The Effect of Salinity on Some Endocommensalic Ciliates from Shipworms

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The ciliates, *Nucleocorbula adherens, Boveria teredinidi, Trichodina balakrishnia, Thingmozoon fencheli* and *Nyctothereus marina,* live inside the mantle cavity of the shipworms in the estuaries and backwaters of the south-west coast of India. Seasonal incidence and relative abundance of these ciliates showed that they were more abundant during the low saline than the high saline periods. Eventhough these ciliates can endure higher salinities through gradual acclimatization of their habitat it was found that they prefer low salinity for active growth and healthy existence.

The present study is an attempt to know the effect of salinity on the ciliates living in the mantle cavity of the shipworm, *Nausitora hedleyi* from the Cochin backwaters. Salinity is one of the most important physical factors that affects the organisms in this estuarine habitat. During and after the South-west monsoon, the salinity of the water in this estuary is very low due to the freshwater drained in by the rivers which pushes out the sea water. This area is a unique environment, very peculiar and has already been described in earlier papers (Nair, 1965; Menon & Nair, 1967; Menon *et al.,* 1971; Santhakumari & Nair, 1969, 1975; Vannucci *et al.,* 1970). The hydrography of this backwaters has been studied mainly by Ramamirtham & Jayaraman (1960, 1963). Sankaranarayanan & Qasim (1969) described the nutrients in relation to environmental characteristics. *N. hedleyi,* the chief host of these ciliates, can withstand wide ranges of salinity than its allied species. Santhakumari (1975) studied the salinity tolerance of the hydroid of *Eutima commensalis* from this region. Fenchel (1965) described the salinity tolerance of a few endocommensalic ciliates, *Ancistrum mytili, Peniculistoma mytili, Ancistrum caudatum* and *Thigmophrya saxicava,* from Scandinavian waters. Santhakumari & Nair (1970, 1973 a) described the taxonomy of these ciliates, *Nucleocorbula adherens, Boveria teredinidi, Trichodina balakrishnia, Thigmozoon fencheli* and *Nyctotherus marina.* The results of the seasonal incidence of these ciliates (Santhakumari & Nair, 1973 b) showed that they were more abundant during low saline than high saline periods.

Materials and Methods

N. hedleyi were collected from infested test panels. Two sets of experiments were conducted (1) during August when the salinity of the habitat ranged between 1–2‰ and (2) during December when the salinity varied from 15 to 18‰. The duration of each experiments was fixed at after preliminary tests which indicated that in an unfavourable salinity 100 percent mortality would be reached within this period. The criterion of death was the complete cessation of ciliary movement and all visible signs of life. Observations were made on the survival of ciliates in different salinities at intervals of 15 min. The tests were wound up after a period of 1 h. The ciliates used for the tests were kept for 30 min in control 'seawater' and 'cleaned' in several changes of filtered seawater before transfer to 0, 3, 5, 10, 15, 20, 25, 30 and 35 and 39‰ salinities.

Results and Discussion

The results of the survival of *Nucleocorbula adherens* in different grades of salinity are presented in Fig. 1.

On exposure to control seawater, the ciliates swam energetically in all directions with rhythmic beats of the cilia at the aboral end. Very active retraction and protrusion of the oral cilia were also discernible. It was observed that in 39, 35 and 30 salinities none survived after 15 min. But in 25‰ survival was 6.3% after 30 min. In all these grades the body contracted and assumed a slender appearence. In 20 and 15‰ the percentage of survival was 10 and 20 respectively. But in salinities 10, 5, 3 and 0‰ the survival was 83.3, 91.7, 92.9 and 66.7% respectively after one h of exposure.

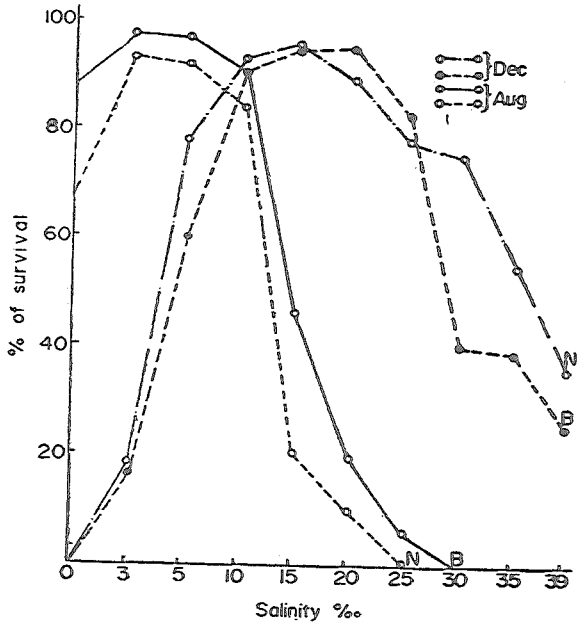

Fig. 1. Salinity tolerance of *Nucleocorbula adherens* (N) and *Boveria teredinidi* during August and December

The rate of survival of *Boveria teredinidi, Trichodina balakrishnia, Thigmozoon fencheli* and *Nyctotherus marina* is presented in Fig. 1.

The results show that the range of salinity most suitable for the existence of *B. teredinidi* is 0–15‰ of *T. balakrishnia* 0–16‰ of *T. fencheli* 0–10‰ and of *N. marina* 0–5‰. A distinct stress of salinity is evident in higher salinities such as 25‰ and above in the case of *N. adherens, B. teredinidi* and *T. balakrishnia*. In the case of *T. fencheli* and *N. marina* the stress is evident only from 20‰ upwards.

Another set of experiments were conducted during December when salinity of the habitat ranged from 15 to 18‰. The methods employed were the same as in the previous tests. The survival rate of the organisms are presented in Fig. 2. No species could survive in freshwater for a period longer than 15 min during the period. In higher grades the discomfort was evident and the percentage of survival was low. The most suitable salinity is in the range 10–20‰.

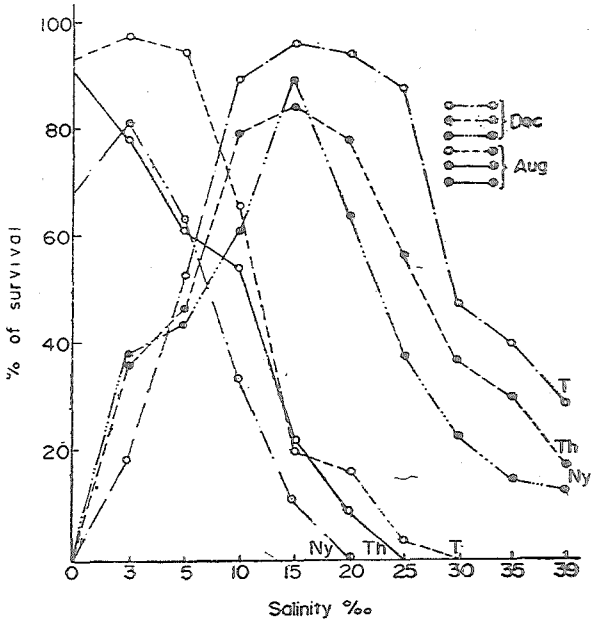

Fig. 2. Salinity toterance of *Tricodina balakrishnia* (T); *Thigmozoon fencheli* (Th) and *Nictotherus marina* (Ny) during August and December

The results of the salinity tolerance of the 5 species of ciliates determined twice during the year, reveal a very interesting shift in the nature of the tolerance of the ciliates to different salinities. Whereas in the low saline period of August higher salinities are positively detrimental, during the medium salinities of December the ciliates are apparently affected by low as well as high salinities. Unfortunately, another test for finding out the tolerance of these ciliates during the high saline periods of the premonsoon could not be carried out owing to the non-avilability of sufficient number of specimens. During August a salinity lower than 10‰ seems to be the most favourable for *N. adherens, B. teredinidi* and *T. balakrishnia, T. fencheli* and *N. marina* prefer much lower salinities. Salinities

above 30‰ were distinctly lethal for *N. adherens*. *B. teredinidi* and *T. balakrishnia* and for the other two species a salinity of 20‰ and above was found to be fatal within a short period of time. This trend showed a noticeable change as the salinity of the ambient water rose during the course of September, October and November. From the results of the second experiment, it is clear that the ciliates seem to survive even in high salinities. The optimum range for *N. adherens,* B. *teredinidi and T. Balakrishnia* seems to be from 10–20‰. A series of environmental stress such as very high or very low temperature or salinity is likey to affect the host species significantly and in turn the commensals harboured in their bodies. No commensal occur throughout the year. Each species occur during its favourable hydrographical conditions when it exist in the habitat. It may be the low or medium salinities of the monsoon and post-monsoon or the hot highly saline period of pre-monsoon when growth and reproduction of typical marine species are vigorous. It is possible that there is high mortality among both juvenile and grown up individuals, yet so many may be produced that large numbers become established and may succeed in surviving the perils of the less favourable seasons of the year. As has been stated earlier, the exact life span of these ciliates is not known. It is also not clear how the ciliates skip over unfavourable conditions. It is also not understood how fresh infestation takes place or what happens to these commensals on the death of their host. It is possible that on release into the ambient water from the host's body after its death, the commensals may be drawn into the mantle cavity of new hosts through the physiological current of water. Many of these ciliates fluctuate in numbers so greatly that during some months of the year they are scarce while in favourable periods they may be abundant. 100 per-cent mortality was noticeable in the lower grades quite contrary to the condition noticed during August. This suggest a process of effective acclimatization of these ciliates. This feature has been noticed in the host animal also.

There is considerable variations in salinity of the surface waters which range from 1.7 to 32.9‰. The lowest records were made in August while the highest were noticed in summer. It is clear that the shipworms with their contained associates experience a very wide range of salinity during the course of an year. The seasonal incidence of these organisms (Santhakumari & Nair, 1973) suggests that many of them do occur in the body of their hosts throughout the year, with fluctuations in their abundance. This suggests that the ciliate associate of *N. hedleyi* are euryhaline as the host species. The capacity to effectively adapt to wide changes in salinity may involve two factors: (1) an active regulation of osmotic pressure within the body which serves to insulate the body from the salinity changes, (2) a wide tolerance in the osmotic pressure of the body fluids with little regulative capacity. The protozoans of the present study possess no body fluids. Therefore, osmotic regulation if exists at all, must be intracellular. The occurrence of contractile vacuoles has been noticed in these forms and the possibility of their effective role should not be forgotten in this respect. Their ability to survive in water of very low salinities may be by virtue of the presence of contractile vucuoles which function as osmoregulatory mechanisms.

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