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ECOLOGICAL OBSERVATIONS ON THE OCCURRENCE OF *LIMNORIA* SP. IN RELATION TO OTHER ORGANISMS AND ITS DIFFERENTIAL RESPONSE TO TIMBERS AT MADRAS HARBOUR*

V. V. SRINIVASAN AND K. CHANDRA MOHAN

Marine Organisms Scheme, Zoology Research Laboratory, University of Madras, Madras-5, India

ABSTRACT

The current report from the east coast of India is a continuation of work on these organisms begun in 1955. Emphasis is now placed upon the incidence of *Limnoria* sp. in association with teredines and an evaluation of the natural resistance of four species of timber against marine borer attack. This is the first time that a heavy attack by *Limnoria* sp. from the east coast of India has been reported.

Test panels of *Cedrela toona*, *Aegle marmelos*, *Terminalia paniculata* and *Xylia xylocarpa* used for piles, catamarans, fishing floats, canoes and fender piles were exposed at Madras harbour for a six month period (May-November, 1970) and examined for the degree of activity of the borers and their significance in the durability of these timbers.

L. pedicellatus together with *Limnoria* sp. are responsible for damage to *C. toona* and *T. paniculata* while the other two were infested moderately by teredines. *Limnoria* sp. hitherto reported as scarce, is of common occurrence like pholads and teredines. The preference of *Limnoria* sp. to *C. toona* and *T. paniculata* and not to *A. marmelos* and *X. xylocarpa* is of interest and importance. The durability of the four species of timbers can be arranged in the following order: *A. marmelos* (most resistant), *X. xylocarpa*, *C. toona* and *T. paniculata* (least resistant).

The occurrence and settlement of foulers *Balanus* sp. and *Hydroides* sp. have been studied. The observations are discussed with reference to hydrographical conditions and earlier reports.

INTRODUCTION

MUCH work has been done on the occurrence and activity of Pholadid and Teredinid wood-borers and on the natural durability of several species of timber (Nagabushanam, 1960; Nair, 1955, 1956, 1956a, 1957; Santhakumaran, 1969; Srinivasan, 1961, 1968) in Indian coastal waters. Experiments indicate that the period of usefulness of untreated timber exposed to sea water is very short, depending on the seasons and the texture of the wood. Unlike in temperate waters, where teredines and limnorids are of common occurrence, in tropical waters, teredines and pholads were hitherto considered to be the major wood-borers. Becker (1958 a, b) collected two species *Limnoria* (*Limnoria*) *tripunctata* Menzies and *Limnoria* (*Limnoria*) *indica* Becker and Kampf from Mandapam while Krishna Pillai (1961) has given detailed taxonomic account of these two species. However, their response to different timbers has not been studied experimentally. It was, therefore, felt desirable to study the incidence and prevalance of *Limnoria* sp. in association with teredines at

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Madras and to evaluate the natural resistance of four species of timber against marine borer attack.

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Panels (7″ x ½″ x 4″) of *Cedrela toona, Aegle marmelos, Terminalia paniculata* and *Xylia xylocarpa*, commonly used in marine underwater structures, were suspended at Madras harbour during the period 23-5-'70 to 10–11–'70 and examined after 100 and 172 days of immersion. The immersion pattern consisted of 10′ PVC transparent tube (0.5″ dia.) with a weight at one end. Four side branches (12″ length 0.5″ dia.) were fastened at 8″ apart with panels. Panels in each branch were kept 1″ apart by means of PVC washers to provide maximum surface area of attack.

Settlement of foulers

The data on settlement of foulers are presented in Table 1. It was found that *Balanus amphitrite variegatus* and *Hydroides norvegica* were the only foulers of significance in all the four species of timber and the former species was the dominant one. It was observed that the density of the settlement declined after 100 days, the number of foulers at the end of 172 days being less than that observed at the end of 100 days. The depth at which the panels were hung appears to be significant from the point of view of settlement of foulers, panels at 2′ depth showing greater settlement than those at the surface. Even in the bottom panel the top surface had fewer foulers than the bottom (Pl. I A, B). This is perhaps due to negative phototropism of the larvae of the foulers. As observed by earlier workers (Daniel, 1956) the red coloured *C. toona* appears to attract more number of foulers than the light coloured *T. paniculata*, suggestive of the positive response of the foulers towards dark coloured substrata.

Among the four panels immersed *T. paniculata* which is commonly used for marine constructions in India is found to be the least resistant to borers (Pl. I G). *Limnoria* sp., *L. pedicellatus* and *T. furcifera* are the principal wood-boring organisms responsible for the destruction. *Limnoria* sp. which attacks the surface of the wood appears to be more active on the bottom surface than on the top. *L. pedicellatus* and *T. furcifera* caused considerable damage to the panel during this period. *L. pedicellatus* had grown to 118 mm in 100 days and 117 mm, 128 mm (* 0.75 and 0.81 mm – mean 0.78 mm) in 172 days.

These observations indicate that the rate of boring is faster in the first 100 days than subsequently. The destruction of wood by teredines and *Limnoria* sp. was maximum after the end of the experimental period (Pl. I C).

It is of interest to draw comparisons with experiments on *T. paniculata* carried out at other centres on the Indian Coast. At Waltair *T. paniculata* panels immersed during January - August 1965 were riddled by *Martesia* sp. only (Nagabushnam, 1960). The absence of *Martesia* sp. at Madras and Limnorids and Teredines at Waltair during these experiments is striking. At Bombay harbour only 25 Limnorids

*Since panels examined within about 15 days after submergence usually showed no attack by Teredines, the average daily cutting is computed on the basis of 15 days less than the actual time indicated for the exposure of the wood. Figures in brackets show average daily cutting in mm.

were recorded in 18 months (Santhakumaran, 1969) indicative of the rare occurrence of this species at Bombay. Balasubramanyan and Menon (1960) reported that at Cochin, during October 1958—December 1959, destruction was mainly due to

TABLE 1. *Range of settlement of foulers (Nos. per sq. inch)*

Species of timber	days		Foulers			
			Balanus sp.	panel	*Hydroides* sp.	panel
Terminalia paniculata	100	Top side	5 – 22	1	1 – 3	1
		Bottom side	8 – 29		1 – 16	
	172		2 – 8	2	1	2
			1 – 6		1	
			2 – 11	3	1	3
			5 – 20		1 – 2	
			6 – 32	4	1	4
			1 – 20		1 – 3	
Cedrela toona	100		22	1	—	1
			12		Very few	
	172		3 – 20	2	1	2
			5 – 20		1 – 3	
			9 – 18	3	1	3
			10 – 20		Nil	
			18 – 32	4	1	4
			22 – 30		1 – 6	
Xylia xylocarpa	100		4 – 28	1	1 – 5	1
			10 – 27		Nil	
	172		8 – 15	2	1 – 2	2
			2 – 10		1 – 4	
			1 – 18	3	1 – 2	3
			7 – 16		1 – 2	
			1 – 28	4	1 – 2	4
			6 – 29		1 – 4	
Aegle marmelos	100		36	1	very few	1
			32		very few	
	172		8 – 17	2	1 – 2	2
			2 – 14		1 – 3	
			7 – 20	3	1	3
			4 – 25		1 – 3	
			7 – 21	4	1 – 2	4
			8 – 16		1 – 3	

Martesia and Sphaeromids, while Teredines and Limnorids were absent. Nair (1955) observed heavy teredine attack on *T. paniculata* drift wood from Madras, while *Limnoria* sp. was not found to occur.

The foregoing observations show dissimilarity of occurrence of borers at different centres on the east and west coast. It is possible that factors such as variations

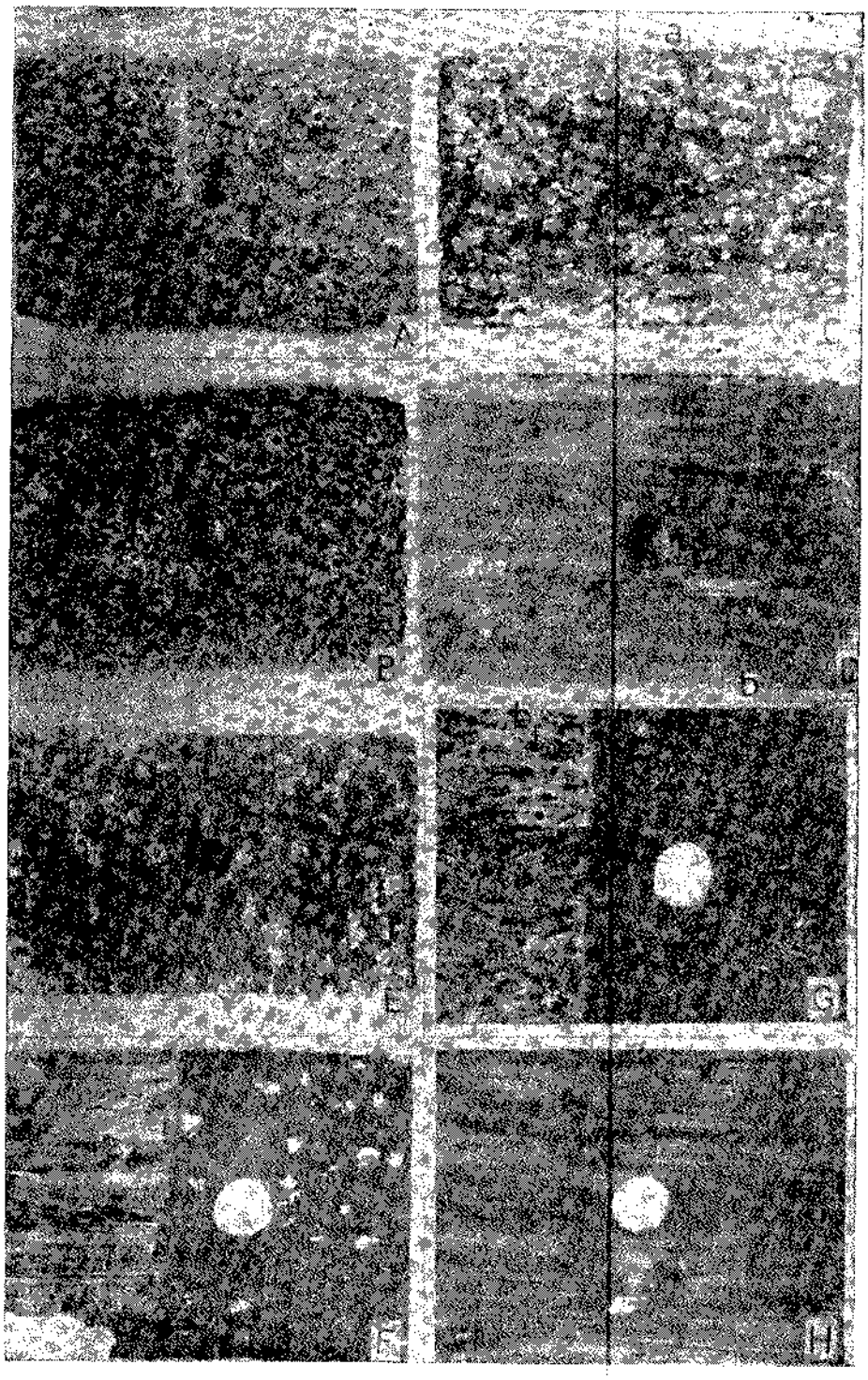

Plate I A & B. C. *toona* (100 days exposure). Contrast of fouling on top (A) and bottom (B) surfaces of the panel. C. Bottom surface scraped off to show *Limnoria* attack, D. Interior of panel showing teredine attack. E. *Aegle marmelos* (100 days exposure) Bottom surface scraped off to show absence of *Limnoria*, F. *C. toona* (172 days exposure) - Panel partly chipped off showing severe attack by teredines and *Limnoria*. G. *Terminalia paniculata* (172 days exposure) - Panel partly chipped off showing severe attack by teredines and *Limnoria*, and H. *Xylia xylocarpa* (172 days exposure) - Panel chipped off showing less moderate teredine attack. Note the absence of *Limnoria*. (a- *Limnoria* burrows, and b - Teredine burrows)

in hydrographical conditions, breeding season and biological differences in sea waters are responsible for the observed differences.

Plate I C, D, F shows the degree of damage by *Limnoria* and teredines after 100 and 172 days of exposure in *C. toona* panels. This is the first record of heavy destruction of these timber species by *Limnoria* sp. It can be seen from the figures that Limnorid borrows are confined to the outer 3 to 4 mm region of the panel while teredines are found below this level. As has been noted for *T. paniculata* the occurrence of wood-borers at Madras and Waltair differ in that *Martesia* and teredines are recorded at Waltair and *Limnoria* and teredines at Madras. Although Nair (1956, 1956 b and 1957) has reported the occurrence of 3 genera of teredines– *Bankia* sp. *Teredo* sp. and *Uperotus* sp. at Madras in *C. toona*, this is the first record of *Limnoria* sp. in this species of timber.

Results for *Xylia xylocarpa* show less moderate attack in a period of 100 – 172 days. Destruction was mainly due to *L. pedicellatus* and *T. furcifera* which had grown to 6 to 30 mm in 100 days (0.35) and 39 mm, 41 mm and 45 mm (0.25 mm, 0. 26 and 0.29 mm – 0.27 mm mean) in 172 days. A feature of interest is the total absence of Limnorids which were dominant in *C. toona* and *T. paniculata* (Pl. I H). The average rate of cutting of *L. pedicellatus* in *Xylia xylocarpa* is comparatively lesser than in *T. paniculata* and *C. toona* (Table 2).

TABLE 2. *Maximum penetration of* L. Pedicellatus *in test panels with probable average daily rate of cutting*

Species	100 days (in mm)		172 days (in mm)
Terminalia paniculata	118		117 (0.75)
	(1.39)		128 (0.81)
		Mean	(0.78)
Cedrela toona	85		74 (0.47)
	(1.0)		78 (0.50)
			79 (0.5)
		Mean	(0.49)
Xylia xylocarpa	30		39 (0.25)
	(0.35)		41 (0.26)
			45 (0.29)
		Mean	(0.27)
Aegle marmelos	50		25 (0.16)
	(0.59)		42 (0.27)
			55 (0.35)
		Mean	(0.26)

The damage to *Aegle marmelos* after 100 days was negligible. (Pl. I E). It was free of Limnorids in contrast to *C. toona* (Pl. I C). After 172 days moderate destruction by *L. pedicellatus* and *T. furcifera* were observed. *L. pedicellatus* had grown to 50 mm (0.59) in 100 days and 25 mm, 42 mm, and 55 mm (0.16, 0.27 and 0.35 - mean 0.26 after, 172 days. From Table 2, it may be observed that the rate of cutting of *A. marmelos* is the least of all the four species of timbers studied. The absence of Limnorids in *A. marmelos* as in *X. xylocarpa* is in contrast to the observations made in *C. toona* and *T. paniculata*.

It is seen from the observations reported above that there is a differential intensity of attack on the four species of timber, that on *T. paniculata* being most intense followed by *C. toona*, *X. xylocarpa* and *A. marmelos* in that order.

Limnoria sp. hitherto reported to be scarce in Madras is now prevalent during May–August 1970 in *T. paniculata* and *C. toona* and not met with in *X. xylocarpa* and *A. marmelos* indicating their differential response to these timbers. They have been reported to feed exclusively on cellulose (Lane, 1958) and their non-preference to certain timbers suggests the possibility of the occurrence of either some chemical substances toxic to the animal or that the wood components are of no nutritive value.

In the present study teredines have been reported in all the four timbers which suggests that all these timbers could serve the nutritional needs of the animal. However, differences in their rate of cutting is possibly due to differences in the texture of the wood. *T. paniculata* and *C. toona* were found to be more susceptible to teredine attack than *X. xylocarpa* and *A. marmelos*. The absence of *Limnoria* sp. in the latter species of timber is therefore more likely to be due to the hard texture of the wood than to the chemical components present.

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