Vertical distribution of *Sphaeroma terebrans* (Isopoda) on submerged stationary structures

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KURZFASSUNG: **Vertikale Verbreitung von Sphaeroma terebrans (Isopoda) an untergetauchten Hafenbefestigungsanlagen.** Im Hafengebiet von Cochin (76° 14' E; 9° 57' N) wurde die vertikale Verbreitung des holzbohrenden Isopoden *Sphaeroma terebrans* untersucht. *Sphaeroma* lebt, wie der Mollusk *Martesia striata,* im Holz untergetauchter Pfähle. Unmittelbar nach dem Herausziehen von 12 Pierpfählen verschiedener Länge wurde das Verbreitungsmuster der Bohrlöcher beider Organismen registriert. Es stellte sich dabei heraus: 7 Pfähle wiesen *Sphaeroma*-Löcher bis zu einer Tiefe von 45 cm unter dem Hochwasserstand auf, 5 bis zu einer solchen von 60 cm. *Martesia*-Löcher dagegen traten an den erwähnten 7 Pfählen erst ab 60 cm Tiefe auf, an den anderen 5 erst ab 75 cm. Von diesen Tiefen bis zum Boden war *Martesia* der alleinige Bewohner. Im vertikalen Verbreitungsmuster der beiden Arten gibt es also praktisch keine Überlappungszone. Die Ursache für diese Segregation wird primär in der Raumkonkurrenz gesehen und in dem größeren Vermögen von *Sphaeroma,* gelegentliches Trockenfallen zu ertragen.

INTRODUCTION

In the Cochin Harbour, 76° 14 'E and 9° 57 'N, jetty piles are pulled out for replacement after a service life of three to four years. These piles provide an excellent opportunity to study the vertical distribution of *Sphaeroma* and other boring organisms attacking the same log. During the present investigation, twelve logs were examined soon after they were pulled out.

The burrows made by *Sphaeroma* can be easily distinguished from burrows made by other organisms on the basis of their external appearance. The external openings of *Sphaeroma* burrows are comparatively wide (3–4 mm in diameter), and the burrow itself is of uniform diameter throughout its length, whereas the external openings of *Martesia* burrows are comparatively small (1–2 mm in diameter). In most cases the distal ends of the shells slightly protrude through the opening.

For studying the number of burrows in a given surface area the number of burrows at each level was counted in an area 3" × 1" (7,6 × 2,5 cm), the greater distance being along the horizontal plane. All the numbers quoted represent averages of four counts in areas along four quadrants at each level. Since the intertidal zone appeared to be the region of intense attack, the counts were made 15 cm apart in this region and 30 cm apart below it. The data thus collected are given in the accompanying table.

RESULTS AND DISCUSSION

From the table it will be seen that in all samples of timber examined, *Sphaeroma* is the sole occupant down to a depth of 45 cm from the high water level, the maximum density being noticed close to the high water level. *Martesia* make their first appearance on a few logs at a depth of 60 cm, and in all cases where *Martesia* is present, *Sphaeroma* appear to be absent below 45 cm under high water level. But on five logs on which *Martesia* are absent at a depth of 60 cm, a few specimens of *Sphaeroma* are present down to that level. Below 60 cm depth *Sphaeroma* is totally absent, and only *Martesia* is noticed down to the mud level. It will thus be seen that on submerged vertical structures in the Cochin Harbour, where both *Sphaeroma* and *Martesia* occur together, they seem to show a marked degree of segregation, *Sphaeroma* never occurring at the same level as *Martesia.*

Previous records on the vertical distribution of *Sphaeroma* are rather scanty. BARROWS (1919) has observed that *Sphaeromidae* are largely shallow water forms. However, GERSTAECKER and ORTMANN, as quoted by BARROWS (1919), are of the opinion that some marine species have been dredged from a depth of 75 fathoms. PILLAI (1955) observed that the attack of *Sphaeroma* is heaviest in the intertidal zone. In the Australian waters, *Sphaeroma quoyana* was found to attack wood only between tide levels in some places but never exceeded two to three feet below low water level. During the present studies also, the author was able to collect *S. terebrans* from sunken pieces of wood obtained from depths of two to three meters. In one case *Sphaeroma* burrows were noticed at depths two meters below low water level on a stake pole, of which 10 meters were under water. But in both of the above instances, the water in the area was only slightly saline, thereby making *Sphaeroma* the only boring organism present on the timber at the time of observation.

PILLAI (1955) has observed that *Sphaeroma* is capable of inhabiting waters shallower than those inhabited by the Molluscan borer *Martesia* because the young ones of *Sphaeroma* leave the brood pouch for fresh attack in a fairly advanced stage of development, and are therefore capable of withstanding occasional exposure, whereas the larvae of *Martesia* at the time of fresh settling are very delicate and must necessarily always be under water. This observation about the capacity of *Sphaeroma* to survive occasional exposure seems to be correct. It does not, however, explain why *Sphaeroma* avoids the deeper levels.

It is quite possible that the distribution of *Sphaeroma* is controlled to a very great extent by the availability of food. Recent investigations (LANE 1959, BECKER 1959) have shown that *Limnoria* depends to some extent for its food on the fungal growths along the sides of their burrows. In an unpublished paper on the habits, structure and development of *S. terebrans,* I have shown that even though cellulose digesting enzymes are present in the alimentary tract of this species, it is fully capable of carrying on its metabolic activities only with the addition of supplementary food in the form of algae and other suspended organic matter. Thus it may not be wrong to presume that the surface layer of water, which contains plenty of suspended organic particles, may favour the greater density of *Sphaeroma* in this region. But it will be noted that all the logs examined during the present study were pulled up

Table 1

Average counts of *Sphaeroma* and *Martesia* holes at different depths

Log. No.	*0* S	M	*15 cm* S	M	*30 cm* S	M	*45 cm* S	M	*60 cm* S	M	*75 cm* S	M	*90 cm* S	M	*105 cm* S	M	*120 cm* S	M	*150 cm* S	M	*180 cm* S	M	*210 cm* S	M	*240 cm* S	M	*270 cm* S	M
1	72	—	65	—	54	—	40	—	—	3	—	3	—	3	—	2												
2	71	—	60	—	58	—	50	—	—	2	—	2	—	1	—	1												
3	57	—	50	—	34	—	30	—	24	—	—	1	—	1	—	1	—	1	—	1								
4	54	—	30	—	10	—	3	—	4	—	—	1	—	2	—	2	—	3	—	3	—	4	—	1				
5	75	—	42	—	13	—	4	—	4	—	—	1	—	1	—	2	—	3	—	3	—	2	—	3				
6	33	—	18	—	7	—	2	—	2	—	—	2	—	1	—	1	—	1	—	1	—	1	—	2	—	3	—	3
7	75	—	63	—	35	—	8	—	—	1	—	1	—	1	—	1	—	1	—	1	—	1	—	2	—	1		
8	78	—	58	—	46	—	40	—	—	1	—	1	—	1	—	1	—	1	—	1	—	1	—	1	—	3	—	2
9	63	—	43	—	40	—	36	—	—	1	—	1	—	1	—	1	—	1	—	1	—	1	—	1				
10	39	—	29	—	28	—	20	—	—	2	—	2	—	1														
11	57	—	25	—	20	—	16	—	—	2	—	1	—	1	—	2	—	3	—	3	—	3	—	2				
12	42	—	39	—	29	—	24	—	18	—	—	2	—	2	—	1	—	1	—	1	—	2	—	2	—	2		

S Number of *Sphaeroma* holes per unit area.

M Number of *Martesia* holes per unit area.

0 High water level; all other figures represent depths below that level.

from very close to the shore, where the depth did not exceed three meters. In this region the water is homogenous in composition (salinity, O_2 content, temp. and turbidity) along the entire depth, especially in view of the fact that water is constantly agitated by waves and tidal currents. Therefore there is no stratification of water in this region and hence no greater concentration of suspended organic particles towards the surface layer.

Moreover, the food of *Martesia* also consists of suspended organic matter and planktonic organisms. In spite of this situation, *Martesia* are found at greater depths than *Sphaeroma.* It is not quite likely therefore that food is the important factor determining the vertical distribution of these organisms.

On the other hand, it is more likely that competition for space is the chief factor which determines vertical distribution. As has already been stated, *Sphaeroma* is capable of withstanding prolonged exposure. Specimens have been kept alive in moist cloth for 12 to 16 hours. *Martesia,* however, is incapable of tolerating such exposure even for short intervals. Consequently, *Martesia* is restricted to regions which are permanently submerged, leaving the upper regions free for occupation by *Sphaeroma.* This view is supported by the fact that in regions of low salinity, where *Martesia* does not occur, *Sphaeroma* have been found two to three meters below low water level. It is therefore evident that the food habits of *Sphaeroma* and *Martesia* are more or less the same and that the chief factor which determines their distribution is the struggle for appropriate space.

SUMMARY

1. *Sphaeroma terebrans* and *Martesia striata* occur on jetty piles in the Conchin harbor (76° 14' E and 9° 57' N).
2. On a given jetty pile or log, however, both species live at different depths. There is practically no overlap in their vertical distribution.
3. A total of twelve logs were examined. On seven of these logs *Sphaeroma* holes occured down to a depth of 45 cm below high water level, on the other five down to 60 cm. *Martesia* holes, however, began to appear on the first seven logs at 60 cm depth and on the other five at 75 cm depth. From these levels they occured right down to the bottom (maximum depth: 270 cm).
4. It is suggested that this vertical segregation is primarily caused by the greater capacities of *Sphaeroma* to withstand prolonged periods of exposure to air and by competition for space.

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