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BIODETERIORATION OF WOODEN BOATS - A MAJOR PROBLEM FACING MARINE FISHERIES

L.N. SANTHAKUMARAN*

Institute of Wood Science and Technology, Bangalore 560 003.

ABSTRACT

In India, the fishing industry alone incurs an annual loss of over 120 million rupees on account of biodeterioration of wooden fishing craft. None of the timber species, currently in demand for boat-building, possesses any natural bio-resistance and will be completely destroyed within 6 to 12 months. Preventive measures against biodeterioration range from application of several indigenous formulations to metallic sheathings and pressure impregnation of wood with preservative chemicals. These methods do not provide lasting protection, as each has its own short-comings and inadequacies. The need for long-term research in the field of marine biodeterioration for improving the efficiency of currently known control measures, with emphasis on application of non-polluting biological methods, has also been stressed in the paper.

INTRODUCTION

Despite extensive mechanisation and introduction of modern fishing methods, the backbone of marine fisheries in India is still the traditional fishermen with their indigenous craft. The development of fisheries is, therefore, intimately linked with their socio-economic upliftment. Supply of suitable materials for the construction of their craft and its maintenance are vital for the sustained activities of these poor fisher-folk.

The traditional construction material used extensively for marine constructions in India is timber. Timber is prone

* Present Address : Wood Preservation Centre (Marine),
C/o National Institute of Oceanography,Dona Paula,Goa 403004.

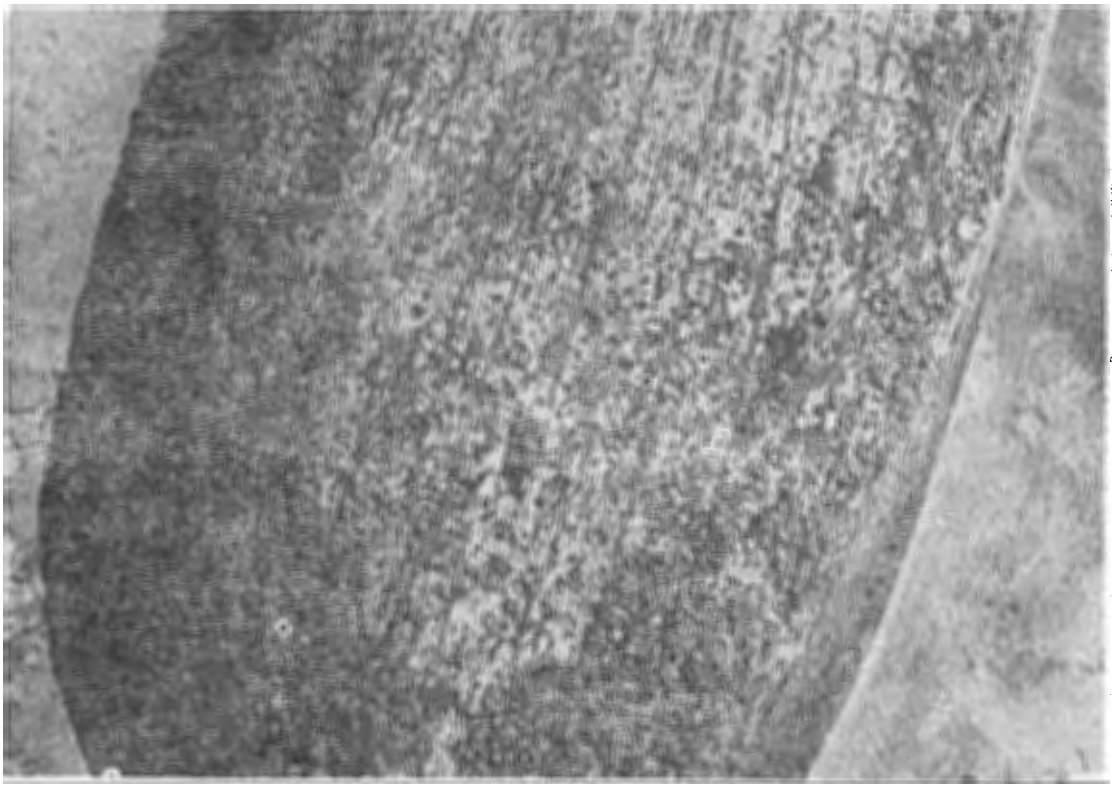

Fig. 1 A country boat at Terracol (Goa) showing heavy borer damage.

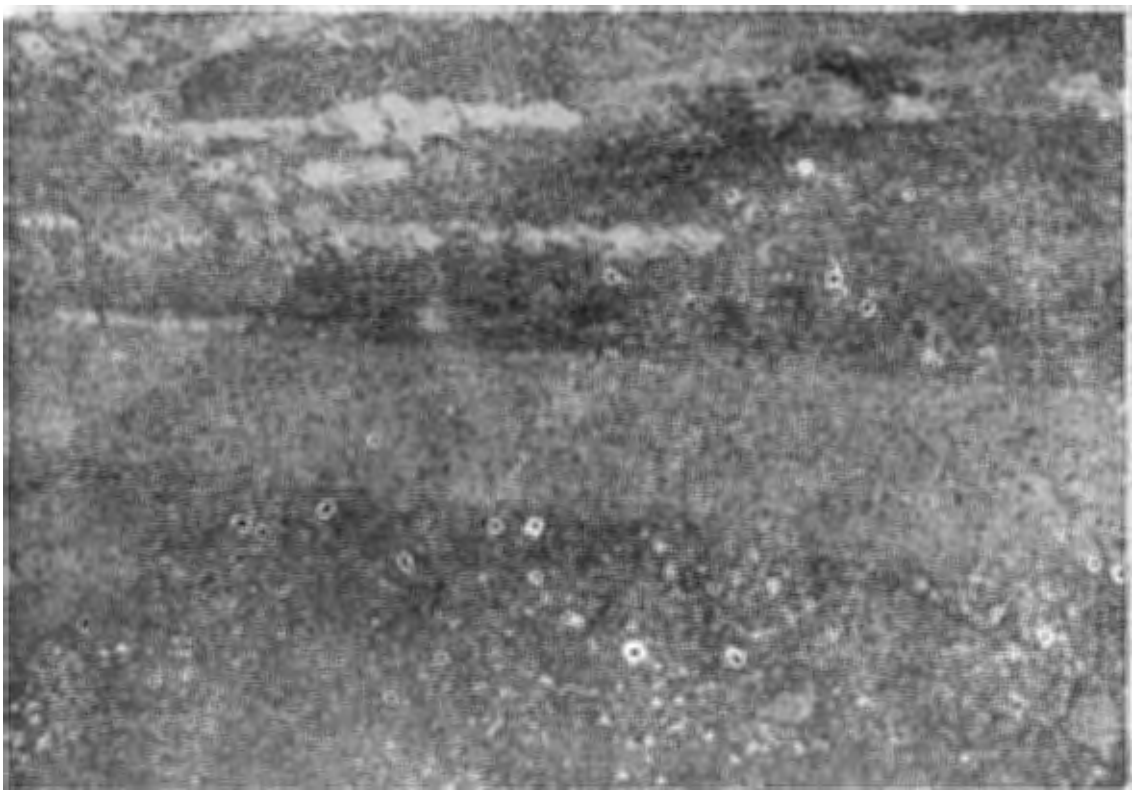

Fig. 2 Keel and bottom planks of an Arab dhow (of teak) heavily demaged by marine borrers in 18 months in Mandovi estuary (Goa).

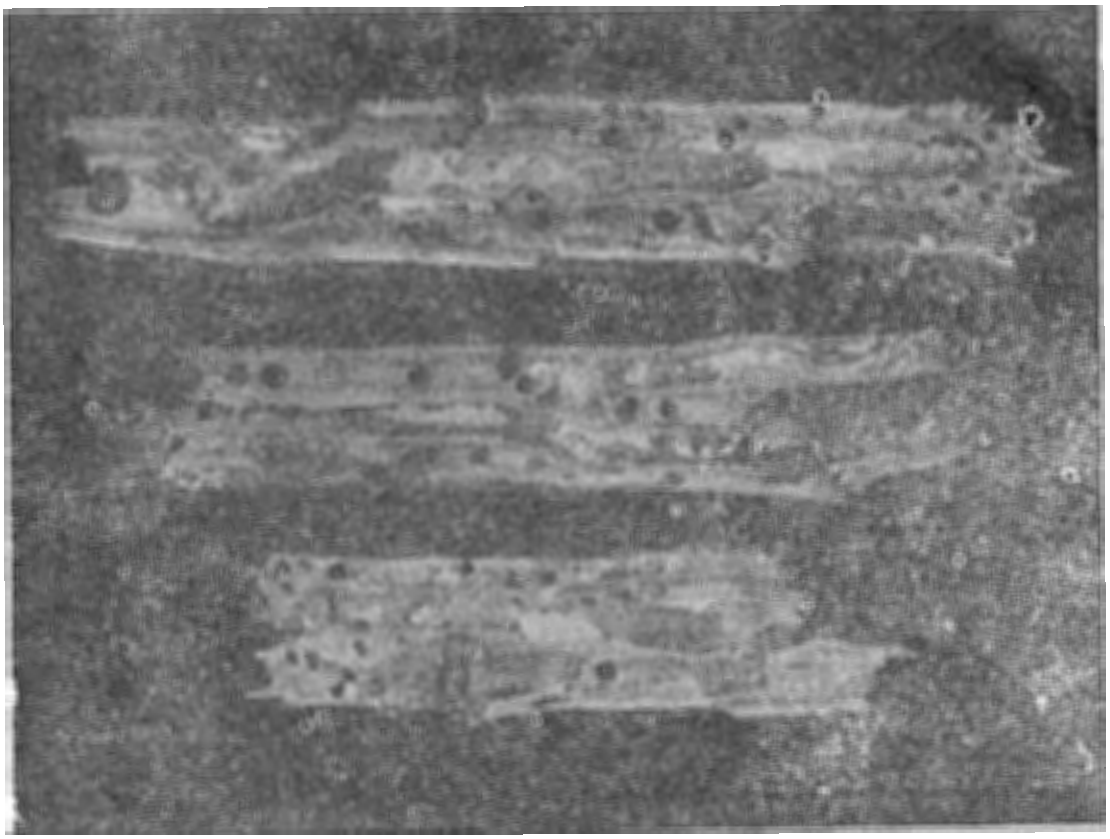

Fig. 3 Casuarina poles from Killai Fish-farm (Chidambaram Tamil Nadu) split open to show damage by shipworms with in 6 months.

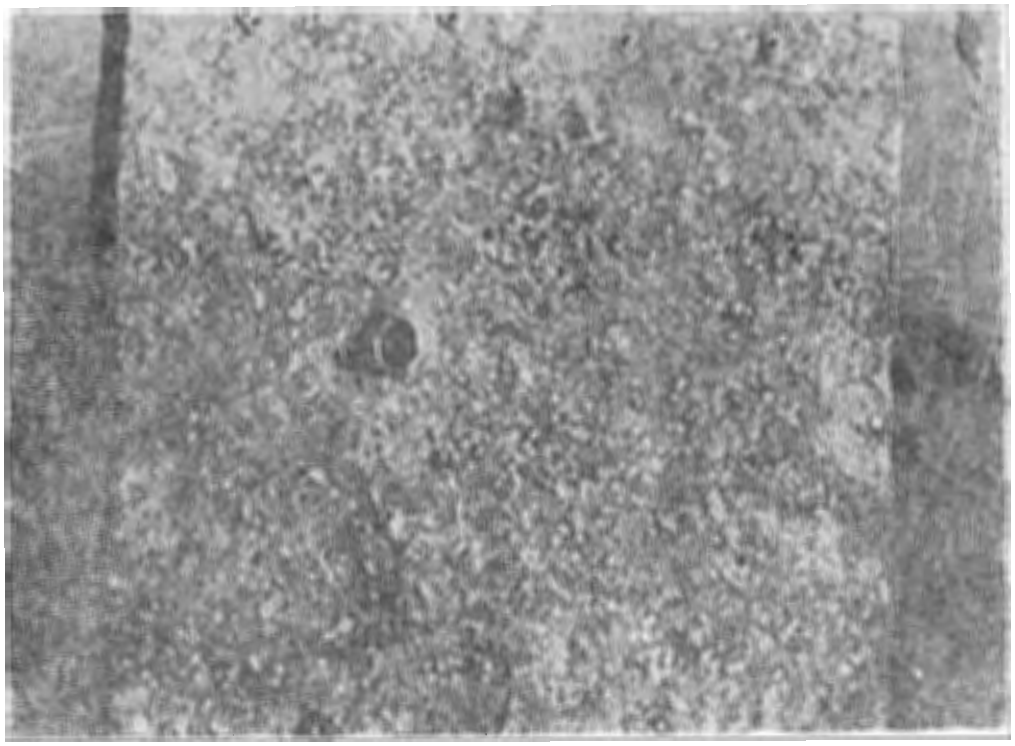

Fig. 4 A piece of copper sheet from the wooden hull of a mechanised boat in Bombay showing fouling by barnacles.

to rapid destruction by marine organisms like shipworms (*Teredinidae*), piddocks (*Pholadidae*), pill-bugs (*Sphaeromatidae*) and gribbles (*Limnoriidae*). The wood surface as well as that of other construction materials, such as steel, fibre-glass or ferrocement, are also subject to heavy fouling by sedentary organisms like coelenterates, bryozoans, sponges, serpulids, barnacles, bivalves and by marine algae. So far, about 54 species of wood-borers and over 170 species of major foulers have been reported from Indian coasts (Nair, 1984; Santhakumaran *et al.*, 1985; Santhakumaran and Srinivasan, 1987). While the borers tunnel through the timber and destroy it with remarkable rapidity (Figs. 1 to 3), the main foulers (Fig. 4) roughen the hulls, thereby increasing the drag resulting in loss of speed and high rate of fuel consumption. In a steel hull, the foulers promote corrosion as well. Thus, marine biodeterioration is really an impediment to the development of fisheries.

ECONOMIC IMPORTANCE

The financial implication of the problem caused to the fishing industry by marine foulers and wood-borers is of a colossal magnitude and the remedial measures so far evolved to combat biodeterioration are quite inadequate and still expensive. The annual loss to the fishing industry, based on a survey conducted in 1981, is over 120 million rupees (Santhakumaran and Srinivasan, 1987). This expenditure is only for repairing and restoring remedial measures against biodeterioration and does not include the actual cost of the timber used for construction or for annual replacements and also the destruction caused to large quantities of timber used to provide the necessary infrastructural facilities at about 1,300 main fish-landing centres and also for mariculture at several places. For example, in India, investment worth 600 million rupees is involved in the indigenous fishing boats itself (Ravindran *et al.*, 1984). If all these are taken into consideration, together with the hike in the cost of ingredients used for preparing protective coatings and also in labour charges since 1981, the additional expenditure at present will soar to a staggering figure. Despite this enormous expense on hull maintenance, wooden boats suffer extensive borer damage and heavy fouling (Figs. 1, 2 and 4).

The problem is again aggravated as none of the timber species currently in demand for boat-building (like *Tectona grandis*, *Terminalia alata*, *Terminalia paniculata*, *Lagerstroemia microcarpa*, *Xylia xylocarpa*, *Mangifera indica*, *Artocarpus hirsutus*, *Hopea parviflora*, *Calophyllum inophyllum*, *Bombax ceiba*, *Albizia* spp ,

Melia composita, *Pterocarpus dalbergioides* and *Pterocarpus marsupium)* possesses any natural bioresistance against borers and foulers. Even teak is destroyed completely within a short time (Fig. 2). Further, considerable inconsistencies in durability of the same timber species at different localities have also been reported. Here is a problem that has defied a permanent solution, but at the same time divising a preventive method is indispensible for the economic effectiveness of the fishing industry.

CONTROL OF BIODETERIORATION

Indigenous methods : Several indigenous preservative formulations are employed by Indian fishermen for protecting the hulls of fishing craft from biodeterioration. Some of the ingredients used, either alone or in combination are : crude fish oil, cashewnut shell oil, poon *(Calophyllum* sp) seed oil (also called hunnai oil or undi oil), neem *(Azadirachta* sp) seed oil, crude engine oil, groundnut oil, castor oil, coal tar, karanjel oil (from seeds of *Pongamia pinnata*), 'chandrus' or 'dammer batu' (solidified resin from trees of the family Dipterocarpaceae) and lime (for details on commonly used combinations, see Santhakumaran and Jain, 1983). Coatings of these indigenous preservatives have no particular efficacy for the purpose they are used, due mainly to their poor adherence to the timber surface. Their apparent effectiveness is evidently due to the frequency of application (sometimes 3 to 4 times in a year) and its continued use is only a practice governed by tradition.

Mechanical barrier methods :Protective methods by providing a mechanical barrier include metal (iron, steel, zinc, copper and alloy of copper and zinc or aluminium and magnesium) or fibre-glass sheathing and application of special marine paints containing toxic chemicals (salts of copper, and mercury, tri-butyl-tin oxide, tri-butyl-tin fluoride or tri-butyl-tin acetate etc.). Methods are effective against marine borers as long as the sheathing remains in good condition. One of the serious problems encountered is the rapid corrosion of metals and their alloys and peeling of the coatings due to mechanical damage. Copper sheathing, though very effective, is prohibitively costly. Further, these mechanical barriers do not prevent the growth of fouling organisms (Fig. 4). Nevertheless, the method is useful in protecting fixed timber structures like fishing stakes, poles, jetty piles, etc., from borer damage. In the case of marine paints, excessive initial leaching of the toxicant from the film and also mechanical damage contribute to early failure of even highly acclaimed antifouling paints. New development in this field is the antifouling elastomers which can be applied in thick

coatings, thereby holding larger quantities of the toxic components.

Chemical impregnation methods : Pressure-impregnation of timber with standard wood-preservatives affords worthwhile protection. Pressure-treated test panels of several species of Indian timber remained free of biodeterioration even after 7 to 15 years; while their life in the untreated condition is only 6 to 12 months (Santhakumaran *et al.*, 1984). It is the best method for fixed structures. Creosote, creosote-fuel oil mixture (50:50), copper-chrome-arsenic (CCA) and copper-chrome-boric (CCB) are some of the good preservatives. Recommended dosages are about 320 kg per cubic metre of oil type and 32 kg per cubic metre of water-borne preservatives. It is important that all cutting and boring of timber should be completed before it is impregnated. If any untreated wood is exposed during the construction of the boat with impregnated timber, such exposed surfaces should be liberally coated with the preservative. Two catamarans made out of *Albizia chinensis* and treated with CCA (at the dosage of 16 kg and 32 kg per cubic metre) remained free of borer attack and fungal decay even after 14 years of continuous operation at Visakhapatnam, whereas in the untreated condition their life is only about 5 to 7 years - that too with frequent maintenance by way of replacements of damaged portion and "shortening" (Santhakumaran and Srinivasan, 1987). These catamarans are still in service .

Although long-term protection is imparted to marine timber by pressure-impregnation method, it has not become popular in India, mainly due to lack of treatment facilities along the coasts. The method can undoubtedly enhance the service life of boats and also can contribute to the rational utilization of secondary varieties of timber, leading to the conservation of our forest wealth. It may, however, be mentioned here that, as in the case of natural bioresistance, durability of pressure-treated timber also may vary at different localities, as a consequence of differential fixing of chemicals in the timber, conditions at the area deciding the leaching rate and also the composition of the borer fauna. Strength properties of the treated timber also are to be evaluated in more details.

FUTURE TRENDS IN RESEARCH ON MARINE BIODETERIORATION

Further long-term investigations on marine biodeterioration are certainly needed to improve the efficacy of control measures

curently available. The use of toxic chemicals may in due course of time aggrevate the hazard of pollution. Hence, the future emphasis on research in this field should be on the biology of the wood-infesting organisms, so as to find out the weak-links in their life history, and also on the biochemical action of naturally occurring chemicals present in certain timbers on wood-borers (like interference of calcium metabolism of borer larvae by obtusaquinone present in *Dalbergia retusa*). Similarly the experimental evidence for the attraction of larvae of fouling organisms, through the production of certain proteins (lectins), to specific bacterial polysaccharides on the substratum, provides a new technique in combating foulers. By preventing bacterial biofilm on the surface, it may be possible to block settlement and growth of marine organisms. These new trends in research may result in developing non-polluting biological control measures. Marine biodeterioration is indeed a major bottleneck in the development of fisheries and any improvement in the efficacy of existing antifouling and antiboring techniques, indigenous or modern, would be a very significant contribution curtailing considerable expenditure on maintenance of books, much to the relief of the poor fishermen of India.

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