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TIMBER DETERIORATION BY *LIMNORIA PLATYCAUDA* MENZIES (ISOPODA) ALONG KARWAR COAST OF INDIA

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ABSTRACT.- *Limnoria platycauda* Menzies, a crustacean marine wood-borer, was recorded from the West Coast of India at Karwar (14^0 49' N and 74^0 07' E). It was observed that the breeding and consequent attack of this species on timber occurred uninterruptedly during all times of the year including during the monsoon when salinity variations were wide and frequent. This species was found to attack the high density timber *Ocotea rodiaei* as well as the timbers treated with copper-chrome-arsenic (CCA) preservative.

INTRODUCTION

The occurrence of *Limnoria* along the Indian coast was first reported by Palekar & Bal (1957). The limnoriids were not considered as a serious pest in Indian tropical waters (Becker, 1959). Becker , however, cautioned that "only where more heat-resistant *Limnoria* species or races occur can we expect this genus to be important in tropical oceans". Earlier 30^0 C was noted to be the upper temperature limit for some species of *Limnoria* (Becker, 1959; Pillai, 1961). Lately it is increasingly realised that as many as nine out of the total 14 Indo-Pacific species described are found along the Indian peninsula and at the Andaman Islands (see Cookson & Cragg, 1991). The species recorded from Indian waters are named in Table 1. Santhakumaran (1969) observed that limnoriids caused considerable damage to timber coupons exposed in Bombay waters and Karande (1978) found *Limnoria* attack was particularly severe in the Andaman Islands.

In a recently concluded biofouling survey carried out at Karwar coast, it was observed that the deterioration of timber by this crustacean borer was very severe. The specimens of limnoriids endemic to Karwar waters were sent to Dr. L. J. Cookson who identified them as *Limnoria platycauda* Menzies. The present note incorporates field observations on the biology of this limnoriid in Karwar waters including observations on its ability to destroy some treated and untreated structural timbers.

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Table 1. Records of wood-boring limnoriids from Indian waters.

Species	Locality	References
Limnoria andamanensis Rao & Ganapati	Andaman Is.	Rao & Ganapati, 1969
Limnoria indica Becker & Kampf	Andaman Is.	Ganapati & Rao, 1960 Karande, 1978
	Mandapam, Madras	Becker & Kampf, 1958
Limnoria insulae Menzies	Andaman Is.	Ganapati & Rao, 1960
Limnoria pfefferi Stebbing	Andaman Is.	Ganapati & Rao, 1960
	TamilNadu, Lakshdweep	Nair, 1984
Limnoria platycauda Menzies	Andaman Is.	Ganapati & Rao, 1960
Limnoria septima Barnard	Andaman Is.	Barnard, 1936
Limnoria tripunctata Menzies	Madras	Becker & Kampf, 1958
Limnoria unicornis Menzies	Andaman Is.	Ganapati & Rao, 1960
Limnoria bombayensis Pillai	Bombay	Pillai, 1961

MATERIAL AND METHODS

This study was carried out for a period of 15 months during 1991-92. A record of hydrographical parameters was maintained primarily to describe the environment (Table 2). With a view to assessing the natural durability of structural timbers, selected ten species including *Ocotea rodiaei* (Green Heart from British Guinea) prepared in the form of panels measuring 20 x 10 x 2 cm were immersed along the harbour jetty in shallow coastal waters as well as at an experimental raft moored 0.5 km away from the coast (Fig.1). Five replicate panels of each timber species were exposed for a period of one year. Along the jetty the panels were bolted to stationary mild steel frames held 1.5 metres below the low tide mark with the help of link chain. On the raft, the panels were held 1.5 metres below the water surface. The depths at the jetty site and at the raft site were 3 metres and 10 metres respectively. The tidal levels at Karwar are 1.74 metres (MHHW) and 0.30 metres (MLLW). The attacks of the wood-borers on the replicate panels were uniformly severe. The highest numbers of borers counted from a single panel of each of the timber species are, therefore, mentioned. The numbers of *Limnoria* and *Martesia* were determined by counting each individuals from 10 cm^2 area of the panel. The density of *Lyrodus* was determined by counting the dome shaped $CaCo_3$ cones guarding the entry holes of the worms into the timber (Karande & Menon, 1972). Because of the the severity of attack, these wood-worms were found to have stunted growth (stenomorphs) and hence difficult to extract from their tunnels.

Five copper-chrome-arsenic (CCA) treated blocks of *Calophyllum* sp. and *Acacia arabica*, measuring 20 x 10 x 2 cm in dimensions and having retentions of 32-40 kg/m^3 of the preservative (Anonymous, 1967) were also immersed at the harbour jetty for a period of 15 months to examine their tolerance to the limnoriid attack. CCA treated blocks were not exposed at the experimental raft.

Table 2. Hydrographical conditions at the two study sites in Karwar.

Period	Temperature (^{0}C)		pH		Salinity (‰)		Dissolved O_2 (mg/l)		Total suspended solid (mg/l)	
	I	II	I	II	I	II	I	II	I	II
Pre-Monsoon										
February' 91	26.9	27.5	8.13	8.05	24.05	35.25	6.58	6.59	13.8	20.4
March	28.0	28.0	8.05	8.07	20.52	35.25	5.92	5.51	11.4	31.6
April	29.8	31.0	7.94	8.01	31.40	35.57	5.09	6.49	21.2	21.6
May	29.1	28.5	8.13	7.87	23.72	35.81	6.16	4.19	9.8	17.6
Monsoon										
June	29.1	29.4	7.98	8.01	26.92	34.81	6.00	6.53	34.4	24.0
July	27.9	ND	7.66	ND	10.90	ND	3.70	ND	86.0	ND
August	26.1	ND	7.79	ND	26.28	ND	6.66	ND	15.0	ND
September	26.0	24.8	7.59	8.03	25.25	36.21	3.56	5.39	18.2	27.8
Post-Monsoon										
October	25.1	24.6	7.90	7.97	28.25	35.25	2.90	4.31	6.0	16.2
November	28.3	27.8	7.95	8.12	32.69	35.81	5.14	5.48	4.6	6.6
December	26.0	26.0	7.85	8.09	35.57	34.60	4.48	6.62	7.4	16.4
January'92	26.0	25.8	7.91	8.09	20.52	35.81	6.37	6.82	11.0	5.0
Pre-Monsoon										
February	27.9	27.0	7.96	8.03	31.40	34.29	5.45	6.33	15.0	4.0
March	29.2	28.9	8.03	8.15	30.45	36.21	4.92	6.53	2.9	2.9

I — Harbour jetty, II — Experimental raft, ND — No data

For recording the prevalence and breeding of *L.platycauda*, ten timber blocks were immersed both at the jetty and the raft in every calendar month and examined at the end of 45 days. To ensure availability of a large number of specimens, timber blocks of an easily attacked species *Abies pindrow* (Himalayan Fir) were used. The timber blocks immersed at the raft were not attacked by *Limnoria*. The observations recorded here, therefore, pertain to the individuals collected from the ferry. Thirty female individuals were randomly selected from three of the ten timber blocks exposed during every calendar month.

RESULTS AND DISCUSSION

The timber blocks were held on the experimental raft were heavily fouled by sedentary organisms. Some of the major species observed were *Bugula neritina, Hippoporina americana* (cheilostomes), *Balanus reticulatus, B. amphitrite, B. variegatus, Chirona amaryllis, Megabalanus tintinnabulum* (cirripedes), *Perna viridis, Crassostrea gryphoides* (mollusca), *Symplegma brakenbielmi, Botrylloides magnicaecum* (ascidians) and *Pomatoleios kraussii* (polychaete). At the jetty, some of the species observed were *H. americana, B. reticulatus, P. viridis* and *Hydroides operculata*. Also recorded were 22 species of diatoms and three species of filamentous algae.

The timber blocks immersed at the raft were heavily attacked by molluscan borers *Lyrodus massa* Lamy and *Martesia striata* Linnaeus. They, however, were free from limnoriid attack.

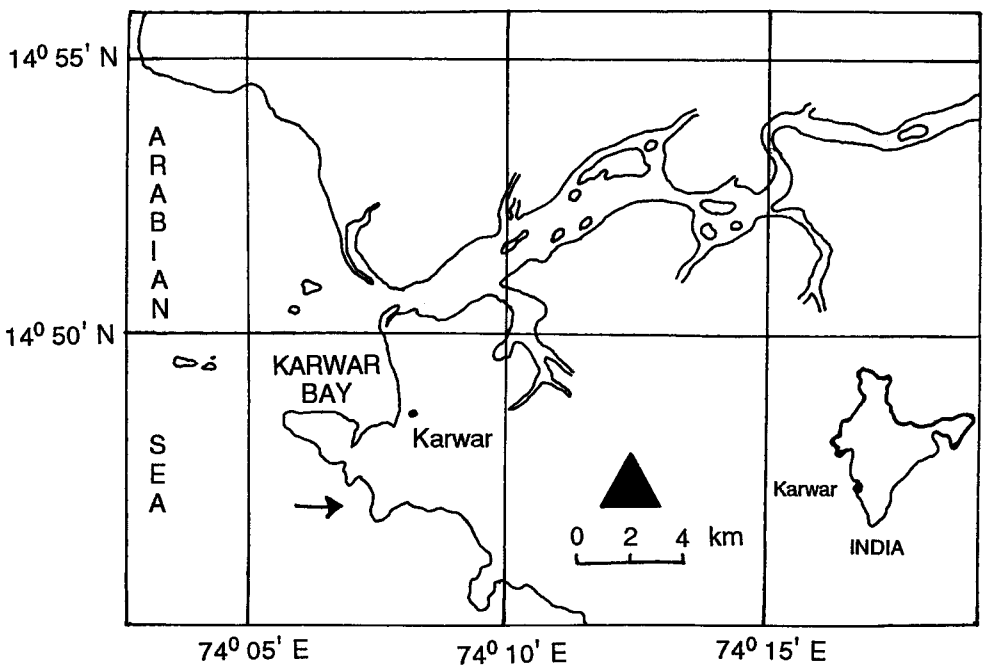

Fig. 1. Location map showing the study area (see arrow) at Karwar, W. India (Bhat & Neelakanthan, 1984).

Limnoria attack in this harbour was restricted to tidal waters as evidenced by their presence in blocks immersed 1.5 metres below water surface at harbour jetty. *Limnoria* are the inhabitants of near shore tidal water (see Pillai, 1961; Cookson, 1987). Their confinement to this water may be attributed to good availability of timber surface, both in the form of man-made marine structures and drifted wood, readily available weed for boring (Chilton, 1914), ensured closeness to commensal bacteria inhabiting mangroves and weeds, relatively poor activity of the sedentary organisms as well as the prevalence of less hazardous sea conditions that offer better protection to both adult and juvenile *Limnoria* which are in a continuous search of fresh timber. A good churning of a shallow sea bed may also provide organic micronutrients which *Limnoria* are believed to procure from their commensal bacteria (Anderson & Stephens, 1969). The raft site differs from the jetty site, in respect of two major hydrographical parameters, namely, temperature and salinity. At the latter site these values remain unchanged throughout the year and therefore, are unlikely to affect the prevalence of *Limnoria*.

Table 3 gives the data on prevalence of the three wood-boring species during different parts of the year at the harbour jetty. The maximum numbers of individuals recorded from any one of the five timber blocks are mentioned in this table. It was noted that *L. platycauda* occurred regularly in varying numbers during every calendar month including during the monsoon months when salinity fluctuated between 10.9 ppt and 26.92 ppt. During January to May, however, *L. platycauda* occurred in a good abundance. Generally, the density of *Limnoria* attack was reduced with the increasing numbers of *L. massa*. Yet a fairly heavy attack by limnoriid despite very stiff competition from molluscan borers was evident. *Limnoria* activity of the magnitude observed in Karwar waters has not been noted by us in other naval harbours like Bombay, Goa, Cochin (West coast), and Vishakhapatnam (East coast). The lack of activity can partly be attributed to estuarine conditions prevailing at Goa, Cochin and Vishakhapatnam (Pillai, 1961). A survey work to establish a distribution pattern of limnoriids in India is desirable.

Table 3. Population densities (thousands/m^2) of crustacean and molluscan wood-borers on *Abies pindrow* blocks exposed at Karwar harbour jetty.

Period	*Limnoria platycauda*	*Lyrodus massa*	*Martesia striata*
Pre-Monsoon			
February	39	14	0.5
March	8	20	2
April	27	9	4
May	16	6	2
Monsoon			
June	4	10	22
July	10	3	2
August	4	62	0.4
September	10	49	Nil
Post-Monsoon			
October	6	38	Nil
November	0.9	477	Nil
December	2	3	0.2
January	34	0.8	3

Table 4 gives the frequency occurrence of females having either fertilized eggs or juveniles during various parts of the year. It was observed that throughout the year, 30 percent of females had fertilized eggs or juveniles in their broods. That the breeding in this species was almost continuous was also evident from the fact that at any given point of time, at least nine to ten percent of the females harboured larvae in their broods. In the temperate waters, *Limnoria* do not survive in 30^0 C (Becker & Kampf, 1958) and its breeding is adversely affected at temperature closer to 24^0 C (Somme, 1940). Poor occurrence of *Limnoria* in Indian waters has been attributed to higher temperature (Pillai, 1961). Pillai has also observed that "uniformly low salinity below 10 ppt or wide fluctuations from 0.35 ppt are known to be definitely unfavourable to the growth of *Limnoria*". Cookson (1987) has also noted that "*Limnoria* rarely bore in locations where the salinity reaches below 25 ppt". In the near shore waters of Karwar, only on rare occasions, salinity was found to be as low as 8 ppt. Generally, it fluctuated between 10.9 ppt and 35.57 ppt and, therefore, did not seem to influence *Limnoria* activity adversely.

Table 4. Breeding potential of *Limnoria platycauda* at Karwar harbour jetty

Period	% individuals:	Egg bearing	Juvenile bearing
Pre-Monsoon			
February		11.2	20.8
March		32.0	30.0
April		32.8	29.2
May		11.2	32.0
Monsoon			
June		24.2	42.8
July		18.6	37.4
August		20.6	11.4
September		14.2	42.8
Post-Monsoon			
October		13.2	24.8
November		24.2	24.8
December		90.0	10.0
January		22.4	9.6

The presence of *L. platycauda*, its incessant attacks and consequent timber deterioration were uniformly high, despite varying hydrographical conditions. A sustained and extensive field work is necessary to establish the influence of temperature and salinity on the life history of limnoriids in India.

The present observations were made on *L. platycauda* specimens collected from the test blocks of *A. pindrow* timber. Cookson (personal communication) observes that "it is possible that other limnoriid species (also) occur at Karwar" because "it is quite common to find that other species become more abundant at different times of the year, or on different timber species". This aspect is being presently examined.

Table 5 summarises data on natural resistance of some untreated structural timbers to the molluscan borers and *L. platycauda*. It was observed that almost all the timbers including *O. rodiaei* were attacked by *L. platycauda* within 15 months exposure. This is the first record in India of *Limnoria* borer attacking this high density timber. Earlier, Menzies (1957) who described this species had collected *L. platycauda* from timber blocks of *O. rodiaei* exposed in Curacao Harbour in Dutch West Indies. Presently there is no uniform method for determining the severity of wood-borer attack and therefore comparison of the results reported from various places, located even within a small geographical region, becomes difficult. One way of overcoming this problem is to use one or two timbers, for instance like *O. rodiaei* or *T. grandis*, as standard reference species every time work of this nature is undertaken.

Presently in India very little information on the efficacy of CCA as a timber preservative against limnoriid is available. One of the reasons for this lack of information was that *Limnoria* was not considered a major wood destroying pest in India. As stated by Nair (1984) "gribbles though present, have not yet assumed any great importance since they occur sparcely". He , however, states that "incidence of *Limnoria* has been steadily increasing". It has been reported by Krishnan *et al.* (1983) that *Limnoria* attacked only panels treated with low concentrations of CCA. At the present site in Karwar, timber blocks of *Calophyllum sp.* and *A. arabica* treated with CCA were found to be attacked by *L. platycauda* within a span of one year. This observation, though based on limited data, can be viewed as adequate warning that in India, CCA treated timber used for marine construction can be badly damaged by *L. platycauda* sooner than the later.

Table 5. Number of each of wood-borer species (thousands/m2)* found on untreated and treated timbers exposed at Karwar harbour jetty.
(Abbreviations: Nm = Not monitored; * = See material and methods)

Timber species	*Limnoria platycauda*	*Lyrodus massa*	*Martesia striata*	Exposure (months)
Untreated				
1. *Abies pindrow*	117	477	22	6
2. *Endospermum malaccense*	21	136	20	6
3. *Terminalia paniculata*	7	66	3	6
4. *Dalbergia sisoo*	Nil	83	2	6
5. *Pterocarpus dalbergioides*	0.1	1000	12	12
6. *Pterocarpus marsupium*	0.4	311	9	12
7. *Calophyllum* sp.	0.5	330	32	12
8. *Shorea robusta*	Nil	232	4	12
9. *Acacia arabica*	0.2	322	1	12
10. *Tectona grandis*	Nil	Poor	Poor	12
11. *Ocotea rodiaei*	10	34	3	12
Treated with CCA				
12. *Calophyllum* sp.	Poor	Nm	Nm	12
13. *Acacia arabica*	Poor	Nm	Nm	12

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