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NEW RECORDS OF OPISTHOBANCHS FROM LAKSHADWEEP, INDIA (MOLLUSCA: HETEROBRANCHIA)

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Abstract: All India Coordinated Project on Taxonomy (AICOPTAX), an initiative of Ministry of Environment and Forests allowed the authors to study opisthobranch fauna of the west coast of India. During the present study, nine species of opisthobranchs are reported for the first time from Lakshadweep of which six are new records to India.

Keywords: AICOPTAX, Heterobranchia, Lakshadweep, Mollusca, opisthobranch.

A careful literature search has revealed about 127 species of opisthobranchs reported until 2008 on the western coast of India by various authors. However, since 2008 after the systematic work undertaken by the authors several new records have been established (Apte 2009, 2012; Apte et al. 2010; Apte & Salahuddin 2011; Bhave & Apte 2011, 2013). The present study was undertaken through the All India Coordinated Project on Taxonomy - Mollusca supported by Ministry of Environment and Forests, Government of India.

The past work on opisthobranchs of the western coast of India was by Gardiner (1903), Winckworth (1946a,b), Hornell (1909b), Gideon et al. (1957), Narayanan (1968, 1969, 1971a,b), Menon et al. (1970), Rao & Kumari (1973); Rao et al. (1974); Balani & Patel (1994), and Jagtap (2009). Gosliner (1995) and Jensen (1992) reviewed the family Elysidae (now Plakobranthidae) from the Indo-Pacific region. Rudman (1983) studied

Chromodoris aspersa colour group.

Materials and Methods

Intertidal survey was done using snorkelling to collect the specimens. Direct search under dead coral boulders and shallow pools during low tides was conducted particularly on the eastern side reef. Digital images were taken of live specimens; specimens were stored in 90% ethyl alcohol after studying the morphological characters for DNA sequencing without relaxing them. The specimens are deposited in the Bombay Natural History Society (BNHS) collections.

Study site and duration: Field collections were carried out for two weeks in December 2009 and April 2010 at Minicoy (8°16'N & 73°3'E) and Kavaratti (10°33'N & 72°36'E), Lakshadweep Archipelago (Fig. 1).

Results and Discussion

During the two week survey, nine species were recorded belonging to eight families (Table 1). Apte (2009) reported 60 species of opisthobranchs from Lakshadweep of which 52 were new records to Lakshadweep and 40 new records to India. During the present work an additional nine new records were established for Lakshadweep of which six are new for India. This clearly reflects the fact that opisthobranch

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Competing Interest: The authors declare no competing interests.

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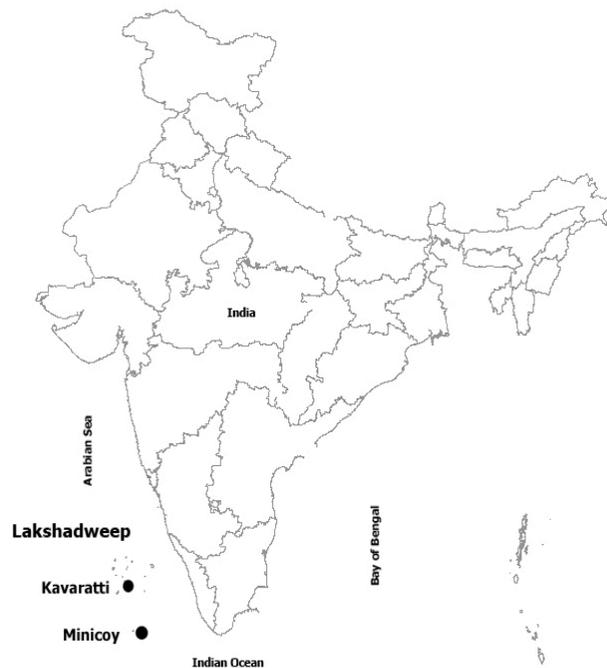


Figure 1. Survey locations in the Lakshadweep (map not up to the scale)

fauna need much more attention.

December 2, 2009 was an exceptional day due to the presence of very high density of species like *Elysia tomentosa*, *Gymnodoris okinawae* and *Polybranchia orientalis* at Kavaratti. Almost invariably, egg cases of *E. tomentosa* were seen in close proximity of egg cases of *P. orientalis*. Similar observations were made on 23 October 2007 where *Gymnodoris ceylonica* timed their appearance with the congregation of the benthic form of *Stylocheilus longicauda* [previously known as *Stylocheilus striatus* (Quoy & Gaimard, 1932)] (Yonow 2012) on which they were seen feeding. Large congregations of *Haminoea cymbalum* were observed for three winter seasons on 4 December 2005, 29 January 2007 and 3 February 2008; which were breeding congregation. Large numbers of *Flabellina bicolor* were seen on 1 March 2009 and *Dolabrifera dolabrifera* on 9 December 2007. Similar observations were made by Yonow (2012) in La Réunion on February 2007 where *H. cymbalum* were seen at a density of 100 individual/m². Walter (1890) observed large congregation of *Haminoea hydatis* and *Aplysia punctata* at Plymouth. Carefoot (1987) in the review paper on the biology of *Aplysia* states that not all such aggregations are strictly for breeding, it is possible to happen due to successful settlement or even when a large number of individuals eat all available food and start moving towards new sources. Though there is no pattern in such occurrences,

Table 1 New records of opisthobranch from Lakshadweep

	Family	Species	New record to Lakshadweep	New record to India
1	Limapontiidae	<i>Sohgenia palauensis</i>	√	√
2	Plakobranchidae	<i>Elysia rufescens</i>	√	√
3	Pleurobranchidae	<i>Pleurobranchus forskalii</i>	√	√
4	Gymnodorididae	<i>Gymnodoris okinawae</i>	√	√
5	Chromodorididae	<i>Chromodoris aspersa</i>	√	√
6	Discodorididae	<i>Sclerodoris apiculata</i>	√	-
7	Dorididae	<i>Doris granulosa</i>	√	-
8	Bornellidae	<i>Bornella stellifer</i>	√	-
9	Facelinidae	<i>Phidiana semidecora</i>	√	√
			9	6

such events are not uncommon.

Details of newly recorded species

Kingdom: Animalia

Phylum: Mollusca

Class: Gastropoda

Subclass: Heterobranchia

Infra-class: Opisthobranchia Milne-Edwards, 1848

Order: Sacoglossa Ihering, 1876

Family: Limapontiidae

1. *Sohgenia palauensis* Hamatani, 1991

India: Kavaratti, Lakshadweep.

Global Distribution: Tropical Indo-West and North-West Pacific (Rudman 2002), Palau (Hamatani 1991), Indonesia (Nudipixel database), Tanzania, Papua New Guinea, Guam, Japan (Gosliner et al. 2008) and Marshall Islands (<http://www.gastropods.com>).



Image 1. *Sohgenia palauensis*

Size: Single specimen. 8mm (BNHS-opistho-083).

Descriptive features: It is a small sea slug and rarely found, primarily due to its cryptic nature. The body is flattened with transparent cerata. Brownish-red dots are clearly visible on the cerata which are bulbous at the tips. The body is deep green in colour. Animal autotomizes cerata if disturbed (Image 1).

Status: Rare.

Family: Plakobranchidae

2. *Elysia rufescens* (Pease, 1871)

India: Kavaratti, Lakshadweep.

Global Distribution: Myanmar, Guam, Indonesia (Nudipixel), Australia, Tahiti, Hawaii, Reunion Island, Christmas Island, South Africa, Philippines, Samoa and Japan (Gosliner et al. 2008)

Size: Three specimens ranging between 20–40 mm (BNHS-opistho-90).

Descriptive features: During the survey, the species was found along with *Elysia tomentosa*. It is common in shallow exposed reef areas. The body is profusely mottled with white scattered acran olive green background. Edge of the parade has red band. Egg case is white in colour. The species has rarely been reported from western part of Indian Ocean (Gosliner 1987) (Image 2).

Status: Uncommon.

Order: Pleurobranchomorpha Schmekel, 1985

Family: Pleurobranchidae

3. *Pleurobranchus forskalii* (Rüppell & Leuckart, 1831)

India: Kavaratti, Lakshadweep.

Global Distribution: Red Sea, Fiji, Australia, Indonesia,

Philippines, Guam, Tanzania, New Guinea and Japan (Gosliner et al. 2008).

Size: Five specimens ranging between 20–72 mm (BNHS-opistho-580).

Descriptive features: It is a large sea slug and seen under coral boulders. It can also be seen moving on the sand floor. The surface is highly tuberculate. Each tubercle at the base is encircled by a bluish-violet colored ring. The species, however, show a wide range of colour variations. One of the specimens collected is deep reddish-orange and has no coloured rings at the base of tubercles. Both the colour forms are illustrated to show the colour variation seen in this species. Rhinophores have a fine rib like pattern. The foot is fleshy, muscular and large (Images 3 and 4).

Status: Seasonally common.

Order: Nudibranchia Cuvier, 1817

Family: Gymnodorididae



Image 2. *Elysia rufescens*



Image 3 & 4. *Pleurobranchus forskalii*



Image 5. *Gymnodoris okinawae*

4. *Gymnodoris okinawae* Baba, 1936

India: Kavaratti, Lakshadweep.

Global Distribution: Reunion, Aldabra, South Africa, Tanzania, Papua New Guinea, Philippines, Midway Atoll, Hawaii and Japan (Gosliner et al. 2008).

Size: Eight specimens ranging between 30–35 mm (BNHS-opistho-065).

Descriptive features: This species seems to have timed their appearance with those of *Elysia tomentosa*. Almost every specimen was seen with whole *Elysia* in its stomach (Image 4). On 2 December 2009, one of the author, Deepak Apte counted and measured size of over 800 individuals in a small area of about 100m². At the same time we counted *Elysia tomentosa* with average density of 90 individuals per m². The congregation though was short-lived and both *Gymnodoris* and *Elysia* disappeared within a span of three days. Colour is light yellow spotted with white and orange. Body also has a scattered network of orange and white lines. Eight gills are clearly visible and form a complete circlet. Rhinophores are short and have 18–20 lamellae (Image 5).

Status: Seasonally common.

Family: Chromodorididae

5. *Chromodoris aspersa* (Gould, 1852)

India: Kavaratti, Lakshadweep.

Global Distribution: Indo Pacific from East Africa, Aldabra, Reunion Island, Seychelles, Papua New Guinea, Australia, Philippines, Marshall Islands, Japan and Hawaii (Gosliner et al. 2008).

Size: Five specimens measuring 16–33 mm (BNHS-opistho-087).

Descriptive features: A mid-sized chromodorid and rarely seen. It is white in colour with deep violet spots on the body. Posterior end of foot is long, pointed and



Image 6. *Chromodoris aspersa*

spotted with violet spots. Gills are translucent white and eight in number. Rhinophores are deep orange in colour and have 16–18 lamellae (Image 6).

Status: Uncommon.

Family: Discodorididae

6. *Sclerodoris apiculata* (Alder & Hancock, 1864)

India: Kavaratti, Lakshadweep, Tamil Nadu and Andhra Pradesh. The species is described from Waltair, Andhra Pradesh as *Doris apiculata* by Alder & Hancock. It was last recorded from Tamil Nadu in 1932 by C.H. O'Donoghue as *Halgerda apiculata*.

Global Distribution: Western Indian Ocean of South Africa, Madagascar, Saudi Arabia, Tanzania, Australia, Papua New Guinea and Japan (Gosliner et al. 2008).

Size: One specimen measuring 50mm (BNHS-opistho-061).

Descriptive features: Mantle of the species is like sponge on which it is found. Surface has deep pits. Mantle also has small tubercles which have white papillae. Larger tubercles have secondary papillae as well. Colour is yellow. Gills are bushy and light yellow in colour. Rhinophores has stout and dark yellow ochre. Foot margin is lined by distinct brownish-black line (Image 7).

Status: Rare.

Family: Dorididae

7. *Doris granulosa* (Pease, 1860)

India: Kavaratti, Lakshadweep and Ratnagiri (Maharashtra). It was originally described as *Doriopsis granulosa* by Pease, 1860 from Sandwich Islands.

Global Distribution: Western India Ocean (Madagascar, Seychelles, Reunion); Western Pacific,



Image 7. *Sclerodoris apiculata*

Central Pacific, Marshall Islands and Hawaii.

Size: One specimen measuring 22mm (BNHS-opistho-879).

Descriptive features: Mantle of the animal bears small and rounded tubercles. Arrangement of gills is diagnostic in this species. Gills are arranged across the back in transverse line. Colour is dark yellow. Rhinophores are dark ochre yellow (Image 8).

Status: Rare.

Family: Bornellidae

8. *Bornella stellifer* (A. Adams & Reeve, 1848)

India: Kavaratti and Agatti, Lakshadweep; Ratnagiri, Revdanda (Maharashtra) and Gulf of Kutch (Gujarat).

Global Distribution: Australia, Hawaii, Thailand, South Africa, Madagascar, Papua New Guinea, New Caledonia, Japan, Singapore, Malaysia, Indonesia, Taiwan, American Samoa, South China Sea, Korea, East Africa, Philippines, Tahiti, Hong Kong and Marshal Is (Pola et al. 2009).

Size: Three specimens. 25–29 mm (BNHS-opistho-00637).

Descriptive features: A small sea slug found under coral boulders. Oral tentacles are paired and finger like. Gills are placed at the base of each cerata. Rhinophores are present on long stalks and surrounded by long filamentous papillae. It feeds on hydroids. The color is deep reddish-brown with white patches. Tips of cerata and papillae have an apical red band (Image 9).

Status: Rare at Lakshadweep but common in Gujarat and Maharashtra.

Remark: Specimens from Gujarat (Apte et al. 2010) and Lakshadweep varies significantly in



Image 8. *Doris granulosa*

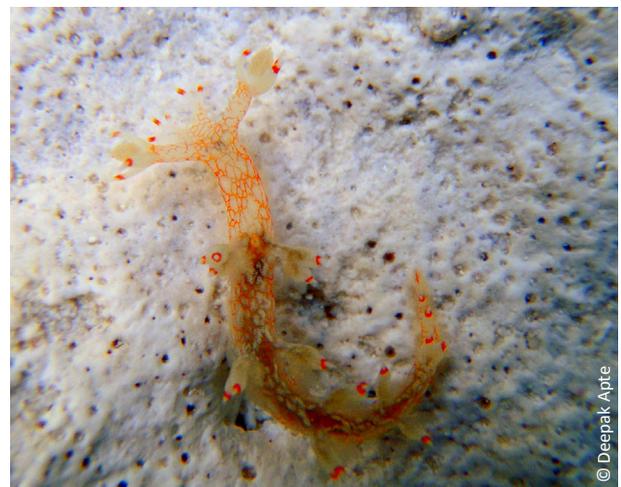


Image 9. *Bornella stellifer*

external morphology. The DNA based study was thus undertaken to confirm the identity of the species found in Lakshadweep. The studies confirmed it as *Bornella stellifer*. Pola et al. (2009) did a revision of family Bornellidae and present findings confer with the same. DNA sequences for Col, 16s and H3 are deposited with gene bank under GenBank accession number KF601556–KF601558 (16S.sqn 637 KF601556, COI.sqn 637 KF601557, H3.sqn 637 KF601558).

Family: Facelinidae

9. *Phidiana semidecora* (Pease, 1860)

India: Kavaratti, Lakshadweep.

Global Distribution: Hawaii (Pease 1860) and Sagami Bay, Japan (Baba 1949, 1965).

Size: One specimen measuring 10 mm (BNHS-opistho-880).



Image 10. *Phidiana semidecora*

Descriptive features: It is a small slug. It shows a close resemblance with *P. anulifera*. However, red lines as seen in *P. anulifera* are absent in this species. The mantle is translucent white and scattered with white and red spots. Foot is translucent white and heavily spotted with white. Rhinophores are annulated with 3-4 annulations with upper half opaque white. Oral tentacles are banded with opaque white and translucent red arranged in alternate manner with opaque red band at the base and at the center. Cerata are arranged in four clusters. Few cerata in each cluster are bulbous at the tip with an opaque white band just below the tip (Image 10).

Status: Rare.

In conclusion it can be said that the AICOPTAX initiative of Government of India has allowed strengthening taxonomic work on molluscs in general and opisthobranchs in particular. Previously, the authors reported 88 new records of opisthobranchs to Lakshadweep, Maharashtra and Gujarat which include 61 new records to India (Apte 2009; Apte et al. 2010; Bhave & Apte 2011). The range extension of nine more species of opisthobranchs to Lakshadweep only reinforces the fact that more intensive surveys are essential as they can add more species to this archipelago. Diversity of cryptic opisthobranchs is virtually undocumented from these islands. Thus, targeted surveys of hydroid, bryozoan and sponge associated cryptic opisthobranch may reveal new records and can be an important area of future studies.

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