Invertebrates Associated with the Marine Wood Boring Isopod, *Limnoria tripunctata*

Thomas D. Sleeter and Bruce C. Coull *

Department of Biology, Clark University, Worcester, Massachusetts 01610

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**Summary.** Untreated wood submerged for 4–6 months and infested with the marine wood boring isopod, *Limnoria tripunctata* Menzies, was analyzed for the associated invertebrate community. Associated with *Limnoria* were aecelous turbellarians, nematodes, the archeannelid *Dinophilus* sp., the tubicolous polychaete, *Polydora* sp., 4 harpacticoid copepods, 2 amphipods and the tanaid, *Leptochelia savignyi*. *Limnoria* ecto-commensals included ciliates and diatoms.

Prior to dying *Limnoria* dug “tomb-like” side tunnels and then crawled inside to expire. All previous reports suggest that *Limnoria* leaves the wood to die.

Knot-free pine boards (9 x 25 cm) were submerged from a float at the William F. Clapp Laboratory, Inc., Batelle-Columbus, Duxbury, Massachusetts, in June 1972. At low tide, the boards were 1 meter above the mud bottom and at high tide 4 metres from the bottom. In late September, October and November, 1972, boards were retrieved and returned to Clark University to a previously stabilized tank with temperature and salinity comparable to that of Duxbury Bay for those months; i.e., 13° C and 34°/00 respectively. The boards were then sawed into equal pieces for study. The cut boards were placed in finger bowls with ambient sea water and examined under a dissecting scope. *L. tripunctata* were observed as they crawled through the fouling and the burrows. Forceps and a scalpel were used to splinter away the wood so as to completely expose the burrows. All organisms were noted as to position and behavior in the burrows or in the fouling and were followed as they crawled over and through the wood. All animals were retrieved with a micropipette, preserved in 10% buffered formalin and later identified.

* Present address: Baruch Coastal Research Institute and Dept. of Biology, University of South Carolina, Columbia, S.C. 29208.

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Observations on *Limnoria tripunctata*

All the gribbles identified in this examination were *L. tripunctata*. *L. lignorum* and *L. tuberculata* are apparently present in the bay, but are rare at our sampling site (Mrs. B. Richards, pers. comm.). *L. tripunctata* infestation was light in the September board but the numbers of animals and burrows increased as did the fouling through November.

The entire *Limnoria* burrow is of equal diameter with smooth walls. Although most of the burrows are straight, they may turn in any direction. The course a burrow takes in the wood is easily followed due to small holes on the roof every few millimeters. The holes aid in water circulation and enable *L. tripunctata* to maintain a fresh supply of oxygenated water. It is this need for fresh oxygen which has made the animal a surface borer. The female occupies the deepest end of the burrow and does most of the excavating. The animals aggregate in the burrows and rarely tunnel into another burrow. Menzies and Widrig (1955) suggest that aggregation is essential for mate selection, encourages deeper burrowing, and increases water circulation. Eltringham (1971) suggests adaptive significance for deeper burrowing as a thigmotactic response to wave action and the reduction of sessile organisms. Deeper burrows in areas subject to tidal fluctuation ensure enough moisture until high tide.

It is generally accepted that *Limnoria* will leave their burrows when conditions approach lethal limits. Henderson (1924) states that *Limnoria* must come out of the wood to die as dead individuals are never found in wood fresh from the sea. However, in all the wood we examined fresh from the sea, dead individuals were observed in the burrows. These dead animals were found in "tomb-like" side tunnels. The "tombs" approximated the contour and size of the individual inside. The animal was in the tomb head first and its telson sealed the entrance, suggesting that the animal dug the tomb to size and died. The dead animals were found intact and in various phases of decomposition. Since adults normally do not start side tunnels, but rather, continue lengthening their original burrow, and these "tombs" were not found in the deeper regions of the burrow, we believe this represents a pre-death behavior. This behavioral pattern would prevent over-crowding of the main tunnel with dead decaying corpses. Furthermore, since the tombs are constructed away from the areas of highest aggregation (i.e., the terminal portions of the burrow) putrefaction of corpses therefore does not obstruct living individuals. In several cases the tombs appeared in burrows where active and healthy individuals were found.

It was not uncommon to see the gribble leave its burrow and crawl on the wood surface. They were often observed feeding on the fouling or on detrital masses in the fouling.
Invertebrates Associated with *Limnoria*

**Associated Organisms**

*Nematoda*. Nematodes were extremely abundant, particularly in detritus, fouling, fecal piles and dead *Limnoria*. In the majority of the burrows, the *Limnoria* fecal pellets gather in one small area. This fecal matter builds up and becomes trapped in the burrow. Nematodes abound in it, feeding on the organic matter and the associated protozoans, diatoms, fungi, and bacteria.

When dead, entombed *Limnoria* were found, nematodes infested the entire body. Although other organisms also occurred here, nematodes were observed actively sucking *Limnoria* remains into their buccal cavity.

Small numbers of nematodes were also found in the brood pouches and on the legs of live *L. tripunctata* but appeared to have no detrimental effect.

*Archiannelida. Dinophilus* sp. was present in October and November. Two species of *Dinophilus* have been reported from the Woods Hole region (Smith, 1964): *Dinophilus gardineri* and *Dinophilus pygmaeus*. However, we were unable to place our species into either of these taxa and must await more material before a description can be given.

*Polychaeta. Polydora* sp., a tubicolous polychaete, was common in October and November. In the fouling and abandoned *Limnoria* burrows *Polydora* tubes were found cemented to the substrate. We never saw *Limnoria* in a burrow that contained *Polydora* tubes. However, *Polydora* would periodically leave its tube and crawl into *Limnoria* occupied burrows. This was the only time we observed the two species in the same burrow. There was not evidence of *Polydora* preying on *L. tripunctata* as Reish (1954) has suggested for other polychaetes, and due to their relative sizes we suspect that *Polydora* feeds on the smaller associated organisms; i. e., copepods, protozoans, etc.

*Copepoda. Harrietella simulans, Paramphiascoides commensalis, Paralaophonte congenera congenera* and *Paramphiascella fulvojasciata* were found throughout the community. They occurred in the *L. tripunctata* burrows and in the fouling. In many burrows, the copepods greatly outnumbered the *Limnoria* and often large swarms (10–20) of copepods were discovered in abandoned burrows. In the October samples *H. simulans* was the most prevalent species, but by December, *P. fulvojasciata* was the dominating form.

*H. simulans* was reported as being commensal on *Limnoria lignorum* by Vervoort (1950), Stephensen (1936) and Wells (1964). Coull and Lindgren (1969) and Pinkster (1968) state *H. simulans* is not necessarily commensal on *Limnoria*, but with it or hiding in its burrows. Very careful examination in this study revealed no direct commensal relationship between any of the copepods and the gribble. Similar experiments were
run as those by Coull and Lindgren (1969). Similarly, it was found that the copepod will attach itself to *L. tripunctata* only when no other suitable substrate is available. However, another less direct relationship does exist between the two in that the copepods feed on *Limnoria* fecal pellets. Fecal piles that build up in the burrows as well as organic debris trapped in the fouling are regular feeding spots for the copepods. We also observed copepods, particularly *Paramphiascella* feeding on dead, entombed gribbles.

**Amphipoda.** Two gammarids, *Corophium* sp. 1 and *Corophium* sp. 2, were rare and inhabited pre-existing *L. tripunctata* burrows. These were found only in the November board suggesting, as does the literature, that they will only inhabit the wood after *Limnoria* has performed extensive excavation.

**Other Taxa.** Unidentified multicolored acelolous turbellaria were common in October and November and one *Leptochelis savignyi* (Tanai-daceae) was found in November.

**Ectocommensals.** Three ectocommensals (2 are shown in Fig. 1) were observed on *L. tripunctata*: 1. the peritrichous ciliate *Vorticella* sp. which
occurred on the isopod's body cilia and appendages; 2. the green hetero-
trichous ciliate *Microfolliculina limnoriae*, on the dorsal portion of the
abdominal somites and the telson; and 3. unidentified octagonal diatoms
on the appendages. *Microfolliculina* has been reported as an ectocommen-
sal by several authors (e.g. Henderson, 1924; Brunell, 1963) but we are
unaware of any previous report of *Vorticella* and diatoms as ectocommen-
sals. The effect of these ectocommensals on *Limnoria*’s well being is
unknown.

All the members of the community excluding *Limnoria* are scaven-
gers. The nematodes are the chief scavengers with the copepods holding
a secondary position. Both animals were found throughout the system
and seem to utilize all the available organic matter: fecal matter, dead
organisms, and various forms of detritus.

The burrows of *L. tripunctata* offer a good source of protection and a
variety of niches to all the associated organisms, while the waste products
of *Limnoria* offer a readily available food source as well as a substrate
for bacteria, fungi, diatoms and protozoa.

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Mr. Thomas D. Sleeter  
Department of Biology  
Clark University  
Worcester, Massachusetts 01610, USA