraj, C.R.

Diagnosis: It has a very characteristic mosaic-like color pattern with orange and creamy color. The orange and black paddle shaped appendages adjacent to the gills and rhinophores are also specific for this animal (Fig. 3d).

Size: 45 to 60 mm.

Natural history: The animal was found on a dead branching coral covered with mud and hydroids of the genus *Plumeria*. When disturbed the animal swims rapidly like an eel; with which the species was named.

Distribution: western Indian Ocean of South Africa Reunion, Madagascar to Myanmar, Thailand, Western and eastern Australia, Vanuatu, Fiji, Papua New Guinea, Indonesia, Philippines, Guam, Japan, Marshall Islands and India; reported for the first time from India.

DISCUSSION

Mangroves, seagrasses and coral reefs are the major tropical coastal ecosystems of the world. The physico-chemical and biological interactions between the coastal ecosystems have been perceived, but are rarely explored for better understanding of their connectivity (Kathiresan and Alikunhi, 2011). There are many works in the recent time to explore more about the diversity and interrelations between the ecosystems (Eghtesadi-Araghi, 2011; Manikandan *et al.*, 2011; Belford and Phillip, 2011).

The knowledge about opisthobranch diversity of Indian subcontinent is too little to interpret. Although variegated, these organisms could drag the attention of only a few researchers. The medical potential of opisthobranchs is yet to be discovered, the advances in the bio-medical research can be used for this (Gupta and Sharma, 2011). Recently few works reported which are focused on opisthobranchiate fauna (Apte, 2009; Raghunathan *et al.*, 2010; Ramakrishna *et al.*, 2010; Sreeraj *et al.*, 2010; Apte *et al.*, 2010; Matwal and Joshi, 2011). The frequent large-scale climatic oscillations and local disturbances on the reefs of this archipelago as well other parts of Indian sub-continent add pressures on biodiversity sustenance. The recent studies show that the coral reef and its associated animals are in stress from various factors (Valavi *et al.*, 2010a, b; Ganesapandian *et al.*, 2011). The development of tourism activities in the coral reef areas should also be monitored for preserving the faunal diversity (Kumar, 2002).

CONCLUSION

The present work which deals with 10 species of opisthobranchs, belonging to 8 families, collected from the Andaman and Nicobar Islands adds in the first instance, to the information on the marine fauna of the Indian waters and secondly gives an account of the extent to which different groups of opisthobranchs are distributed in Andaman and Nicobar archipelago. These findings suggest that the Andaman and Nicobar Islands is indeed a region of high opisthobranch diversity, although to date it remains understudied as established by our new regional records.

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