



On the record of two species of the family Pholadidae (*Martesia fragilis* and *Martesia striata*) off Dhamara Estuary (Odisha), Bay of Bengal

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Abstract

Present study provides first authentic record on the presence of two wood boring bivalve species belonging to the family Pholadidae, namely *Martesia fragilis* collected from offshore region of Dhamara estuary and *Martesia striata* from driftwood obtained from Dhamara estuarine complex. Recurring coastal water current pattern might be the cause of large scale dispersal of such marine wood borers by passive transport mechanism. Since, the study area is located much nearer to the Mangrove forest, Dhamara port and jetty area, the presence of wood boring organism could be a challenge in future for the mechanical durability of the coastal natural resources and artificial structures.

Keywords: Dhamara Port, *Martesia* sp., Mangrove Vegetation, Threat, Wood Borer Bivalve

Introduction

Wood-boring mollusc of the genus *Martesia* G.B. Sowerby I, 1824 possess a global distribution having the geographical range extends from the Atlantic to Pacific and Indian Oceans. Wood boring pholads, also called as 'piddock' belong to the family Pholadidae. The representatives of the genus *Martesia* are considered as efficient wood borers. These have serious destructive potential to the wooden structures of all forms (Turner, 1955; Subba Rao, 2017). According to the available reports there are six extant species of *Martesia* (MolluscaBase eds, 2020) are being accepted globally. Only three species of *Martesia*, namely *M. striata* Linnaeus, 1758, *M. fragilis* Verrill & Bush, 1890 and *M. nairi* Turner & Santhakumaran, 1989, are known to have distributed in the coastal and marine waters of India (Subba Rao, 2017). From Odisha, two species were reported, i.e. *M. striata* from Chilika Lake and Mahanadi estuary (Tudu *et al.*, 2018) and *M. fragilis* from Subarnarekha estuary (Mitra *et al.*, 2010). Very less information is gathered in relation to bivalve community of Dhamara estuary. Mahapatro *et al.*, (2011) while working on the shelf zone macrobenthos

off Dhamara, Bay of Bengal have documented about the presence of the bivalve species of the genus *Tellina*, *Donax*, *Thyasira*, *Tagelus*, *Anadara*, *Bathyarca* etc including numerous unidentified molluscan species. However, authentic scientific information about the occurrence of any species of marine wood boring organisms in general and borer bivalves in particular are not recorded from Dhamara estuary or its adjoining offshore region till date.

Because of the bio-network of mangrove forest, sea turtle mass nesting ground, feeding, nesting grounds for horseshoe crabs and for migratory birds the Dhamara estuarine system is considered as one of the prominent ecosystem along the east coast of India. After the discovery of the potential region of petroleum and natural gas resource at deep sea bottom in the offshore region of Dhamara estuary followed by the construction of all-weather port in the very close proximity of estuarine province, it becomes ecologically very sensitive. Therefore, it appears as mandatory to carry out regular scientific monitoring to this part of Bay of Bengal.

This is well known that the representatives of *Martesia* are efficient wood borers and substrate destructors

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(Turner, 1971; Turner & Santhakumaran, 1989; Oliver 1992; Subba Rao, 2017). Therefore, their possible impact on the mangrove vegetation as well as the human engineered coastal structure such as port, boats, ships and trawlers including submersed equipments become the matter of the great concern. Under this backdrop the present study is describing as range extension of two species of marine wood borer species of the genus *Martesia*.

Material and Methods

The sampling work for this study had been carried out during the year 2005 - 2006 and subsequently continued till December 2018. Dhamara estuary is formed by the confluence of the two rivers, Brahmani and Baitarani (Figure 1) surrounded by two sensitive ecosystems such as “*Gahirmatha*” (Olive ridley sea turtle rookery) “*Bhiterkanika*” (Mangrove vegetation). The wood borer bivalves used in the present study were collected from a surface floating driftwood (mangrove timber) at Dhamara estuary (Figure-1, Point-1, depth 2 meter, 20°45'29"N 87°01'39"E) and in the offshore region off Dhamara (Figure-1, Point-2, Depth 30 meter, 20°26'55"N 87°55'27"E) from the deteriorated wood while operating a sediment grab sampler. The second sampling location (i.e. Point 2) exclusively falls in the region of the rich resource of petroleum oil and natural gas off Dhamara estuary (Mahapatro *et al.*, 2011). Soon after collection, the unidentified samples were photographed, immediately preserved in the 10 % neutralised formalin solution

and then transferred to Marine Biology Laboratory, Berhampur University. Essential taxonomic tools from standard literatures were employed for the species level identification (Turner & Santhakumaran, 1989; Oliver, 1992). All identified bivalves were deposited in the Marine Biology Laboratory of Berhampur University.

Results

Taxonomic account of the collected specimen is given hereunder.

Phylum MOLLUSCA

Class BIVALVIA

Order MYIDA

Family PHOLADIDAE

Genus *Martesia* Sowerby I, 1824

1. *Martesia fragilis* Verrill & Bush, 1898 (Figure 2 & 3)

1898. *Martesia (Martesiella) fragilis* Verrill & Bush, *Proc. U.S. Nat. Mus.*, **20**: 777.

2017. *Martesia fragilis*: Subba Rao, *Rec. zool. Surv. India, Occasional Paper No.*, **375**: 440

Material examined: Dhamara offshore region (30 m depth), three live specimens were examined from a deteriorated wooden structure (Figure 1, Point 2, 20°26'55"N 87°55'27"E).

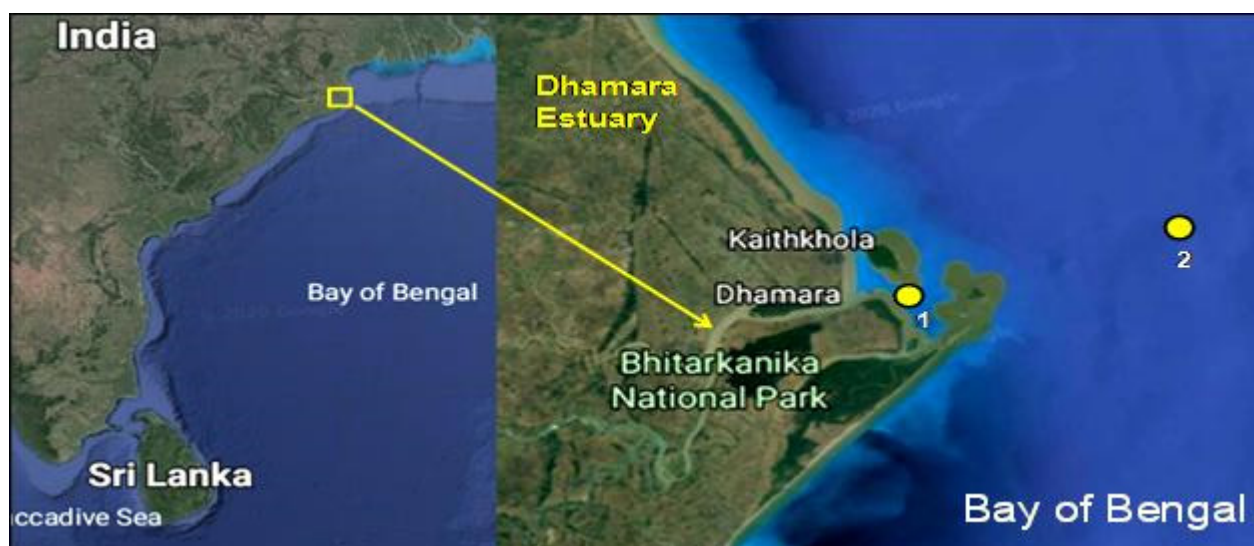


Figure 1. Map showing the occurrence location of *M. striata* (Point 1) and *M. fragilis* (Point 2) in the off Dhamara estuarine zone and offshore area respectively, Bay of Bengal.



Figure 2. Image showing *Martesia fragilis* collected from the offshore region off Dhamara estuary (30 m depth).

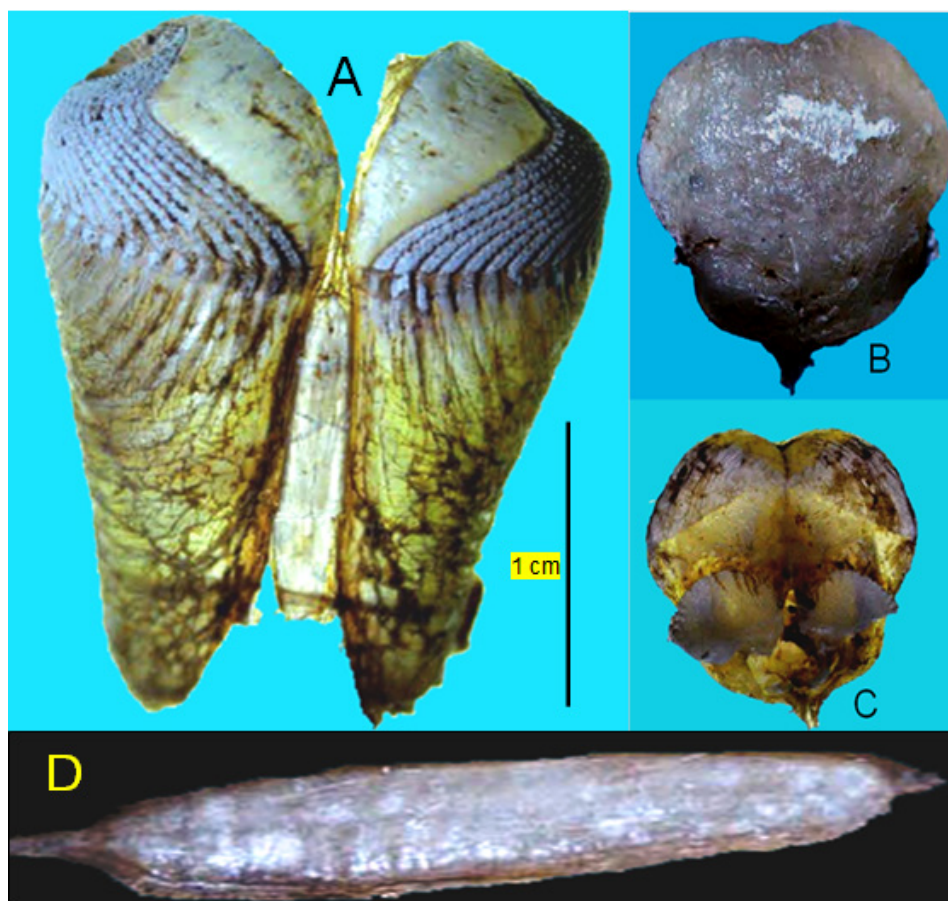


Figure 3. A. Image showing anterior and posterior portion of two halves of the bivalves joined with hypoplax, B. exterior of Mesoplax, C. interior of Mesoplax of *Martesia fragilis* collected off Dhamara estuary, Bay of Bengal D. Metaplex of *M. fragilis*.

Diagnosis: Shell obliquely divided in the middle with angularly and longitudinally ribbed anterior half; posterior part with concentrically striated towards margin; one ventral shield and two dorsal shields upon the umbo present; one elongated and narrow shield on posterior part body is straighter and posterior part is brittle. Metaplast proportionately larger and lanceolate; mesoplast depressed and with concentric lines dorsally, and hypoplast is lanceolate (Mitra *et al.*, 2010; Subba Rao, 2017).

Habitat: Found to be attached in the wooden pole and mangrove plants as borer.

Distribution: India: Odisha (Subarnarekha estuary; Offshore region of Dhamara estuary), Karnataka, Kerala, Maharashtra; Tamil Nadu, Gujarat and West Bengal, Andaman and Nicobar Islands (Mitra *et al.*, 2010; Subba Rao, 2017). *Elsewhere:* Eastern Pacific; Indo-Pacific; West Atlantic.

2. *Martesia striata* (Linnaeus, 1758) (Figure 4 & 5A)

1758. *Pholas striata* Linnaeus, *Syst. Nat.* ed. 10: 669.

2017. *Martesia striata*: Subba Rao, *Rec. zool. Surv. India., Occ. Paper*, 375: 348.

Material examined: Five live specimens from Dhamara estuarine systems from a depth of 2 meter of Dhamara estuary (Figure-1, Point-1, 20°45'29"N 87°01'39"E).

Diagnosis: Main body subovate; shell divided by a radial groove; robust; posterior part brittle; posterior extension narrower and irregular; inequilateral beaks close to the anterior part; tumid at umbos; anterior broadly rounded with initial pedal gape filled by the callum, large subcircular mesoplast; dorsal area behind mesoplast covered by a long lanceolate metaplast; posterior ventral region covered by a long lanceolate hypoplast (Turner & Santhakumaran, 1989; Oliver, 1992; Subba Rao, 2017) .

Distribution: India: Odisha coast (Dhamara estuarine system, Subarnarekha estuary), Andaman and Nicobar Is., Maharashtra (Bombay), Gujarat (Gulf of Kutch), West Bengal (Kidderpore docks, Port Canning) Andhra Pradesh (Visakhapatnam, Godavari and Krishna estuaries); Tamil Nadu (Madras, Poto Novo, Tuticorin, Krusadai Island, Pamban); Kerala (Cochin, Kayankulam); Karnataka (Subba Rao, 2017). *Elsewhere:* Eastern Pacific; Indo- Pacific, West Atlantic; Widely distributed in Temperate and Tropical waters.

Remarks: This species is widely distributed along the coastline of India, estuarine systems & creeks. It frequently attacks the live and dead mangrove timber; makes burrow into soft clay, sand stone, wood and can tolerate a wide range of salinity fluctuation (Subba Rao, 2017). The major morphological differentiation between *M. striata* and *M. fragilis* can be well visualised from the Figure 5. It is evidenced that the overall body shape of *M. fragilis* is much straighter and more fragile than the *M. striata*. The posterior part of *M. striata* is narrow and irregular as compared to former one (Turner & Santhakumaran, 1989). The comparison of mesoplast and metaplast of *M. fragilis* and *M. striata* which is considered as one of the important tool for species level identification can also be depicted from Figure 5.

Discussion

There are significant differences among the genera *Martesia*, *Pholas*, and *Barnea*, which are clearly keyed out in Subba Rao (2017). These three genera belonging to the family Pholadidae are popularly known as 'Piddocks'.

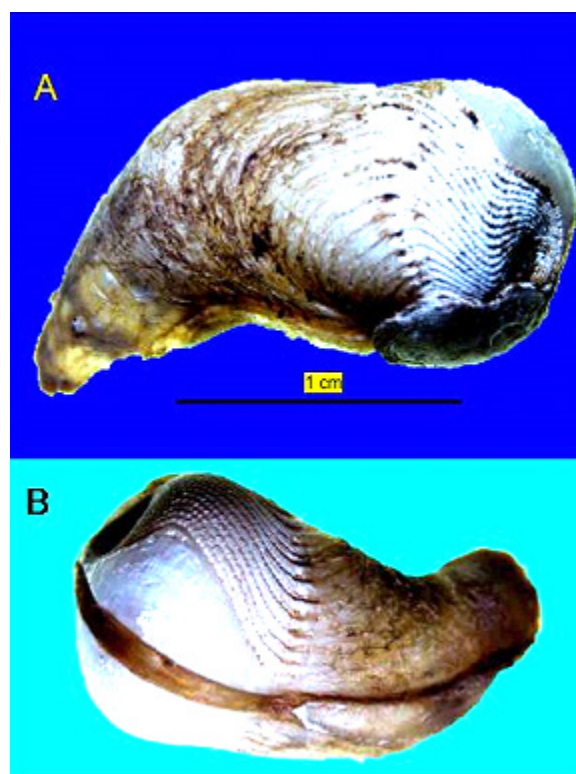


Figure 4. A. Image showing dorsal side and B. Ventral side of *Martesia striata* collected from off Dhamara estuary.



Figure 5. Image showing morphological differences between Mesoplax and Metaplax of *Martesia striata* from estuary and B. *Martesia fragilis* from offshore of Dhamara respectively.

However, they have different signature pattern to make burrow in to the marine wood. Sharp visible heterogeneity in the size and structure of burrow made by *M. striata* and *M. fragilis* are observed during the present study.

The noteworthy feature associated with *M. striata* is that it enters in to the wood by mechanical force without secreting the chemical substance to dissolve the mangrove wood or any substratum (Turner & Santhakumaran, 1989; Yennawar *et al.*, 1999; Çevik *et al.*, 2015) including hard PVC piping structures (Scott, 1991). So far the hydrography is concerned, *M. striata* can sustain in large scale fluctuation in salinity ranged from 0.5 ppt to 35 ppt. Consequently, it prefers to live in the estuarine regions whereas, *M. fragilis* prefers more saline condition (Turner & Santhakumaran, 1989; Yennawar *et al.*, 1999; Çevik *et al.*, 2015). Similar observations were evidenced in this study i.e. in the sampling point no. 2 in which salinity was near 35 ppt. Perusal of research findings delineated that the geographical spreading and distribution of *Martesia* species usually occurs in two ways. It is either through the sea water current pattern, storm wave action or by the passive displacement through the driftwood (Yennawar *et al.*, 1999; Çevik *et al.*, 2015). In Dhamara estuary the presence of wood borers is more likely to occur through the passive drifting.

Substantial research evidence is available in describing the detrimental activities of wood borers of *Martesia* species up on the live mangroves (Ansell & Nair 1969; Scott, 1991). Dharmaraj & Nair (1981) reported that the live shoot and prop root of mangrove *Rhizophora* was attacked by *Martesia* group in the Talapady mangrove, Arabian Sea. Pholadidae members are also reported of making multiple burrows in the live shoots and roots of the mangroves around Krishna estuary, Bay of Bengal (Pachu *et al.*, 2008). Singh & Sasekumar (1994) found that the trunks of live *Avicennia* mangrove are highly colonised by *Martesia* sp. in the Peninsular Malaysia. This information reflects that the *Martesia* group of bivalves have a great affinity to bore into the live shoot and roots of mangrove vegetations.

Present study has described the range extension of *M. striata* from the estuarine region of Dhamara and *M. fragilis* from offshore of Dhamara estuary from the deteriorated wooden substratum. The cause of occurrence is supposed through passive drifting. Since, this sensitive ecosystem is located very close premises of Dhamara port and jetty area. Therefore, a comprehensive research plan needs to be implemented on priority basis. Quantification of substantial loss related to the detrimental action of marine wood borers upon the mangrove vegetation *vis-a-vis* socio-economic aspects related to fishery, tourism and port activities demands an integrated monitoring approach.

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References

- Ansell, A. and Nair, N. 1969. The mechanisms of boring in *Martesia striata* Linnaeus (Bivalvia: Pholadidae) and *Xylophaga dorsalis* Turton (Bivalvia: Xylophaginidae), *Biological Sciences*, **174**: 123–133.
- Çevik, C., Ozcan T. and Sedat, G. 2015. First record of the striate piddock *Martesia striata* (Linnaeus, 1758) (Mollusca: Bivalvia: Pholadidae) in the Mediterranean Sea, *BioInvasions Records*, **4**(4): 277–280. <https://doi.org/10.3391/bir.2015.4.4.08>
- Dharmaraj, K. and Nair, B.N. 1981. Timber boring animals of Talapady Mangroves and adjoining areas with a record of *Martesia* sp., (Bivalvia: Pholadidae) boring in to living tress. *Mahasagar- Bulletin of the National Institute of Oceanography*, **14**(2): 159-162.
- Mahapatro, D., Panigrahy, R. C., Naik, S., Pati, S. K. and Samal, R. N. 2011. Macrobenthos of shelf zone off Dhamara estuary, Bay of Bengal. *Journal of Oceanography and Marine Science*, **2**(2): 32-42.
- Mitra, S., Mishra, A. and Pattanayak, G. 2010. Inter-tidal macrofauna of Subarnarekha Estuary (Balasore: Orissa). *Rec. zool. Surv. India, Occ. Paper No.*, **313**: 1-135.
- MolluscaBase eds. (2020). MolluscaBase. *Martesia* G. B. Sowerby I, 1824. Accessed through: World Register of Marine Species at: <http://www.marinespecies.org/aphia.php?p=taxdetails&id=156864> on 2020-09-04
- Oliver, P.G.1992. *Bivalve sea shells of the Red Sea*. Hemmen, Wiesbaden, Germany and National Museum of Wales, Cardiff, UK; 541.
- Pachu, A.V., Rao, M.V. and Balaji, M. 2008. Marine woodborer fauna in mangroves of the Krishna Estuary, East Coast of India. *Bioresources Conservation and Management* Ed. Dr. A.J. Soloman Raju, Today's and Tomorrow's Printers and Publishers, New Delhi-110002; 41-51.
- Scott, P. 1991. Rapid destruction of PVC piping by boring bivalves. *International Biodeterioration*, **27**: 87–92. [https://doi.org/10.1016/0265-3036\(91\)90026-N](https://doi.org/10.1016/0265-3036(91)90026-N)
- Singh, H. R. and Sasekumar, A. 1994. Distribution and abundance of marine wood borers on the west coast of Peninsular Malaysia, *Hydrobiologia*, **285**: 111-121. https://doi.org/10.1007/978-94-011-0958-1_12 PMID:7610755
- Subba Rao, N.V. 2017. Indian Seashells (Part-2): Bivalvia. *Rec. Zool. Surv. India, Occ. Paper No.* **375**: 1-568.
- Tudu, P., Prasanna, Y., Tripathy, B. and Mohapatra, A. 2018. An updated checklist of marine and estuarine mollusc of Odisha coast. *Indian Journal of Geo-Marine Sciences*, **47**: 1537-1560.
- Turner, D. 1971. Identification of marine wood-boring molluscs. In Jones E.B.G. and Eltringham, K. (eds.), *Marine borers, fungi and fouling organisms of wood*. Organisation for Economic Cooperation and Development, Paris; 259–301.
- Turner, D. and Santhakumaran, L. 1989. The genera *Martesia* and *Lignopholas* in the Indo-Pacific (Mollusca: Bivalvia: Pholadidae), *Ophelia*, **30**: 155–186.
- Turner, D.1955. The family Pholadidae in the western Atlantic and the eastern Pacific, Part II Martesiinae, Jouannetiinae and Xylophagininae, *Johnsonia*, **34**: 65–160.
- Yennawar, P., Thakur, N., Anil, A., Venkat K. and Wagh, A. 1999. Ecology of the wood-boring bivalve *Martesia striata* (Pholadidae) in Indian waters. *Estuarine, Coastal and Shelf Science*, **49**: 123–130.