

Current Trends in Oceanography and Marine Science

Research Article

Mohan PM, et al. Curr Trends Oceanogr Mar Sci 2: 110.

DOI:10.29011/CTOMS-110.100010

New Reports on Ophisthobranch Fauna from the Intertidal Environment of Port Blair, Andaman Island India

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Citation: Jeeva C, Muruganantham M, Mohan PM (2019) New Reports on Ophisthobranch Fauna from the Intertidal Environment of Port Blair, Andaman Island India. Curr Trends Oceanogr Mar Sci 2: 110. DOI:10.29011/CTOMS-110.100010

Received Date: 13 August, 2019; **Accepted Date:** 26 August, 2019; **Published Date:** 30 August, 2019

Abstract

The ophisthobranch fauna is highly diversified in the tropical and subtropical reefoidal and mega diverse environments like Indonesia, Australia, Papua New Guinea and Philippines. However, one among the mega biodiversity hot spot Andaman and Nicobar Island investigated the literature of ophisthobranch fauna which revealed that there were 47 families and 126 Genus and 210 species listed. In addition, the present study carried out the survey on inter tidal regions for one year which reveals 17 species of Ophisthobranch fauna belongs 9 families 15 genus. This study also found that a total of 7 species as first time record for this Andaman and Nicobar Islands. The present has leads the diversity of the ophisthobranch fauna from 210 to 223 species based on the present reports as well as earlier reports.

Keywords: Andaman & Nicobar Islands; Inter Tidal; New Record; Ophisthobranch

Introduction

The Andaman and Nicobar archipelago consists of 572 islands, islets and rocky outcrops and entire coastline of 1,962 km. This archipelago is one among the bio-diverse and reserve of the world heritage as well as considered as eco-region of the world. This archipelago brightly stands with its high diverse and pristine coral reefs than any other south Asian countries. While this coral reef ecosystem provides a shelter and entertain enormous variety of flora and invertebrate fauna. Those invertebrate organisms and other floral taxa are making the coral reef and intertidal environment as flowering garden with its brightness of their colourful and beautiful nature. Among the reef dwelling organisms, the nudibranch is also one of the colourful animal they playing an important role in the food webs of the coral reef and intertidal environment. The word nudibranch (*nudes* = naked, Latin), (*brankhia* = gills, Greek) means naked gills. They are one among the gastropod mollusks, these group of animals does not have their protective shells which is a distinguishing character from the other gastropods and it is a member of lower Heterobranchia. Even though some mem-

bers of this groups bearing shells it is not much strong and thick as well as they are very tiny and often fragile that they using for their protection from their predators. The structure and life style of them is very different and they possessing soft and fleshy body. The soft body consist with muscular foots and tentacles (Rhinophores) which are used as locomotory and sensory organs and it has gills on their back used for their respiration. The habitations of these animals are almost all the available environments of marine and from the intertidal to great depth of the oceans. It has the diverse food habits and for their feeding they are using the radula which is differing in species to species, it is also a key character for their identification.

In the case of review on ophisthobranch fauna of Andaman and Nicobar Islands suggested that a very minimal study was carried out [1]. The study of ophisthobranch begin in this Islands by [2], and continued with several workers are [3-10]. were made a check list and the list was suggested that total 210 species of ophisthobranch were distributed in the Andaman and Nicobar Islands but these excluding the reports of [11-15]. In addition, [16] were reported 4 species of first record from Nicobar Islands. The present study was conducted to account the ophisthobranch fauna from the Port Blair coast of South Andaman.

Materials and Method

To document and make the online catalogue of marine biota distribution and diversity as well as geographical location of the animal the INDOBIS program were made. A part the program was conducted in the intertidal and coral reef environment of south Andaman were made in the period of January to December 2016. The lowest tide of four days of each month were chosen for faunal survey and a 25m transect of intertidal exposed area were covered by 5 people to observe and collect the fauna at a time and total 1km area were covered within in the low tide time range. While total of 17 species of ophisthobranch fauna were collected from the four selected study area of south Andaman i.e. Carbins Cove, Burmanallah1, Burmanallah 2, and Badabalu. The collected specimens were carried to laboratory in live condition and specimens were identified by using the Nudibranchs Encyclopedia Catalogue of Asia/Indo – Pacific Sea Slugs Papua New Guinea [17,18]. The photographs of the animal were made under the LEICA M205C Sterioscopic binocular microscope with the inbuilt camera of LEICA MC 170 HD. The identified specimens were preserved in the 5% ethanol and stored in the Laboratory (Figure 1).

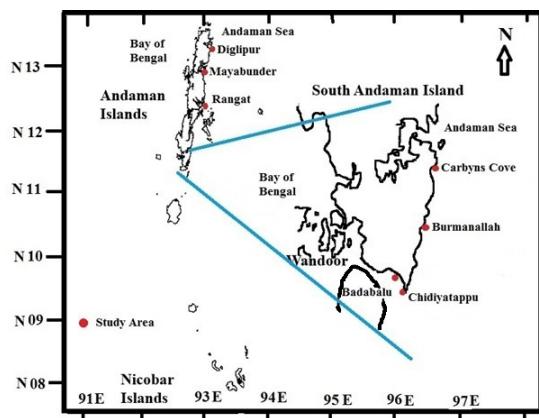


Figure 1: Study area map.

Result and Discussion

The Macro-faunal observation and collections were made for records of biodiversity of the intertidal fauna of Andaman Islands and there were selected different intertidal area from south Andaman is i.e. Carbins Cove, Burmanallah 1, Burmanallah 2, and Badabalu to execute this work (Figure 2).

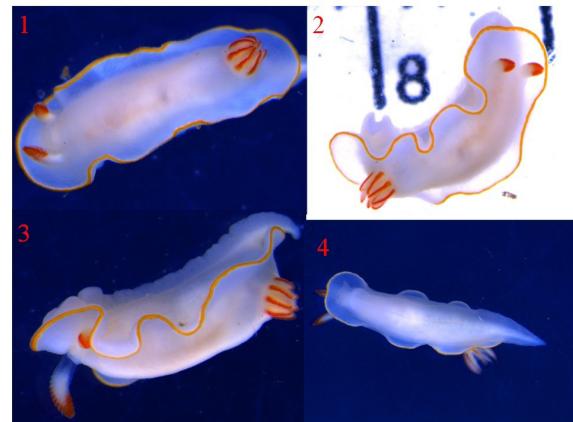


Figure 2: 1 and 2 Dorsal View of *Ardeadoris electra*. 3 Lateral View, 4 Ventral View.

The survey was found 17 species belongs to 15 genera and 9 families of Ophisthobranch fauna among the collected several group of invertebrates. There was the present study has found 7 species as first time for this Island in that 4 species were new to Indian waters. The species are *Ardeadoris electra*, *Coastasiella kuroshima*, *Haminoe natalensis*, *Lobiger viridis*, *Oxynoe viridis*, *Thamnovalva limax* and *Thuridilla lineolata* (Figures 1-5). are the first time reports of the present study. The 7 species belongs to 6 families and details of these species and station wise distribution has given (Tables 1 and 2). in detailed. They are the species *Ardeadoris electra* were belongs to family Chromodorididae. The family chromodorididae has large numbers of most attractive colourful species especially of the genera Chromodoris, Hypselodoris, Glossodoris and Cadlina. Systematic of the Glossodoris is often underwent debate and it is conflicting with the taxonomy. It was also had considered as a synonymous of Chromodoris and Hypsolodoris. They also have potential technological applications like new molecules, pharmacological properties and secondary metabolites. As well as in the genus glossodoris was already used for experimental work and produced some new applications [19]. The species of above said groups are often associated with sponges for their prey and similarly the reported species (*A. electra*) of the present study were also found with the sponge *Styliissa massa*. Some of the glossodoris has the attributed prey of sponge, as well as this taxon has the significances of chemotaxonomy [20]. These groups of species can obtain toxic anti-feedant chemicals from the sponge prey [21]. which can be useful for their defence system. One of the important

character of the family has mantle flap were described [22]. And gills are also an important key character for the taxonomical classification to species level of family Chromodorididae (Figure 3).

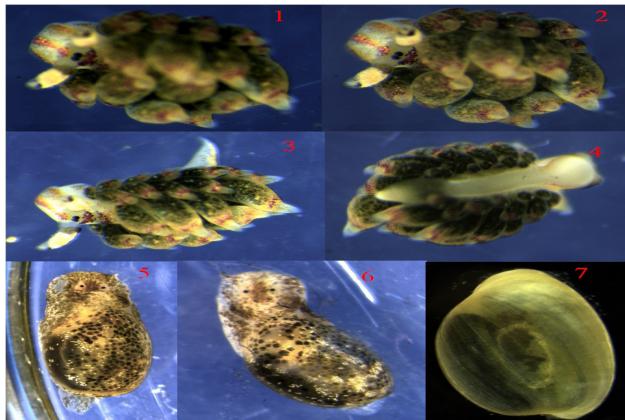


Figure 3: 1 and 2 Dorsal View of *Costasiella kuroshimae*, 3 Lateral View, 4 Ventral View.

5 and 6 Dorsal View of *Haminoe natalensis*, 7 Shell.

A total of 38 genera categorized under this family and total 13 species are belonging to the genus Ardeadoris as world report. Therefore, a total of 10 genera and 47 species had been reported in Andaman and Nicobar Islands. While the species *Ardeadoris electra* can often be identified in the intertidal regions with the colour of white and yellowish border of mantle. The length of the animal was measured as 13 mm in the present study. A pair of rhinophores was present which has appeared as orange red in colour on the top and whitish in the base. A long foot has present with whitish colour. Gills are present on the back and it has the similar colour pattern like tip of the rhinophores. The genera *Costasiella* belongs to family Costasiellidae and it seems to unite a combination of limapontioid morphological characters. However, some of the species have one or more of the following characters i.e. pedal tentacles, a cerata shaped tail, a penial stylet, pharyngeal pouches and albumen gland in the cerata. Therefore, a separate family [23] was eventually created which comprises very less number of genera (2) and only 17 species were reported in worldwide in the case of Andaman and Nicobar Island there is no any report till date. The morpho-characters of this family very close related to the phylogeny of this group [24]. The inferred molecular analysis of this family suggested that the affinity of the genera is uncertain [25]. Therefore, species of this family were described very poorly as well as the fundamental characters are not rightly matching and this issue has risen by and suggests that the genus should be split up, but further they did not provide any specific suggestion or proposal [26], (Figure 4).

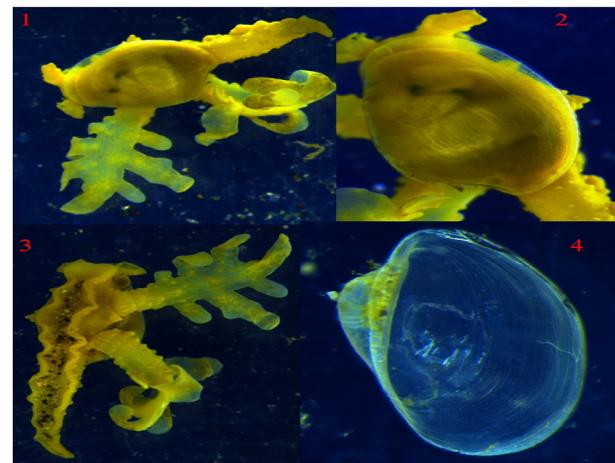


Figure 4: 1 and 2 Dorsal View of *Lobiger viridis*, 3 Ventral View 4 Shell.

Although present study identified a species *Costasiella kuroshimae* from this family which has the distinguished characters as the animal is very small in size it has the two pairs of eyes as brownish to orange in colour which lie forward to the head region of dorsal midline. Mainly cerata is green and has numerous white spots which are surrounded beneath by a ring of pinkish-orange colour. An orange and brown colour bands were present on the head between rhinophores. Many cerata-like structures are densely arranged on either side of the body and looks like an aeolid and greenish colour. The tips of rhinophores are appeared as white in colour. Ventral side of the body has pale yellowish-white. A total of 4 species among the studied 17 species found belongs to the family Haminoeidae. Out of them only one species *Haminoe natalensis* were identified as a first time report for these Islands remaining were reported earlier by various authors. The family Haminoeidae has a total of 32 genera in that the genus haminoea has 56 species as status of worldwide while the status of Andaman and Nicobar Islands revealed those 2 genera and 18 species were reported. Although the special characters of the species of haminoea genera has the external shell which is covered by the spiral grooves. Either an ovoid or cylindrical elongated type of shells can be mostly found in this group. It is also commonly called as haminoeidae bubble snail and it is a genera rich family in the Cephalaspidea gastropod [27]. Most of the species are reported as cosmopolitan from this family and mostly crawling in the sandy bottoms and also they can bury the soils with the help of shells. The character of the *Haminoe natalensis* identified in this present study is that the body is appeared as green in colour and comprises black spots on the entire body. Visceral mass has present, the margin of the mantle has light white in colour. The darker band and blotches are present between

eye spot on the top of the head. Shell is translucent and has wavy spiral striate and whole shell darker appeared as olive green and pale yellow colour as partially. The foot was somewhat developed as parapodium which is folded over to cover the shell (Figure 5).

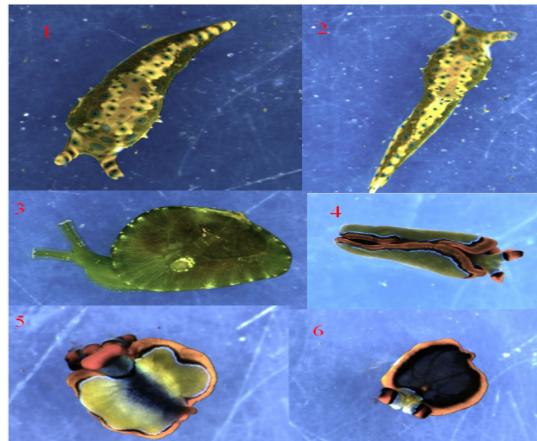


Figure 5: 1 and 2 Dorsal View of *Oxynoe viridis*, 3 *Thamnovalva limax*, 4 *Thuridilla lineolata* (Crawling position), 5 *Thuridilla lineolata* (During Rest, Dorsal Side) -6 *Thuridilla lineolata* (During Rest, Ventral Side).

The species *Berthelinia limax* is belongs to the family Julidae, in this family total 6 genera as well as genus *Berthelinia* has 19 species they were recognized from the world wide reports and from the Andaman and Nicobar Island belongs this family 2 genus and 02 species could have noticed. The genus *Berthelinia* clearly differs from other gastropods with their distinguished shells which consists of two valves and is less relative to that of pelecypods. Therefore, a more than 70 years, this genus has been assigned to the class Pelecypoda. However, the live animals were collected by [28]. At present they are classified as the Class Gastropoda, Subclass Opisthobranchia and Order Sacoglossa is absolutely undeniable. The morpho character of this species *Berthelinia limax* in the preset study noticed as grass green colour in whole body. The marginal edge of the mantle has pale yellow colour of bands. A pair of rhinophores was present and same length of oral tentacles was also observed. It has a translucent bivalve shell as well as it is highly fragile and thin. The umbo of the shell has not much elevated and in the shell scarce of adductor muscle is visible as well as it has brownish colour of liver which appeared through the shell valves. The shell had broadly rounded anterior end and narrowly rounded posterior end. The animal has a narrow foot, sole is medially grooved and the tail is very short and not extended behind the shell. The family Oxynoidae has consist total of 9 genera and the present study found two genera they are *Lobiger* and *Oxynoe* and two species are *Lobiger viridis* and *Oxynoe viridis* one from each genus respectively. The genus *Lobiger* has 9 species whereas genus *Oxynoe* has 13 species in worldwide and in the case of An-

daman and Nicobar Islands have no reports till date from both the genus. Family Oxynoidae has the distinguished character that they have reduced shells on its body but they cannot retract the body into the shell and also it has lack of shell adductor muscle. Here the character of the *Lobiger viridis* observed in the present study, it was the bright yellowish colour throughout body. The animal had a pair of rhinophores at above the mouth region as short in length. The body was broad and somewhat oval in shape and it bears a reduced shell like bivalve shell. It also had a special character that the two pair of lateral parapodia which had branch and leaf like structure. The tail was little longer and almost pointed. The specimen of the present study had lost one side parapodia due to handling. The species *Oxynoe viridis* of oral side appeared as greenish colour and the aboral side as well as mid body has yellowish patch. The blue green rounded spots are dispersed in whole body and the body has fleshy grooves in aboral sides as well as centre of the body. In oral sides the grooves appeared as filaments or cilia. A yellow and greenish band has arranged in an alternative way on rhinophores. The tail portion is longer than body and fleshy as well as it has pointed end. The study also found 03 species out of this only one species noticed as a first report of these AN Islands which is *Thuridilla lineolata* from the family Plakobrachidae.

The family Plakobrachidae has a total of 18 genera and in the genus *Thuridilla* total 25 species were listed from worldwide while out of 25 species from the Andaman and Nicobar Islands 6 species already reported. The size of the species is varying from 4mm to 8mm in length and the oral side banded with tricolors are orange in the outer edge, black is in the centre and the white colour is in the inner edge. Centre of the body black patch and outer body is appeared as parrot greenish colour in both sides. A small pair of rhinophore also banded with orange and black colours. The oral side has often been folded like a role was noticed from the specimen of present study. In addition, the studied 17 species of Ophisthobranch fauna distributed in five different study areas and also from different seasons of the year 2016 of the intertidal environment of Port Blair of Andaman Islands. Among the 17 species 10 species noticed and collected as single specimen, whereas two species found as two numbers and a five species found as more abundance. Those five species are counted per square feet or square meter, they are the species *Elysia ornata* were counted with 8 numbers during the month of August in the rocky intertidal area of Carbyns Cove, then the species *Pteraeolidia ianthina* were encountered with 10/m² from the Carbyns Cove as well as Badabalu during the month of November, whereas species *Haminoe natalensis* and *Haminoe ovalis* were notice with 35 and 10/30cm² respectively in the month of February-2016 from the coast of Burmanallah 1. Moreover, the species *Thuridilla lineolata* were observed with number of 15/10m² area. Also the Plakobrachidae species *Plakobranchus ocellatus* were noticed in almost all the stations as well as all the seasons of the year with the average number of 10/m².

The abundance and seasonality of this ophisthobranch fauna also may have some ecological importance to this habitat which has to be delineated (Tables 1 and 2).

SL.NO	Species Name	Reference	Distribution Elsewhere
1	<i>Ardeadoris electra</i> *	Present Study	Japan, Australia, Western Pacific Ocean.
2	<i>Ceratosoma sinuatum</i>	Present Study	Japan, Solomon Islands, Thailand, Hawaii. Indonesia, Philippines, Australia.
3	<i>Coastasiella kuroshima</i> *	Present Study	Japan, Solomon Islands, Thailand, Malaysia. Indonesia, Philippines, Australia.
4	<i>Goniobranchus conchiliatus</i>	Sakthivel et al., 2014	India.
5	<i>Haminoe natalensis</i> *	Present Study	Japan
6	<i>Herviella mietti</i>	Baskaran et al., 2013	Japan, Hawaii. Marshal islands.
7	<i>Lobiger viridis</i> *	Present Study	India, Thailand. Indonesia, Philippines, Australia, Mexico, Venezuela.
8	<i>Oxynoe viridis</i> *	Present Study	Andaman islands, Thailand, Indonesia, Philippines, Australia, Egypt, Turkey and Taiwan.
9	<i>Phaenerophthalmus smaragdinus</i>	Narayana and Mohanraju (2013)	Philippines, Kenya, Guam.
10	<i>Phyllidiopsis krempfi</i>	Kiruba-Shankar et al., (2016)	Thailand. Indonesia, Philippines, Australia, Singapore, Kenya, Vietnam, Micronesia, Sri Lanka. Malaysia, South Africa, Japan.
11	<i>Thamnovalva limax</i> *	Present Study	India, Australia.
12	<i>Thuridilla coerulea</i>	Sakthivel et al., 2014	India
13	<i>Thuridilla lineolata</i> *	Present Study	India, Thailand. Philippines, Indonesia and Timor-Leste.

Table 1: List of new records reported after Venkataraman et al. (2015) and including present study*.

SL.NO	Family	Species Name	Distribution	Number of Specimen Found	Month and year
1	Aplysiidae	<i>Stylocheilus striatus</i>	Burmanallah 1	2	November-2016
2	Chromodorididae	<i>Ardeadoris electra</i> *	Burmanallah 2	1	August-2016
3		<i>Astacolus tenuissima</i>	Carbys Cove	1	February-2016
4		<i>Ceratosoma sinuatum</i>	Burmanallah 2	2	February-2016
5	Costasiellidae	<i>Coastasiella kuroshima</i> *	Carbys Cove	1	November-2016
6	Fascillinidae	<i>Pteraeolidia ianthina</i>	Carbys Cove, Badabalu	10/m ²	November-2016
7	Haminoidae	<i>Haminoe natalensis</i> *	Burmanallah 2	35/30cm ²	February-2016

8		<i>Haminoea ovalis</i>	Burmanallah 2	10/30cm ²	February-2016
9		<i>Haminoea sym-balum</i>	Carbys Cove	2	February-2016
10		<i>Liloa mongli</i>	Burmanallah 1	1	February-2016
11	Oxynoidae	<i>Lobiger viridis*</i>	Carbys Cove	1	August-2016
12		<i>Oxynoe viridis*</i>	Burmanallah 1	1	February-2016
13	Juliidae	<i>Thamnovalva limax*</i>	Carbys Cove	1	August-2016
14	Phyllidae	<i>Fryeria marindica</i>	Badabalu	1	August-2016
15	Plakobrachidae	<i>Plakobranchus ocellatus</i>	Burmanallah 1 Burmanallah 2 Carbys Cove, Badabalu	10/m ²	February-2016, August-2016 and November-2016
16		<i>Thuridilla lineolata*</i>	Carbys Cove	15/10m ²	August-2016
17		<i>Elysia ornata</i>	Carbys Cove	8	August-2016

Table 2: overall species documented in the present study, star mark mention first time reported species of Ophisthobranch fauna from various stations of south Andaman.

Conclusion

The one-year study of the ophisthobranch fauna from the intertidal environment of Port Blair was revealed a total of 7 species as a first time report for this Andaman Island. It is suggested that since the Island is biodiversity hot spot as well as its stand with the uniqueness of endemism with various biotas. In the concern of marine biodiversity of this Island the ophisthobranch fauna also one among the diverse group although there was no endemism identified in this group for this Island. So in a special concern the study of ophisthobranch can take to delineate their diversity, endemism, ecological importance, molecular aspects and in the view of pharmaceutical applications would be valuable. It is also a noteworthy to report of 7 species as a first time from this Island by the concern of biodiversity.

Acknowledgement

The authors thank the Central Marine Living Resources and Ecology, Ministry of Earth Science, Kochi for funding this work (MOES/CMLRE/10-IT IS/5/2012, Date: 01/10/2012). They also acknowledge The Head, Department of Ocean Studies and Marine Biology and Other authorities of Pondicherry University to provide the facilities to execute this project.

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