

# Biodiversity of shipworms (*Mollusca: Bivalvia: Teredinidae*) in the vicinity of a tropical mangrove ecosystem along Bay of Bengal, Andhra Pradesh, India

## Abstract

In efforts to generate information on the occurrence and distribution of marine wood borers from unexplored areas of the east coast, Bhavanapadu (18° 32' 11"N, 84° 18' 21"E) back water system, adjoining Bay of Bengal; in Srikakulam District of Andhra Pradesh was surveyed. Infested samples of unprotected stake net poles of Casuarina timber, obtained from the water body, revealed the occurrence of several teredinid borers. Regarding various community characteristics of these wood boring organisms, species richness was found to be 16, density 2036 individuals.m<sup>-2</sup>, diversity 1.835 and evenness 0.950. Of these forms, the genus *Bankia* represented by 7 taxa, followed by *Teredo* with 4 taxa, were found to be dominant. A few rare teredinids such as *Teredo bartschi* Clapp, *Spathoteredo obtusa* (Sivickis), *Bankia martensi* (Stempell), *B. gracilis* Moll, *B. rochi* Moll, *B. philippinensis* Bartsch and *B. destructa* Clench and Turner were present in the collections. The occurrence and distribution of all these borers was discussed in the light of available literature from other coastal localities in the country and elsewhere.

**Keywords:** Shipworm, teredinidae, mangrove ecosystem, bay of bengal, bhavanapadu, marine wood borers

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## Introduction

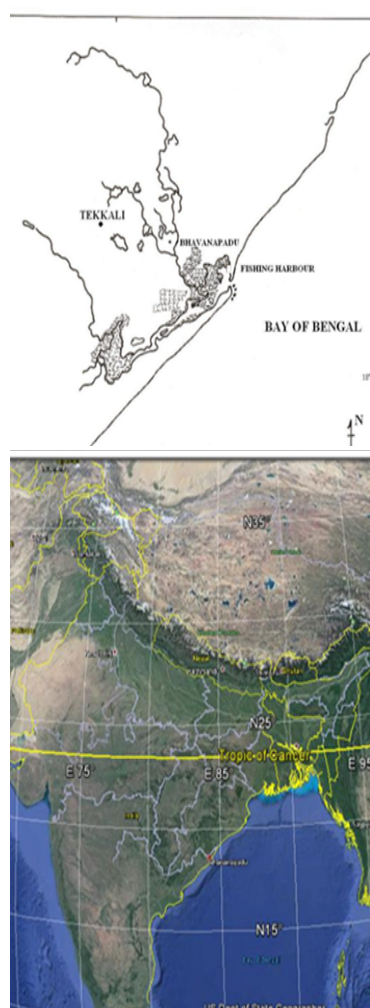
As agents of biodeterioration, the economic significance of marine wood borers is well known because they interfere with the structural and functional integrity of timber installations and craft in marine milieu.<sup>1,2</sup> In order to reduce the material and monetary losses, various aspects of marine wood biodeterioration have been pursued worldwide for long and among them, the recent works of Sanchez-Alferz & Alferz-Leon,<sup>3</sup> Leonel et al.,<sup>4</sup> Brearley et al.,<sup>5</sup> Santos et al.,<sup>6</sup> Brooks,<sup>7</sup> Borges et al.,<sup>8</sup> Cragg,<sup>9</sup> Filho et al.,<sup>10</sup> Borges et al.<sup>11</sup> deal with the occurrence, diversity or distribution of marine wood borers at various geographical localities. Similar efforts have also been put in India for quite some time.<sup>12</sup> A vast array of structures are used all along the 8129km long stretch of the Indian coast and their prolonged use demands sustained inputs to understand all facets of the wood deterioration problem. However, many a gap remains in information on the very occurrence and distribution of the organisms responsible for timber deterioration along the vast sea board of India.<sup>13</sup> While around 40 localities along the west coast of peninsular India have so far been surveyed for wood borers, only half that number along the east coast was covered. Therefore, in recent years, efforts to generate data from unexplored coastal localities<sup>14-16</sup> and mangrove wetlands<sup>17,18</sup> were renewed. In continuation of this endeavour, we surveyed Bhavanapadu back water mangrove ecosystem in Srikakulam District of Andhra Pradesh.

Bhavanapadu, lying between latitudes 18° 32' 11" - 18° 34' 18" N and longitudes 84° 18' 21" - 84° 20' 51" E is situated 20km to the north east of Tekkali town, and constitutes one of the most important fishing harbours of Andhra Pradesh (Figure 1). The back-water system in this region, running more or less parallel to the Bay of Bengal coast, receives fresh water input from a couple of ephemeral streams (Garibulagedda and Desigedda) around, and consists of mangrove wetlands spread

over an area of 593 ha. However, most of the wetlands, having been converted into salt pans and brackish water culture ponds, chiefly remain now as a degraded ecosystem, yet inviting lot of migratory birds from places far and wide. Shell collection and stake net fishing are extensively carried out in the locality. A proposal mooted to the establishment of a 2640MW coal based thermal power project in this wetland ecosystem, became a burning issue during recent years, due to strong opposition from environmentalists and local populace; and therefore, was finally dropped. The latest proposal, however, is to expand the fishing harbor and contiguous wetlands for developing a sea port.

## Material and methods

During the present work, mangrove vegetation in the entire wetland area was surveyed for the incidence of marine wood borers, but as almost all plants were under-shrubs, no incidence was observed. However, Casuarina timber poles (5 to 6m height and 28 to 34cm girth) without any protective measure, erected in the water body for stake net fishing, were found to be severely attacked by the wood borers and broken off around the intertidal level. Timber samples (n=12), approximating to 0.05 m<sup>3</sup> in volume, were collected from the remains of these poles during the ebb phase of low tide; and pallets of teredinid wood borers retrieved as animals had already perished due to near exhaustion of the timber. A similar technique was followed earlier by Cragg et al.<sup>19</sup> and Borges et al.,<sup>11</sup> to decipher important scientific facts about teredinids from elsewhere. The species, after identification following Turner<sup>20</sup> were enumerated and expressed as individuals per unit area. Species diversity and evenness of the borer community were estimated following Magurran<sup>21</sup> employing the Brillouin index (HB), as the kind of sampling performed in this study falls under non-random method, according to this author.



**Figure 1** Bhavanapadu, a tropical mangrove ecosystem along Bay of Bengal, India.

## Results

A total of 5 genera of wood borers belonging to the family Teredinidae (*Mollusca: Bivalvia: Myoida*) were found to have infested the Casuarina poles erected in the Bhavanapadu back water body (Table 1). Of these, the genus *Bankia* was represented by the highest number (7) of species; viz., *carinata* Gray, *campanellata* Moll and Roch, *martensi* (Stempel), *gracilis* Moll, *rochi* Moll, *philippinensis* Bartsch and *destructa* Clench and Turner. This was followed by *Teredo* with 4 species, namely, *parksii* Bartsch, *furcifer* von Martens, *bartschi* Clapp and *clappi* Bartsch and *Lyrodus* with 3 species, viz., *takanoshimensis* (Roch), *pedicellatus* (Quatrefages) and *bipartitus* (Jeffreys). The genera *Spathoteredo* and *Nausitora* were represented each by a lone taxon, namely, *obtus* (Sivickis) and *dunlopei* Wright, respectively. Among these species, *L. pedicellatus* was noticed to be most abundant with 433 individuals/m<sup>2</sup> followed by *T. bartschi* with 368 animals/m<sup>2</sup> and *T. parksii/S. obtus* to be least abundant with 22 numbers/m<sup>2</sup> each, while all others fell into the intermediate range. Together, these borers were responsible for an average destruction of 90% to the stake net pole samples.

## Discussion

With regard to various community characteristics of the wood

boring organisms that infested unprotected timber in Bhavanapadu back water system, species richness was 16, density was 2036 individuals.m<sup>-2</sup>, diversity was 1.835 and evenness 0.950. Besides this species richness, it is quite surprising to note the complete absence of borers belonging to the families Sphaeromatidae (*Arthropoda: Crustacea: Isopoda*) and Pholadidae (*Mollusca: Bivalvia: Myoida*) that are usually encountered almost throughout the Indian coastal waters, especially in back waters, brackish waters and estuaries.<sup>22</sup> Eaton,<sup>23</sup> however, observed that the rate and type of wood biodeterioration in marine environment is influenced by geographical location, nature of the substrate and position of timber in relation to the mean sea level. The reasons for the absence of Sphaeromatids and Pholadids during the present instance might be due to collection of samples from sub-tidal region and also to the possibility that the poles did not stand through the breeding periods of the two categories of borers, as unprotected casuarina poles last for 3-12 months under marine conditions depending on the vagaries at a given place.<sup>24</sup> Earlier, Natarajan et al.<sup>25</sup> also noticed that casuarina poles used in pen-culture at Killai near Chidambaram in Tamilnadu were heavily damaged by marine borers in 6 months. In a recent study on the seasonal abundance of shipworms in mangrove driftwood from a northern Brazilian beach, Filho et al.<sup>10</sup> could recover only a single species of teredinid, *Neoteredo reynei* (Bartsch) from as low as 87 logs out of as many as 720 logs collected. Therefore, absence of other groups of borers as in the present instance, or even other genera/species within a group in the collections, may not be surprising.

**Table 1** Teredinids recorded near the tropical mangrove ecosystem of Bhavanapadu

Sl. No.	Species	Abundance (no./m <sup>2</sup> )
1	<i>Lyrodus takanoshimensis</i> (Roch)	152
2	<i>L. pedicellatus</i> (Quatrefages)	433
3	<i>L. bipartitus</i> (Jeffreys)	152
4	<i>Teredo parksii</i> Bartsch	22
5	<i>T. furcifer</i> von Martens	43
6	<i>T. bartschi</i> Clapp	368
7	<i>T. clappi</i> Bartsch	43
8	<i>Spathoteredo obtus</i> (Sivickis)•	22
9	<i>Nausitora dunlopei</i> Wright	43
10	<i>Bankia carinata</i> Gray	195
11	<i>B. campanellata</i> Moll and Roch	195
12	<i>B. martensi</i> (Stempel)	43
13	<i>B. gracilis</i> Moll♦	65
14	<i>B. rochi</i> Moll	130
15	<i>B. philippinensis</i> Bartsch●	43
16	<i>B. destructa</i> Clench and Turner●	87
Species richness:		16
Density:		2036 no./m <sup>2</sup>
Brillouin diversity index (HB):		1.835
Brillouin evenness index (E):		0.95

•First record to peninsular Indian east coast

●Second report from India

♦Second report to peninsular Indian east coast

The occurrence of *B. destructa* and *B. philippinensis* in Indian waters was reported for the first time for the Krishna estuarine mangroves;<sup>17</sup> and that of *B. martensi* for the Sarada-Varaha estuarine mangroves;<sup>18</sup> therefore, our present records become the second for India. The latter authors also found *B. gracilis* to be a new record for the Indian mainland, and therefore its report now becomes second to the mainland. Incidentally, the present record of the above four taxa is also from mangrove wetlands, though not from mangrove timber itself.

So far, *L. takanoshimensis*, *L. bipartitus* and *T. bartschi* are known to be occurring exclusively along the mainland east coast<sup>13,17</sup> either in mangrove or coastal habitats. *Spathoteredo obtusa* was recorded for the first time for the mainland east coast, although recorded earlier for the sub-oceanic Andaman-Nicobar Islands,<sup>26,27</sup> West coast<sup>28</sup> and Lakshadweep Archipelago.<sup>29</sup> The remaining species, namely, *L. pedicellatus*, *T. parksi*, *T. furcifera*, *T. clappi*, *N. dunlopei*, *B. carinata* and *B. campanellata*, within the limits of their temperature and salinity tolerance; are more or less cosmopolitan in their occurrence along the Indian coasts.<sup>22</sup>

In recent years, a number of wood borer species encountered during the present work was also recorded for various other mangrove environs of the world. Among others, the occurrence of *T. bartschi* was reported from the mangroves in Mamanguape estuarine region of the north-eastern Brazil by Leonel et al.<sup>4</sup> and the presence of *B. rochi* and *L. pedicellatus* in the mangrove habitats of the Burrup peninsula in Western Australia by Brearley et al.<sup>5</sup> Like-wise, Beasley et al.<sup>30</sup> identified the presence of *L. pedicellatus* and *Teredo* spp. from Ajuruteua Peninsula of northern Brazil while Borges et al.<sup>11</sup> recognized the incidence of *L. pedicellatus* in the Tagus Estuary, Borges et al.<sup>31</sup> found the occurrence of *B. carinata*, *L. pedicellatus* and *T. bartschi* in European coastal waters.

## Conclusion

The current work, though limited in nature with several other limitations, definitely indicates, the presence of a good number of rare marine wood boring teredinid species in Indian waters. This underlines the need for intensive collections along the vast coastal stretches of the country, particularly from mangrove habitats, to generate sufficient information on this economically important group. A baseline data on marine timber dwellers thus established is essential for developing suitable wood deterioration control measures that prolong the service life of timber used under marine conditions.<sup>32,33</sup>

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## Conflict of interest

Author declares that there is no conflict of interest.

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