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ABSTRACT

The incidence of borer population in five harbours viz. Bombay, Cochin, Port Blair (Andamans), Marmagao (Goa) and Visakhapatnam has been examined with respect to the damage caused by them to the structural timbers.

The effect of varying borer populations either individually or collectively on the underwater deterioration of selected structural timbers has been assessed. The intensity of borer population was highest at Port Blair followed by Goa, Cochin, Bombay and Visakhapatnam. Pollution of sea water appears to have significant influence at Visakhapatnam where least borer activity has been recorded.

The attack of wood borers on timbers was selective in most harbours. Only a few timbers were found susceptible to attack by *Limoria* sp. at Port Blair. This selective deterioration by woodboring organisms has been discussed in relation to chemical and physical properties of timbers.

INTRODUCTION

Timber is a primary construction material for many harbour and waterfront structures for maritime nations particularly rich in forest resources. Even in the present era of 'steel age' and other man-made constructional material, timber is widely employed in India for many varied purposes both by naval and harbour authorities. The destruction of timbers by biological agencies in the sea water thus has become a problem of great importance in order to combat the groups of organisms responsible for damage.

The damage to the timbers in sea water is caused by a wide variety of micro and macro organisms ranging from bacteria and fungi to crustacean

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and molluscan wood borers. However, the macro organisms like crustacean and molluscan fauna has caused large scale deterioration of timber in different ports in the country and many workers have examined the borer fauna prevalent in the various harbours. Thus at Bombay Palekar and Bal (1955, 1957a & b) Palekar *et al.* (1964) Karande (1958); at Cochin Balasubramanian and Menon (1963); Nair and Saraswathi (1968, 1971); at Madras Srinivasan (1959, 1968) and at Visakhapatnam Nagabhushanam (1958, 1960 a & b); Ganapati and Lakshmana Rao (1960) have examined the prevalence of marine borers. Various species of borers prevalent in the Indian waters has been reviewed recently by Purushotham and Satyanarayana Rao (1971). It has been observed by them that 23 species of teredinid borers, two species of pholadid borers and 9 species of limnoid borers have been recorded so far. Another crustacean borer viz. *Sphaeroma* sp. has also been recorded by many but this group is primarily surface scappers and does not contribute significantly in the destruction of the structural properties of timbers as compared with the other three groups.

It may, however, be mentioned here that though such a large number of species have been encountered from various ports, only a few species have been responsible for timber destruction. The underwater destruction of timbers at each port is, therefore, primarily dependent upon the faunal composition of the borers prevalent in any particular harbour. The borer species not only varies from port to port but in some cases it varies in the same port during different periods. The present study was, therefore, taken to determine the prevalence of borer species in five different harbours during the same period. Studies were hence conducted at Bombay, Cochin, Port Blair (Andamans), Marmagoa (Goa) and Visakhapatnam by exposing several varieties of timbers possessing good structural properties in an attempt to determine the influence of borer species on the natural durability of individual timber species. The performance of different timbers at the five ports of investigation has been published elsewhere and hence is not dealt with here.

FAUNAL INTENSITY AND DISTRIBUTION

The intensity and degree of destruction of timbers has been found to vary from port to port. Thus timber of any variety has been found to be destroyed in a short period at Port Blair in Andamans and Marmagoa in Goa (Kalyanasundaram and Ganti, 1974). The destruction of timbers was moderately high at Cochin followed by Bombay. At Visakhapatnam, however, the intensity of borer population was very poor and degree of timber destruction negligible (Kalyanasundaram and Ganti in Press). Comparative destruction of one timber at all the five ports is shown in Fig. 1. The responsible species of borers affecting the timber species at all the five ports is described below.

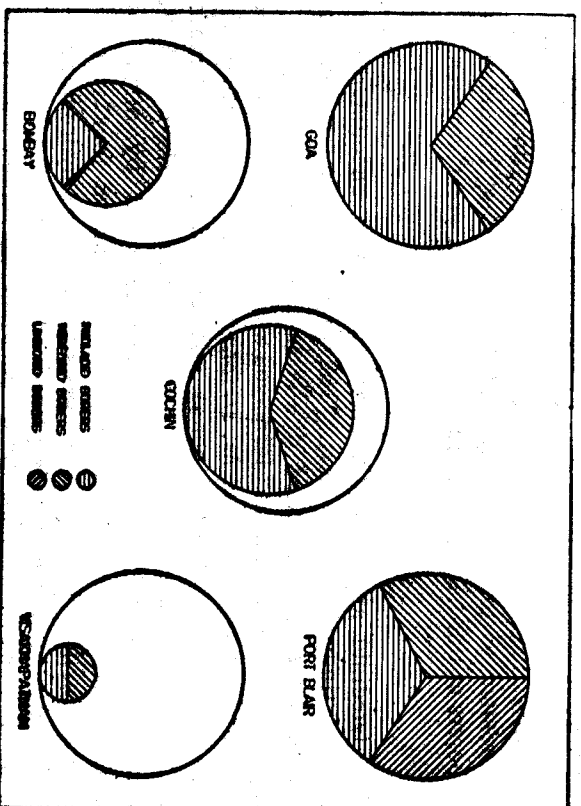


Fig. 1. Comparative destruction of timber at five Ports.

Bombay

The results of present investigation have shown that the teredinid group plays a predominant role in the destruction of timbers at this harbour. Although pholadid borer *Martesia striata* has been encountered in a few instances, their influences on the timber damage was virtually inconsequential. Palekar and Bal (1957) had recorded the occurrence of crustacean borer *Limnoria* sp. which was not encountered in the major part of present investigations, though towards the end of the studies a few timber species were found to exhibit attack by this group to a limited extent. The borer species encountered in the present study were (i) *Teredo furcifer*, (ii) *Lyrodus petiellatus*, (iii) *Bankia companelata*, (iv) *Limnoria* sp. and (v) *Martesia striata*.

The predominance of teredinid borers at Bombay is of rather recent origin. In the early twenties Messent (1920) observed heavy activity of *Pholas* in Bombay harbour causing destruction of timbers and thus confirming two reports published earlier from the same port. In the present studies, the activity of pholadid borer *M. striata* was not recorded and the deterioration of timber was due to teredinid borers only. Incidence of limnoriid borers was recorded by Palekar & Bal (1957) though the species did not appear to thrive in the water as evident from the fact that the incidence of the group was not

recorded in the later years. The incidence of limnoriid borers has been reported recently by Santhakumaran (1969) and was observed in 1972 during the present investigations on a few timbers. Since the natural durability of timbers is related to the composition of borer species, the occurrence of limnoriid borers at this harbour should be viewed with great concern.

Cochin

Only teredinid and pholadid borers have been encountered causing destruction of timbers at this port. The intensity of borer population as observed from degree of destruction of a large number of timbers was comparatively less severe than that at Marmagao and Port Blair. The rate of destruction of timbers by the pholad *M. striata* was much more than that by teredinids. The species of wood borers encountered from the timbers are *Martesia striata*, *Bankia companellata*, *Nausitora hedleyi* and *Teredo furcifera*. Many more species have been recorded by other workers (Nair and Saraswathy 1968), although only the above four species have shown predominance in spite of greatly varying hydrographic conditions. Salinity in particular is greatly affected by heavy rainfall and salinities as low as 3‰ have been recorded for long periods during monsoon months. Under these widely fluctuating salinity conditions also the borer activity is quite intense and in one particular species viz. *N. hedleyi* it has been observed that the animals can withstand extreme salinity conditions ranging from fresh water to 50‰ (Nair & Saraswathy, 1968). The four species commonly encountered thus apparently show a great degree of salinity tolerance, though breeding of the individual species may have been adversely affected. As a result, the timber species which have shown moderate life in *Martesia* infested waters of Goa have exhibited a good life at Cochin.

Port Blair

Destruction of timbers at Port Blair is jointly caused by all the three groups viz. teredinid, pholadid and limnoriid borers. The activity of all the three groups is so intense that timbers normally showing a good degree of durability in other harbours failed to show a life beyond 24 months. The following wood borer species were encountered in the present study: *Bankia bipalmulata*, *B. companellata*, *Teredo furcifera*, *Nototeredo* sp., *Martesia striata*, *Limnoria indica*, and *L. pfefferi*.

It was difficult to determine the predominance of any one group of borers and the competition for space was so acute that the animal could not attain their normal size. This was particularly evident in respect of teredinid borers where the size of individual burrow was distinctly retarded when compared with size of burrow in any other harbour like Bombay or Cochin. This

high intensity of borer population is largely attributed to the persistence of timber seasoning ponds belonging to both Government and private agencies in the vicinity of harbour. The timbers in the pond were heavily infested with the borers and in fact this timber pond acts as the "breeding ground of borers". In addition to these "borer breeding ponds", which no doubt influence the borer population, environmental factors may also be responsible for facilitating this population explosion. Port Blair as a city itself is comparatively free from any man-made pollution problems to hinder or adversely affect the borers and thus allowing maximum opportunities for propagation of the species.

Goa

Only pholadid and teredinid borers were found to be primarily responsible for the destruction of timber panels. The chief causative species encountered were *M. striata*, *B. campanellata* and *T. furcifera*. The incidence of *Limnoria* was not recorded in these waters. The destruction of timbers in this harbour was mainly due to the severe attack by the pholadid *M. striata*, the teredinid borers playing secondary role. The number and intensity of the pholadid borer was very high and the life of timber species examined was comparable to that in Port Blair. The timbers were riddled with *M. striata* to such an extent that there was little scope and space for settlement and growth of teredinid borers.

The growth of pholadid borers was very much uninhibited and the size of individual specimens was one and half times bigger than the specimens of *M. striata* collected from either Cochin, Port Blair or Visakhapatnam. The reasons for this healthy growth and propagation of pholadid borers in this port are not known. This port is comparatively free from industrial and other pollutants, and hence probably may be conducive for pholadid propagation.

Visakhapatnam

During sixties, this harbour has been reported to be the port of intense borer activity. Thus, Purushotham & Satyanaraya Rao (1971) observed that of the four harbours Bombay, Cochin, Madras and Waltair, damage was severest at Waltair. Both teredinid and pholadid borers were known to be actively destroying any timber structures in short durations (Nagabhushanam, 1958, 1960). During the present investigation, which began in this harbour since early 1970, it was observed that borer population was very much limited in this port. Only *M. striata* and *B. campanellata* were encountered in the few panels which showed a moderately poor attack. In fact, it was observed that most susceptible timber like Himalayan fir (*Abies pindrow*) was free from borer attack for about 8 months, whereas the same was destroyed

within six months period at the rest of the places. As a result only 3 timber species in addition to Himalayan fir (*A. pindrow*) had shown any degree of destruction.

It is rather difficult to determine reasons for this alteration in the borer populations in the recent years. Ganapati and Raman (1973) had recorded a great degree of pollution of sea water in the harbour area of Visakhapatnam which is being originated from such vast industrial complexes like oil refinery and fertiliser plants. The addition of effluents like sulphuric acid and waste products of oil refineries probably has adversely influenced the borers. It is also probable that a change in eco-system itself might be undergoing in this harbour which in turn has indirectly affected the marine borers. In recent years, a central American bivalve *Mytilopsis sallei* (Recluz) has migrated to this port, and since its migration in 1967 (Ganapati *et al.*, 1971) the species has multiplied in such large numbers as to inhibit the settlement and growth of many other fouling and woodboring organisms. The timber panels exposed for trapping wood borers were completely covered by the mollusc *M. sallei* which had virtually formed a physical barrier against the larvae of wood boring species. Both industrial pollutants and the heavy settlement of *M. sallei* may have jointly influenced the borer population, thus leaving the timber structures free from any borer damage.

The underwater deterioration of any timber can be said to be influenced by the inherent physical and chemical properties of timber and intensity of the marine borers. Although both these aspects are totally independent, they are related to each other particularly in determining the natural durability of any timber.

On the basis of destruction of large number of timbers by predominant borer species, the intensity of borer population at all the five ports has been arbitrarily determined. It may be observed from Fig. 1 that when the intensity of borers and extensive deterioration of a variety of structural timbers are taken as criteria, Marmagao and Port Blair represent hundred per cent population of borers. The intensity of borers was almost 70% having predominance of pholadid wood borers at Cochin. While at Bombay, the borer population being mostly teredinid with pholadid and limnoriid species in much smaller numbers, the intensity of timber destruction was less than 50%. Visakhapatnam, however, showed least a borer activity, averaging 15% that of either Marmagao or Port Blair.

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