

THE OCCURRENCE OF *LIMNORIA* IN AUSTRALIA

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There are about twenty different species of the marine wood-boring crustaceans *Limnoria*. Perhaps the best known species is *L. tripunctata* Menzies, largely because it can cause premature failure of creosote-treated timber in warm temperate waters (Hochman *et al.*, 1956). These timbers are used extensively as piles in America. Although *Limnoria* is common around Australia's coastline (Anon., 1972), the only species identified has been *L. tripunctata* from Sydney Harbour (Jones *et al.*, 1972). Many early Australian publications (e.g. Iredale *et al.*, 1932; Watson *et al.*, 1936) referred to *L. lignorum* (Rathke); however, this occurrence has yet to be confirmed for Australia. Prior to the comprehensive review on limnoriid taxonomy by Menzies (1957), few species were recognised and most limnoriids were called *L. lignorum*. It is now known that *L. lignorum* occurs mainly in cold waters such as in the Arctic-boreal region (Menzies, 1957). Recently, *L. quadripunctata* Holthuis was found at Hobart and (in association with *L. tripunctata* and *L. indica* Becker and Kampf) at Goat Island, Sydney, attacking various CCA-treated hardwoods and radiata pine (Barnacle *et al.*, 1983). *L. tripunctata* and, more commonly, *L. quadripunctata* have been recorded from New Zealand (McQuire, 1965).

Because the success of timber preservative/protection systems in a particular port is often greatly influenced by the species and activity of marine borers present, a knowledge of the distribution of *Limnoria* in Australia is being sought.

This paper reports the species of wood-boring limnoriids so far identified (in the absence of a detailed survey), from a limited number of sites. The following table summarises the specimens identified and the structure or timber from which they were recovered.

Distribution of *Limnoria* in Australia

Site	State	Date collected	Where found and comments
(i) <i>L. quadripunctata</i>			
Hobart	Tas.	Dec. 1981	<i>E. globulus</i> pile (unknown age), 12 yr old CCA-treated (32 kg/m ³) <i>E. obliqua</i> pile, 10 mm deep holes in patches by <i>Limnoria</i> , light teredinid.
Williamstown (Hobson's Bay)	Vic.	Feb. 1983	Boat keel
		Apr. 1983	<i>P. radiata</i> bait block, 60 cm below water (attached to float).
Lakes Entrance	"	May 1983	Boat, 1 cm deep in wood adjacent to caulking.
Brighton	"	May 1983	Red gum piles, 50-60 yr old, destroyed <i>Limnoria</i> and teredinid. <i>Limnoria</i> from midtide to mudline (about 4 m deep).
Sandringham	"	Apr. 1983	<i>E. pilularis</i> cross brace, in tidal zone, destroyed <i>Limnoria</i> . In eucalypt piles, to mudline (3 m deep).
Port Welshpool	"	Aug. 1983	Stringybark - probably messmate - pile in No. 2 light. Hit by boat. Built 1939, renovated 1951.
Point Cook	"	Sept. 1983	Eucalypt, 5 m deep (from low tide).
Queenscliff	"	" "	Huon pine from sunken ferry, in water less than 10 years, 4.3 m deep.
		Dec. 1983	<i>P. radiata</i> bait block, 30 cm below low tide after 6 weeks.
St Kilda	"	Oct. 1983	Eucalypt pile
Cape Woolami	"	" "	Eucalypt pile from launch ramp.
Hastings	"	Nov. 1983	Grey gum pile from slipway.
Port Arlington	"	Feb. 1984	Red gum piles, more than 50 yr old, midtide to mudline (3 m deep).
Hanns Inlet, HMAS Cerberus	"	July 1984	Eucalypt pile, tidal zone.
Rhyll, Phillip Island	"	" "	<i>E. obliqua</i> pile, 37 yr old, from low tide zone.
Inner Harbour, Pt Adelaide	SA	Dec. 1983	<i>P. radiata</i> bait block, 30 and 60 cm below low tide, after 6 weeks.

Sydney	NSW	Dec. 1982 Nov. 1983	Untreated and CCA-treated timbers: small specimens just below low tide.
(ii) <i>L. tripunctata</i>			
Williamstown	Vic.	July 1935	Dockyard and pier.
Williamstown (Hobson's Bay)	"	Apr. 1983	<i>E. obliqua</i> cross brace in tidal zone. <i>P. radiata</i> bait block, 30, 60 and 150 cm below a float. Heaviest attack 1.5 m below float (near mud at low tide).
Sandringham	"	Apr. 1983	<i>E. pilularis</i> cross brace, in tidal zone, destroyed <i>Limnoria</i> .
Hanns Inlet	"	July 1984	Eucalypt pile, tidal zone.
Rhyll	"	" "	<i>E. obliqua</i> pile, 37 yr old, from low tide zone.
Arno Bay	SA	Dec. 1983	<i>P. radiata</i> bait block, 30 cm below low tide.
Tumby Bay	"	" "	<i>P. radiata</i> bait block, 60 cm below low tide.
Albany	WA	" 1961	-
Geraldton	"	Oct. 1961	-
Bunbury	"	May 1961	-
Roebourne	"	Apr. 1961	-
Port Hedland	"	Sept. 1961	-
Sydney	NSW	Dec. 1982 Nov. 1983	Untreated and preservative treated timbers.
Port Stephens	"	Nov. 1983	Untreated and preservative treated timbers.
Bowen	Qld	May 1984	Double treated <i>Araucaria</i> sp. (hoop pine) attack around knot after 12 years.
Cairns	"	May 1984	<i>E. maculata</i> treated with 5% arsenic in HTC, after 10 years.
(iii) <i>L. indica</i>			
Sydney	NSW	Dec. 1982 Nov. 1983	Untreated and CCA treated timbers: small specimens just below low tide.
Port Douglas	Qld	May 1984	<i>S. glomulifera</i> pile, light attack after about 12 years.

L. quadripunctata is an ubiquitous species, which, according to Menzies (1959) is found everywhere in the world where the sea water temperature averages between 11.4°C and 16.2°C for at least five successive months of the year. In Australia, this species is most common on the southern coastline, occurring in South Australia and from Hobart to Sydney. Sydney approaches the northerly limit for this species. In November 1983, fewer specimens of *L. quadripunctata* were found in Sydney than in December 1982, and none have yet been found at Port Stephens. At Sydney, the mean surface water temperature is about 23°C in February, and 17°C in August (Knox, 1963).

L. tripunctata is also found worldwide, preferring warmer waters than *L. quadripunctata*. In Australia, this species has been found in various sites south of, and including, Port Hedland and Cairns. Victoria may approach the southerly limit for *L. tripunctata*. It is not yet known if it occurs in Tasmania, where the surface water temperature range is between about 11°C and 15°C (Knox, 1963). *L. tripunctata* does not breed at 10°C, although some breeding occurs at 15°C (Beckman and Menzies, 1960). On the east coast of America, *L. tripunctata* was found at Massachusetts, which is about the northerly limit for this species. The mean annual sea water temperature at Massachusetts is about 11°C, and for five months of the year it rises above 15°C (Beckman and Menzies, 1960). It is noteworthy that in Victoria, *L. tripunctata* has so far only been taken mainly from the slightly warmer upper water layers, whereas *L. quadripunctata* has also been found down to 5 m, i.e. the greatest depth from which destroyed wood has been collected.

L. indica occurs at Sydney and Port Douglas (and possibly between these sites). *L. indica* has previously been recorded from Madras in India, Hong Kong, and the Philippines (Kühne, 1976).

Creosote-treated blocks of *Pinus radiata* have failed due to *Limnoria* (probably *L. tripunctata*) within ten years at Sydney and Kwinana. However, creosote-treated *P. radiata* piles are reported to be in good condition in South Australia after 12 to 20 years (L. Pitcher pers. comm., 1984), even though *L. tripunctata* has been found in South Australia. The difference in performance between these sites appears to be due mainly to differences in

water temperature and thus borer activity. The mean annual temperature in South Australia is about 16°C (range = 14-19°C) and in Sydney is about 20°C (range = 17-23°C) (Knox, 1963). According to Vind and Hochman (1961), when the mean annual water temperature does not exceed 15°C to 16°C, creosote-treated softwoods may last more than 25 years.

Some creosote-treated and double-treated eucalypts are much more resistant to *L. tripunctata* than similarly treated softwoods. For example, creosote-treated sapwood (320 kg/m³) of red stringybark (*Eucalyptus macrorhyncha* F.Muell. ex Benth.) remains unattacked after 24 years at Sydney Harbour. At Baker's Marina in Pittwater at Bayview, Sydney, double-treated piles of spotted gum (*E. maculata* Hook) remain in good condition after 12 years (R. Garland, pers. comm., 1984).

In the tropical-subtropical regions of Australia (north of approximately Brisbane and Carnarvon), *Limnoria* attack appears to be much less severe than in temperate regions, even though the hazard from marine borers, in general (e.g. *Martesia*, Tereidinids, *Sphaeroma*), is higher in the more northerly regions. The light attack produced by *Limnoria* in this area may indicate that other borers attack susceptible wood before *Limnoria* can become established, or that there is a lower population of *Limnoria* in this region, or that the dominant limnoriid species is less destructive than their more southerly relatives. Breeding by *L. tripunctata* is retarded at temperatures above about 28°C (Kampf, 1957); these temperatures are reached in the tropical regions of Australia. This factor was used by Becker and Kampf (1959) to explain the meagre occurrence of *Limnoria* in Indian waters.

Approximately 3000 to 4000 eucalypt piles have been treated with CCA in Tasmania. Some attack by *L. quadripunctata* has been found in CCA-treated (32 kg/m³) messmate piles pulled from Hobart after twelve years (Barnacle et al., 1983); however, some of these piles were considered good enough for re-use as mooring dolphin piles. Other similar piles are still in good condition after 23 years at the mouth of the Tamar River in Tasmania. These results indicate that the hazard from *Limnoria* is lower in the southern waters than at Sydney and Kwinana where CCA-treated eucalypts have been heavily attacked after ten years.

It should be remembered that temperature and salinity, and thus marine borer hazard, can change near a particular pier when, for example, warm effluent is released from factories, or water diversions such as dams and irrigation systems are made up-river.

At a recent workshop, primarily for harbour engineers, the participants indicated that more comprehensive data on marine borer distribution in Australian waters is required, essentially as a pre-requisite for more appropriate protection systems. We agree with that view.

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