Rec. zool. Surv. India: Vol. 120(4)/313–321, 2020
DOI: 10.26515/rzsi/v120/i4/2020/150834

ISSN (Online) : 2581-8686
ISSN (Print) : 0375-1511

New record of an oyster species from Chilika Lagoon, Odisha, north-western Bay of Bengal

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Abstract

This paper reports first record of a marine bivalve *Isognomon ephippium* Linnaeus from the Chilika lagoon as well as mainland of India since this species is highly restricted to Andaman waters only. Actual cause of occurrence is still unknown however, it is believed that passive migration of larva / juvenile through high energetic cyclonic water current might have helped to settle in Chilika lagoon or else it is carried out by the ballast water. The observed species contains many of the miniature pearls within it that provides new prospective to pearl industry. Nevertheless, occurrence of this reef based and mangrove linked species in the Chilika indicates highly adoptive nature of the lagoon ecosystem for the congregation of diverse marine benthic fauna.

Keywords: Chilika Lagoon, *Isognomon ephippium*, Mangrove, New Record, Outer Channel

Introduction

Globally, sixteen extant species are known under the genus *Isognomon* (Lightfoot, 1786) belonging to the family Isognomonidae (Gofas *et al.* 2001). This family is considered as one of the cryptic group that coexists either with mangrove habitat, sea grass meadows or in the coral reef structures. Being sessile in nature, its habitat is ranged from all type of hard structures observed in the intertidal to deeper sub-tidal regions. Isognomonids often exhibit well developed byssus threads through which they can attach to different hard surfaces of natural or manmade structures (Tëmkin & Printrakoon, 2016). These molluscs are used as important food stuff for coastal population (Palomares & Pauly, 2019) and play an important role in the bio-geo-chemical cycling in the mangrove vegetation and in the coral reefs (Tëmkin & Printrakoon, 2016).

Five out of 16 extant species are recorded from India till date (Subba Rao, 2017), viz., *Isognomon ephippium* (Linnaeus, 1758), *I. isognomon* (Linnaeus, 1758), *I. legumen* (Gmelin, 1791), *I. nucleus* (Lamarck, 1819) and *I. perna* (Linnaeus, 1767). The species *I. ephippium* is known only from Andaman waters (Subba Rao, 2017) and never reported from the estuarine or marine waters of main land of Indian peninsula as revealed by the scrutiny of published literature (Tripathy & Mukhopadhyay, 2015; Pawar & Al-Tawaha, 2017; Mahapatro & Kadam 2018; Tudu *et al.*, 2018; Dey & Tripathy, 2019; Yadav *et al.*, 2019).

From Odisha coast two species of the genus *Isognomon* were documented earlier off Ganjam coast (Subba Rao *et al.*, 1991), namely *I. isognomum and I. legumen*. Hitherto, there is no further scientific documentation on occurrence of Isognomonidae species along the coastal waters of Odisha within the last three decades (Tudu *et al.*, 2018). Chilika lagoon is a hotspot of biodiversity having international importance. Therefore, while conducting regular monitoring surveys to the outer channel area of Chilika lagoon many of the live uncommon bivalves were observed during low tide. These are firmly attached to the roots and stems of mangroves and other large dead and live shells of bivalves. Further investigation revealed that the observed bivalve species is not reported earlier

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Article Received on: 13.02.2020 Accepted on: 12.05.2020

even from the coasts of the mainland of India. The present study reports new record of *Isognomon ephippium* in the main land of India, i.e. from a shallow coastal lagoon: the Chilika Lake.

Material and Methods

Study Area - The outer channel area of the Chilika lagoon (19°39'48.98"N 85°29'2.70"E to 19°44'14.82"N 85°39'27.56"E) is a crisscrossed 32 km long channel that originates from the "*Rambharatia*" region and ends at "*Mottu*" village nearer to the closed old lagoonal inlet (Figure 1). Couple of lagoonal inlets are connecting to the Bay of Bengal responsible for exchanging of water and sediment from lake to sea and vice versa. A long sand bar separates the lagoon from Bay of Bengal. The eastern side is flanked with luxuriant growth of Casuarina plantations and sand dune vegetation. The western shore of outer channel has human settlements. Massive growth of artificially implanted mangrove vegetation is observed in between "*Bhabakundaelswar*" (new mouth) to "*Arakhkuda*" (old closed mouth) encompassing a distance of 10 kilometres. Sporadic patches of molluscan shell bank are noticed instantly during the low tide periods comprising of several bivalve species of the genera *Crassostrea*, *Saccostrea*, *Anomia* and *Placuna* community as well as the gastropod of the genera *Telescopium*, *Cerithidea* and *Nassarius* community mostly predominate in the study area. There are many Islands found in the form of intertidal mudflats which are acted as the main feeding ground for many of the migratory birds. Healthy patches of sea grass meadows are also seen all along the coastal belt of outer channel area belonging to the genera *Halophila* and *Halodule* (Mahapatro & Kadam, 2018).

Multiple specimens (25 no.) of bivalves were collected of which 11 numbers were collected during the month

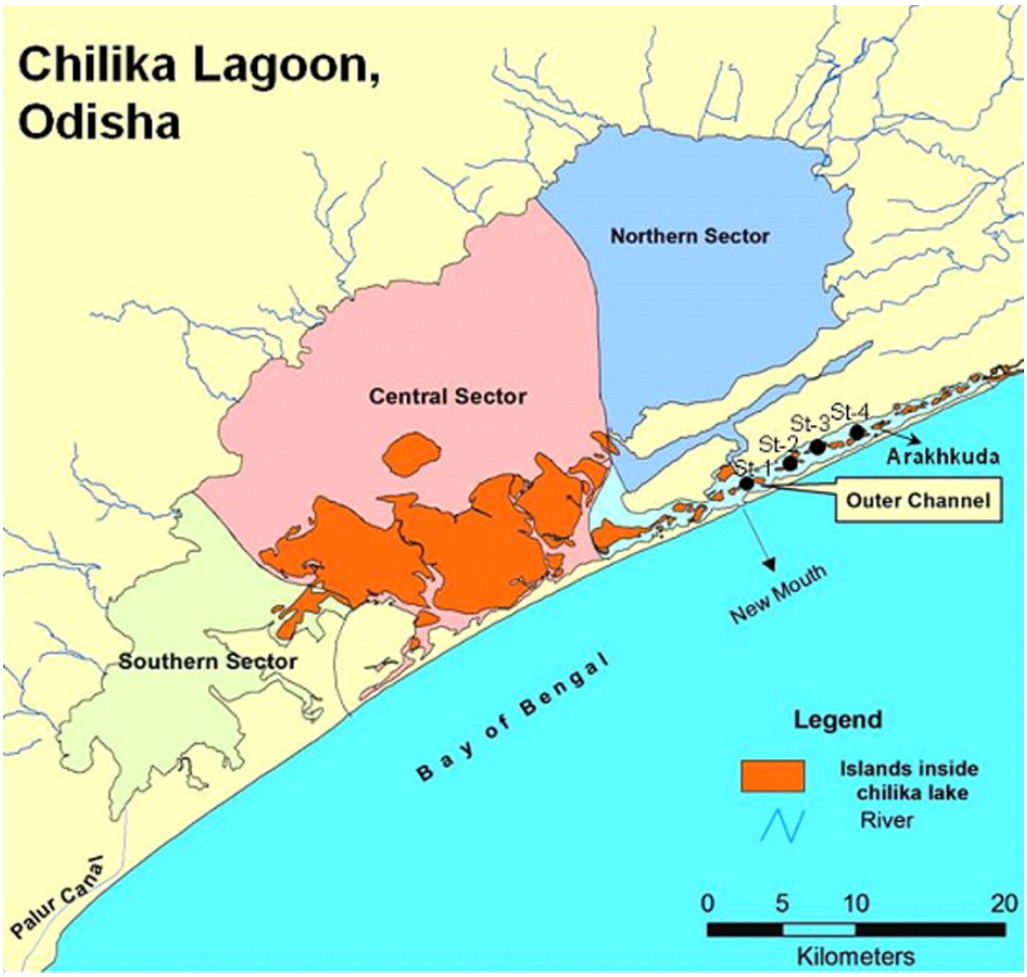

Figure 1. Chilika lagoon, showing four sampling points at outer channel area.

of October 2017 and 14 no. in the month of December 2017. The geo-references of the sampling points were taken through hand held GPS and designated as Station-1 (St-1: 19°41'52.47"N & 85°32'49.86"E) and Station-2 (St-2: 19°42'35.93"N & 85°34'41.58"E) these locations are closer to "*Bhabakundaelswar*" mangrove vegetation. Similarly Station-3 (St-3: 19°42'49.23"N, 85°35'29.87"E) and Station-4 (St-4: 19°43'10.70"N, 85°36'43.10"E) are located much closer to the "*Arakhkuda*" i.e. the old mouth region (Figure 1) attached with other molluscan species. Standard sampling protocol was maintained for bivalve sampling which was carried out during low tide period from the roots, stems of the mangrove plants and from the attached hard shells of *Crassostrea* and *Placuna*. Sample were immediately photographed and preserved in the 10 % formalin solution, then taken to the WRTC laboratory in polythene jar for further analysis. The identification and taxonomic classification were made after following the standard literatures such as (Poutiers, 1998), (Tëmkin & Printrakoon, 2016) and (Subba Rao, 2017).

Results

The observed species is of the following the taxonomic classification

Phylum MOLLUSCA

Class BIVALVIA

Subclass PTERIOMORPHA

Figure 2. External feature of Isognomon ephippium.

Order OSTREIDA

Superfamily PTERIOIDEA

Family ISOGNOMONIDAE Woodring, 1925 (1828)

Genus ***Isognomon*** Lightfoot, 1786

Species ***Isognomon ephippium*** Linnaeus, 1758

(Figure 2 & 3)

1758. *Ostrea ephippium* Linnaeus, *Syst. Nat,* ed., **10**: 700.

2017. *Isognomon ephippium*: Subba Rao, *Rec. zool. Surv. India, Occ. Paper No.* **375**: 123, pl. 20, fig. 96.

Synonyms used: Ostrea ephippium Linnaeus, 1758 (original combination); *Isogonum scapula* Röding, 1798; *Melina ephippium* (Linnaeus, 1758); *Melina periculosa* Iredale, 1939; *Perna argillacea* Gould, 1850; *Perna cumingii* Reeve, 1858; *Perna imbricata* Reeve, 1858; *Perna lamarckiana* Clessin, 1890; *Perna reeveana* Clessin, 1890; *Perna spathulata* Reeve, 1858.

Common Name: Saddle tree oyster or Jingle shells.

Diagnosis: Shell variable, irregularly rounded in outline (Figure 3), with height about equal to length; dorsal margin straight and relatively short; not expanded posterior in a wing-like ear; on dorsal side anterior margin sharply sinuous; ventrally strongly convex and extending well forward of umbones; posterior margin slightly concave, forming an obsolete angulations with the rounded ventral margin; umbones small, pointing at anterior end of dorsal margin; outer surface covered with concentric lamellar processes, with very low radial ridge ending at postero-ventral angulation; ligamental area with a dozen transverse grooves; hinge dentition are well developed (Figure 4); nacreous area of the inner side of shell surrounded by a broad, non-nacreous margin; colour: outside of shell horny to purplish brown; interior nacreous, with a broad dark brown margin (Palomares & Pauly, 2019). Large number of miniature, undeveloped, semi-developed pearls are observed on the nacreous layer found in the inner lining of the bivalve.

Habitat: It is strictly a marine benthic bivalve having a sessile mode of life style since it gets attached to a variety of hard objects and mangroves plants by its strong byssus threads (Figure 5). It can sustain in brackish water environment (Thangavelu *et al.,* 2010) too. This species

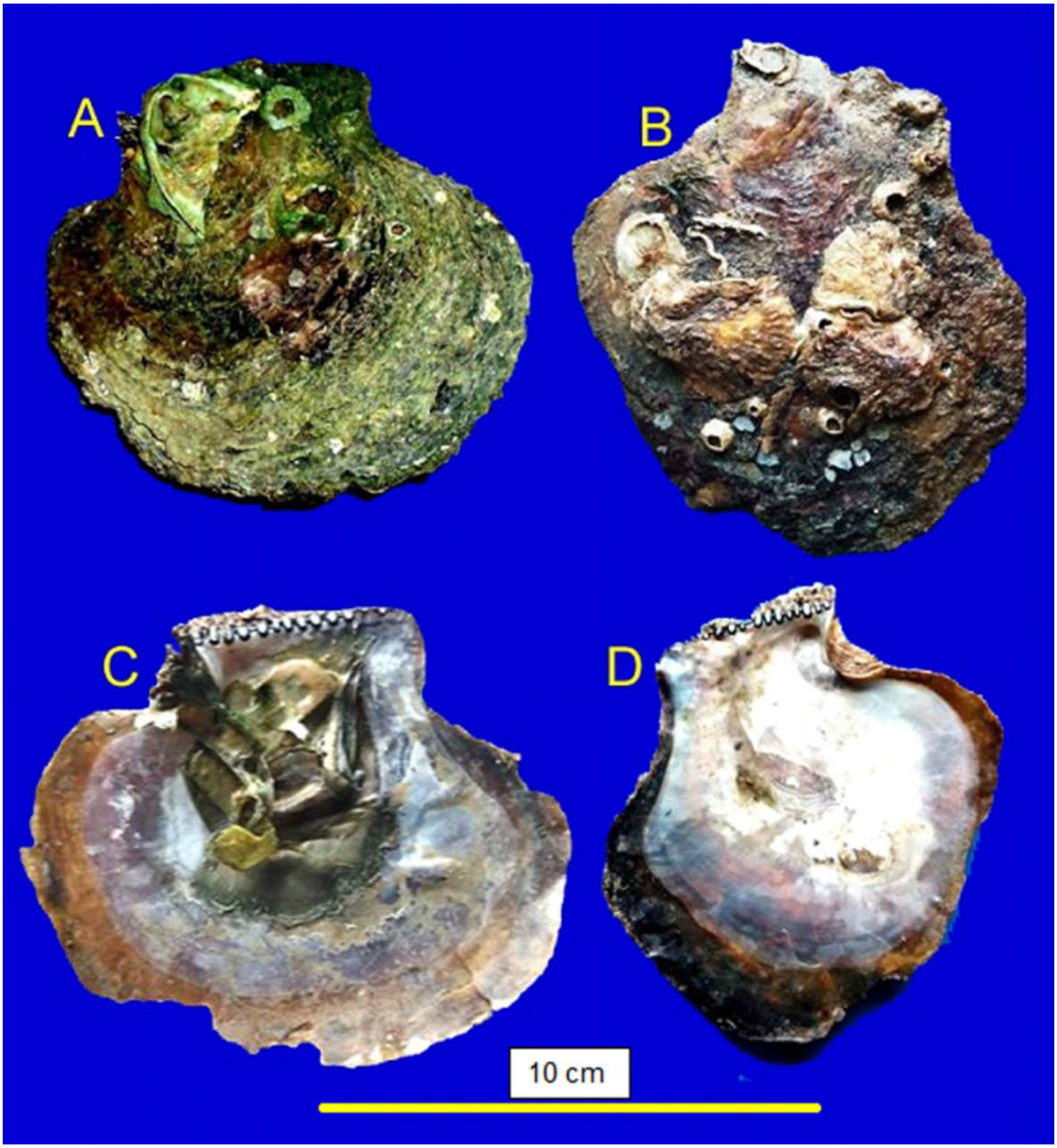

Figure 3. (A&B). Exterior of the Bivalve Isognomon ephippium, (C&D). Internal part of I. ephippium.

is frequently observed in coral reef areas either found solitary or by forming colonies through firmly attached with each other by byssus threads (Morton, 1983).

Distribution: Available literature suggests that the common distribution of this round shelled saddle tree oyster is in the Indo-Pacific region from East Africa, to Melanesia; north to Japan and south to Indonesia (Poutiers, 1998). This species is not observed earlier from the coastal region of peninsular India (Subba Rao, 2017). However substantial information available regarding its occurrence is mostly confined to Andaman waters only.

Discussion

The saddle tree oysters or *Isognomon ephippium* Linnaeus (1758) generally found in lower intertidal areas of Indo-pacific regions. In India, genus *Isognomon* is very commonly

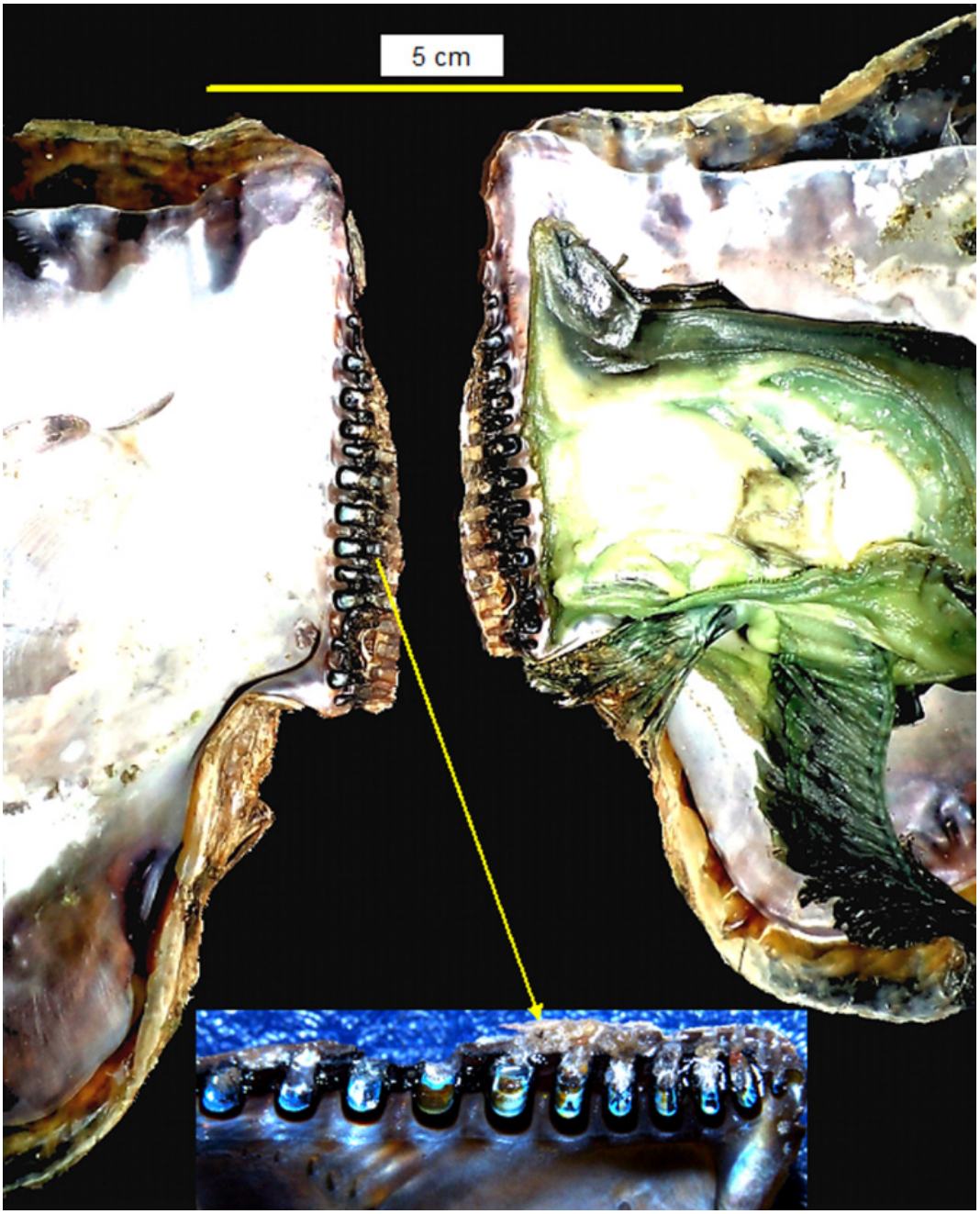

Figure 4. Ligament area, hinge dentition and white layer showing layer of mother pearl in I. ephippium.

observed in the shallow intertidal waters of Andaman & Nicobar Islands (Tikader *et al.,* 1986; Subba Rao & Dey, 2000; Ramakrishna & Dey, 2010; Subba Rao, 2017), but it was never reported from the coastal region of Indian main land. During the present study in Chilika Lagoon, many clusters of *I. ephippium* were frequently scattered in the intertidal bed of "*Bhabakundaleswar*" (new mouth) region and "*Arakhkuda*" (old mouth) region (Figure 5). Large numbers of sessile organisms are found on both valves of the *I. ephippium.* These are marine macroalgae, small sized *Crassostrea* sp., barnacles, gastropod, egg capsules of molluscs, calcareous tube of marine polychaeta, bryozoans, isopods, foraminiferans etc (Figure 6). The sessile inhabitant up on the valves of *I. ephippium* mostly

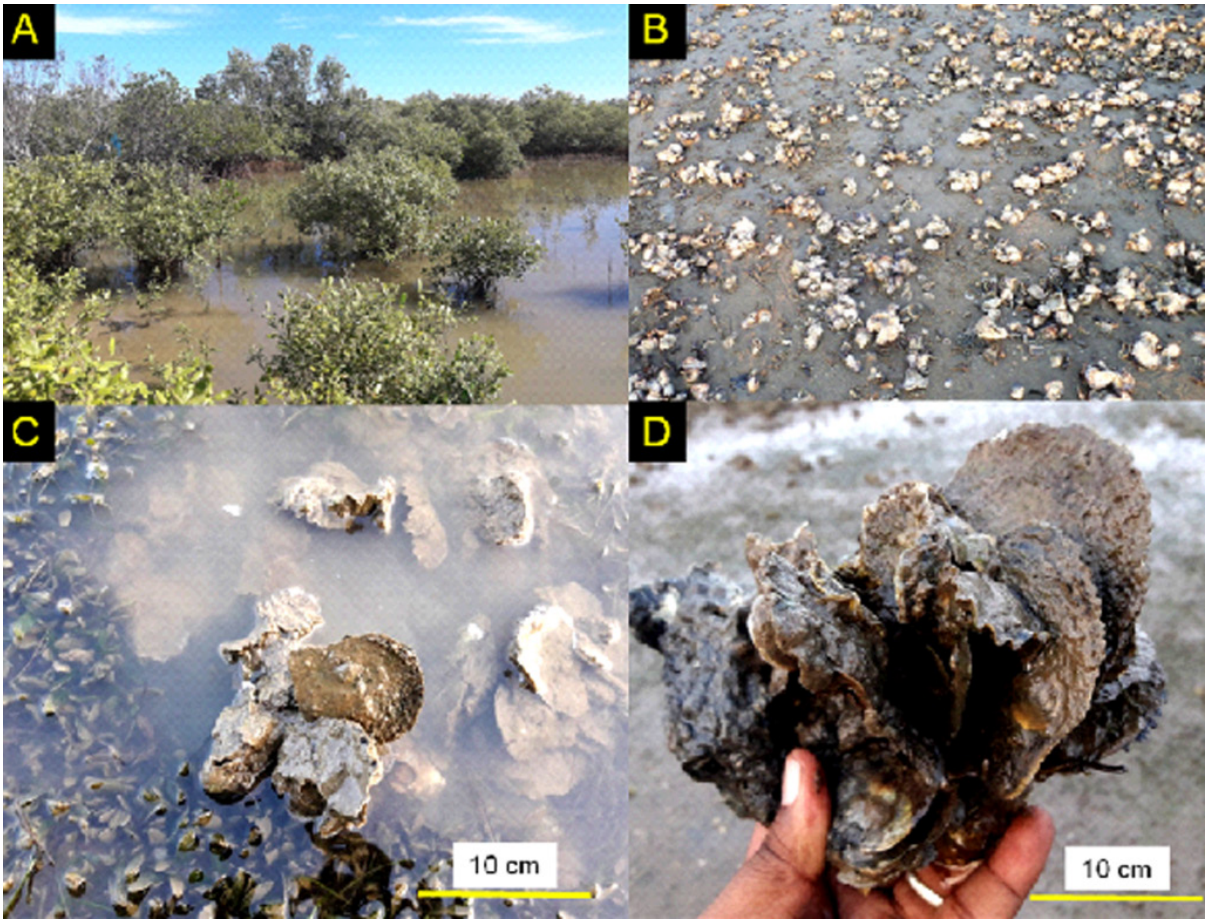

Figure 5. **A.** Mangrove vegetation at outer channel area of Chilika lagoon. **B.** Large bivalve colony exposed during low tide period at mangrove vegetation of "Bhabakundaleswar" region, **C.** Occurrence of multiple colonies of Isognomon ephippium in the sea grass bed at "Arakhkuda", **D.** Single colony of *I .ephippium* from mangrove vegetation.

belongs to marine habitat. Because of the presence of interior glaze lining of the nacre coating furnished with miniature pearls (Figure 3 D) it is often mistaken as large pearl oyster. The lagoon Chilika is cumulatively influenced with natural events and anthropogenic activities. Simultaneously, as a part of significant management practise eviction of illegal prawn embankments has been carried out. This has sufficiently cleared the habitat area meant for the colonisation of various marine and brackish water fauna. Coupled with increased tidal incursion there would be much probability of new occurrence of marine species in the recent future in the lagoon ecosystem. With this new observation, *Isognomon ephippium* forms the third representative of the family Isognomonidae from Odisha coast which is reported after 30 years of last documentation by Subba Rao *et al.* (1991).

Geographical distribution of this Isognomonid species is vast. It has been recorded from a wide range of notable habitat such as from coral reef (Morton, 1983), mangrove vegetation (Printrakoon *et al.,* 2008), muddy bottom (Cernohorsky, 1978), and rocky substrates of intertidal and subtidal regions (Tsubaki *et al.,* 2011). This shows that the species can adopt and accommodate with significant habitat heterogeneity. Under such circumstances occurrence of sympatric species together and/or parapatric species in various geographical boundaries cannot be ruled out completely. Similar observation were made by (Printrakoon & Tëmkin 2008) who identified two very congruent, but ecologically dissimilar and morphometrically similar, parapatric populations of mangrove-associated Isognomonids of Kungkrabaen, Thailand. Subsequently, (Tëmkin, 2010) described the

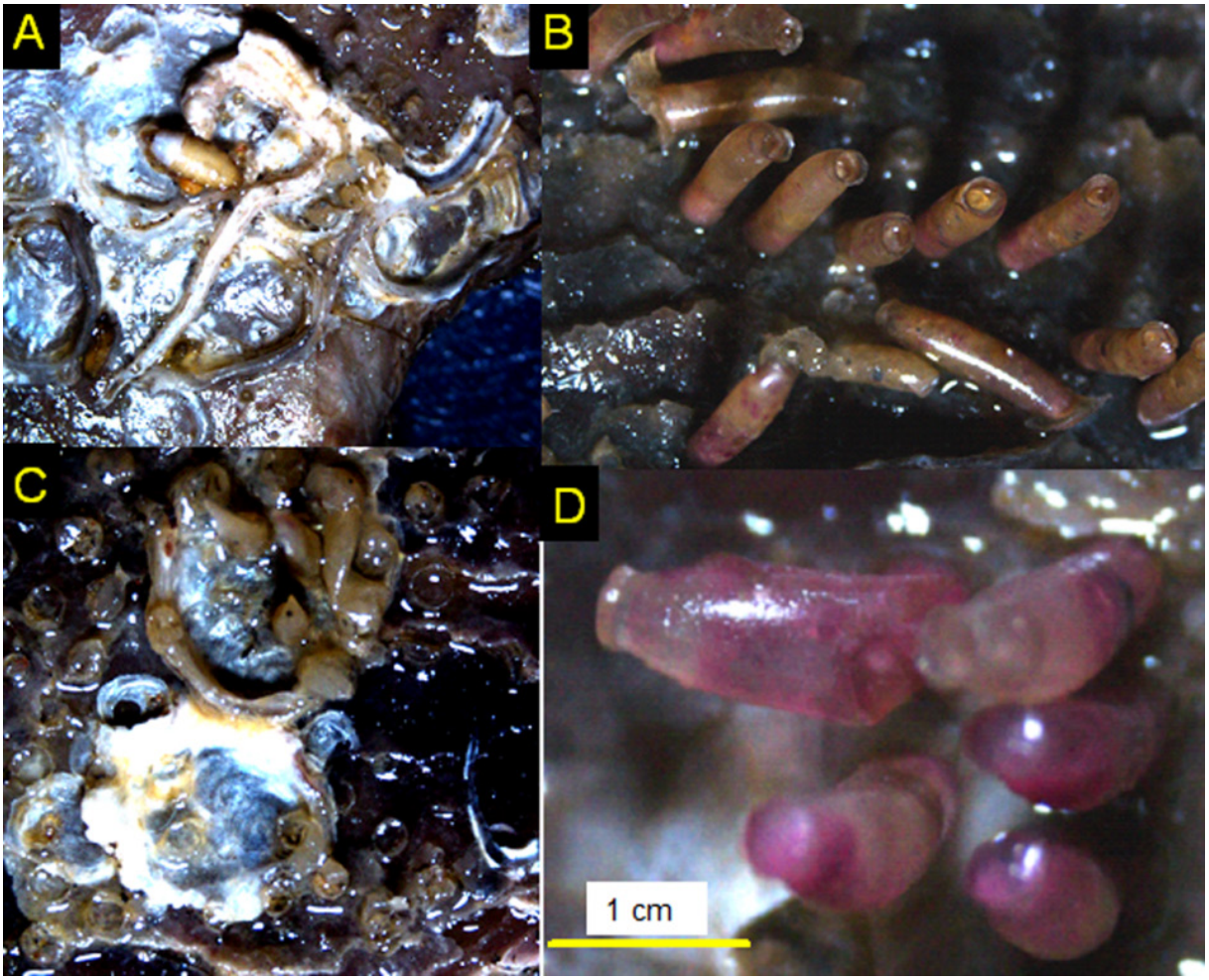

Figure 6. Sessile organisms on the shell of *I. ephippium*. **A.** Calcareous tube of marine polychaeta, **B.** Gastropod full egg capsule, **C.** Reminiscent of attached bivalve and barnacles, **D.** Empty gastropods egg capsule over oyster shell collected from "Arakhkuda" region.

clade *Isognomon* as a group of cryptic species complex. In the present study also the collection of Isognomonid species is made from two different substrates; first is from the external parts of the mangrove vegetation and second is from the hard shell of the bivalves. They have been attached firmly with their byssus threads. Consequently, the newly recorded Isognomonid species possesses a strong preference for the substrate suitability in Chilika lagoon.

The possible reason of occurrence of this bivalve species in the Chilika lagoon however is difficult to explain. There may be possibilities of larval migration through cyclonic water current, or translocation through ballast water, since the shipping activities along the Odisha coast is getting momentum in recent times.

It may be supposed that synchronised passive migration of *I. ephippium* larvae or juvenile might have taken place through the high energetic cyclonic wave surges that occurred during super cyclonic storms namely '*Phailin*' and '*Hudhud*' during the month of October in the year 2013 and 2014 respectively. Both these severe tropical cyclones have made land fall nearer to the south Odisha coast. Since, these super cyclones have a common originating point, i.e. in the Andaman Sea, chances could exist regarding the migration of larvae or juvenile through passive mode along with the large energetic wave current of cyclonic track. It is already documented that severe tropical cyclones and storms have serious implications on the density, diversity and distribution of marine organisms particularly in the coral reef areas (Harmelin-

Vivien, 1994; Fabricius *et al.,* 2008). This is the time where intended migration of adults and unintended migration by less mobile larval or juvenile meroplanktonic forms of marine organisms is apparently possible through the high energetic water current. Accordingly, succession of molluscan species might have occurred after the availability of preferred substratum for larval settlement. Since, information on larval time period and biology of *I. ephippium* is largely unknown and very less examples are available to explain this phenomenon therefore, more study is required further to substantiate. However, information on larval time period and biology of *I. ephippium* is unclear and largely unknown to strongly suggest such a migration. Under such circumstances another possible source of migration i.e. through the ballast water seems logical but needs conclusive facts and figures to accept.

Present finding describing the new record of the bivalve, *Isognomon ephippium,* in the outer channel of Chilika is significant in the light of suitability of the lagoon condition to accommodate a range of marine fauna. This is the third representative of the family Isognomonidae observed from the coastal waters of Odisha as well as the first record of the species from Indian mainland. The information furnished hitherto is preliminary since, the actual cause of occurrence in Chilika is still based on presumptions only. A proper in-depth study is required to understand its biology followed by intra-species and inter-species interaction. However, the impacts of severe cyclonic storms up on the marine faunal community in general and larval / juvenile migration in particular needs further long term study. This finding may have significant contribution for the pearl culture industry since large number miniature pearls are observed in it.

Acknowledgement

Authors are thankful to the Project Director, Integrated Coastal Zone Management Project, SPMU, Bhubaneswar, Odisha for providing financial support to carry out this research work. Two authors (BT and SSM) are thankful to Director, Zoological Survey of India, Kolkata for permission. The help of lake monitoring team of Chilika Development Authority is highly appreciated.

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