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**Salinity Tolerance & Preference of Enchytraeid Oligochaete Enchytraeus barkudensis**

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Preference and tolerance capacities of a littoral oligochaete, *E. barkudensis* from the southern lighter channel, Visakhapatnam Harbour were studied over a wide salinity ranges (Fresh water - 30°/oo) in vitro. It showed more than 60% survival in all salinities even after 2 weeks except in fresh water. It always preferred higher salinities in all combinations except 25 - 30°/oo combination. Both survival and preference values obtained can be attributed to the distribution of the worm above mid water mark at the Harbour.

Several members of oligochaeta, in particular of family Enchytraeidae inhabit a variety of environs. Tolerance capacities of the enchytraeid worms to varying salinities, temperatures and other abiotic factors are reported. Since abiotic factors influence largely the organisms in limiting their population abundance and distribution, knowledge of their ecophysiology is of importance in evaluating their distribution. However, studies on the effect of the interaction of these abiotic factors in marine/brackish water oligochaete worms are scanty.

The enchytraeid worm *Enchytraeus barkudensis* occurs fairly in large numbers along with the littoral oligochaete *Pontodrilus bermudensis* in the southern lighter channel, Visakhapatnam Harbour, where the salinity fluctuates widely (6 - 33°/oo) than the other hydrographical parameters. This species has been reported earlier from Chilka Lake and Ennur Backwaters, where the salinity ranges from 10-30°/oo. It occurs considerably in large numbers at mid tide level and above in the Visakhapatnam Harbour, contributing a high biomass value. Hence salinity tolerance and preference experiments on *E. barkudensis* have been made as part of ecophysiological investigations to elucidate its distribution.

Method of collection and maintenance of worms were same as described earlier. Two sets of experiments, viz. tolerance capacities and preference over different salinity combinations were conducted at room temperature (30 ± 1°/oo).

Tolerance capacity was studied by the method of Ganapati and Subba Rao and expressed as percentage survival. Worms of equal size (15-17 mm) were chosen and the number of experiments varied from 6 to 10. In the preference experiments the apparatus used was a simple alternative chamber (perspex petridish of 78 mm diam. made into 2 equal halves with a plastic strip) constructed based on the principle of Jansson. There was no leakage in between the 2 halves of the chamber. A layer of sand as substratum was offered at the bottom to facilitate movements of the worms. The bottom of the chamber was perfectly flat and did not permit any angle of inclination. Sea water of different desired salinities was put into each chamber with the help of a syringe. The suitability of the alternative chamber was tested by measuring the salinity gradient in 2 halves after 24 hr with out animals (Fig. 1).

During experimentation the chambers were covered with perspex lid to avoid evaporation and also to provide darkness at room temperature. Equal number of worms (10) were placed in each half of the chamber. Preliminary observations showed that the worms moved freely in the chambers during the first 30 min. A period of 1 hr was found enough for the worms to choose a favourable side. The entire experiment was, however, allowed for a maximum period of 3 to 4 hr to enable the worms to select and settle in the least unfavourable side. At the end of the experiment the perspex lid was opened and the water sucked with a syringe to arrest the movement of organisms. The sediment was carefully removed and transferred gently into clean petridishes containing sea water of experimental salinities. The number of worms present in each half was counted carefully. No mortality was observed during the course of the experiments. The results, averages of a number of experiments (7 to 20), were treated with the chi-square test.

*E. barkudensis* showed fairly good ability to withstand wide salinity variations [Fresh water (FW)
to 30°/oo; Fig. 2]. The low survival values in FW may indicate its inability to adapt. Owing to great tolerance capacities of the worms we could not get the LD50 curves in all the salinities except in FW even by 16th day. In wide range of salinities (2.5-30°/oo) 60% survival, ingeneral, even after 16 days clearly shows its euryhaline nature.

In the preference experiments 28 salinity combinations (FW to 30°/oo) were offered to assess the preference of the species over wider and narrower ranges (Fig. 3). When a choice between 2 different salinities was offered the worms always preferred higher salinity. But when a choice between 30 and 25°/oo was offered, they preferred lower (25°/oo) salinity. In extreme combinations E. barkudensis preferred higher salinities (Fig. 3). The preference was not distinct in closer salinity combinations. The chi-square values obtained are significant at 5% level only when a salinity combination with a minimum difference of 10 to 12.5°/oo was offered (Table 1).

Marine oligochaetes are well known for their wide geographical distribution8,17-20. Since salinity is a limiting factor, euryhalinity becomes one of the prerequisites for adapting to ecologically and geographically varying environments21. Therefore, a close correlation between the distribution of fauna and salinity can be demonstrated.

Jansson8 reported that the enchytraeid oligochaetes, Akedrillus monospermatecus and Marionina precitellochaeata survived well in salinities 1.25 to 20°/oo and 2.5 to 10°/oo respectively. The former species was

Fig. 2—Survival percentage of E. barkudensis in 16 days in different salinities at 30±1°C

Fig. 3—Preference of E. barkudensis to different salinity concentrations

Table 1—Chi-square Values and Probability Levels Showing Salinity Preference of E. barkudensis

<table>
<thead>
<tr>
<th>Salinity combination</th>
<th>Chi-square value</th>
<th>Salinity combination</th>
<th>Chi-square value</th>
</tr>
</thead>
<tbody>
<tr>
<td>30-FW</td>
<td>7.2*</td>
<td>20-2.5</td>
<td>5.2*</td>
</tr>
<tr>
<td>30-2.5</td>
<td>5.2*</td>
<td>20-5</td>
<td>4.18*</td>
</tr>
<tr>
<td>30-5</td>
<td>4.05*</td>
<td>20-10</td>
<td>2.45+</td>
</tr>
<tr>
<td>30-10</td>
<td>5*</td>
<td>20-15</td>
<td>2.45+</td>
</tr>
<tr>
<td>30-15</td>
<td>4.42*</td>
<td>15-FW</td>
<td>5.62*</td>
</tr>
<tr>
<td>30-20</td>
<td>0.97+</td>
<td>15-2.5</td>
<td>3.04*</td>
</tr>
<tr>
<td>30-25</td>
<td>0.05+</td>
<td>15-5</td>
<td>1.68*</td>
</tr>
<tr>
<td>25-FW</td>
<td>9.8*</td>
<td>15-10</td>
<td>0.8*</td>
</tr>
<tr>
<td>25-2.5</td>
<td>9.25*</td>
<td>10-FW</td>
<td>4.8*</td>
</tr>
<tr>
<td>25-5</td>
<td>10.95*</td>
<td>10-2.5</td>
<td>2.59*</td>
</tr>
<tr>
<td>25-10</td>
<td>3.87*</td>
<td>10-5</td>
<td>1.15+</td>
</tr>
<tr>
<td>25-15</td>
<td>1.93+</td>
<td>5-FW</td>
<td>1.8+</td>
</tr>
<tr>
<td>25-20</td>
<td>1.43+</td>
<td>5-2.5</td>
<td>0.13+</td>
</tr>
<tr>
<td>20-FW</td>
<td>11.04*</td>
<td>2.5-FW</td>
<td>0.25+</td>
</tr>
</tbody>
</table>

*significant; + not significant; FW = fresh water
considered as more euryhaline and widely distributed than the latter. *M. southerni* showed high survival values in rain water to 15% and about 50% survival in salinities from 20 to 30% after a week. Sanders *et al.* reported the distribution of more euryhaline oligochaetes in upper few centimeters of the sediment than the less tolerant species occurring in deeper sediments. *M. subterranea* a well known enchtraeid from the coastal ground water showed good survival values in salinities 1.3 to 15% and was regarded as very euryhaline. *Grania postclitellochaeta* tolerates salinities from 11 to 35%. Erseus and Lasserre presumed that *G. postclitellochaeta* was more euryhaline since it occurs intertidally in the North Sea. Both *M. achaeta* and *M. spicula* were reported to tolerate salinities > 25%. American representatives of cosmopolitan species, *M. achaeta* and *M. spicula* exhibited greater abilities to withstand wide fluctuations of temperature and salinity with minimum of more than 25°C and 15%. Distribution of 6 species of polychaetes was explained by their abundance and capacity for salinity tolerance in the Indian tropical brackish water zones of Adayar estuary. Salinity tolerance range of *P. bermudensis* was in agreement with the salinity fluctuations in its natural habitat. In the present study, *E. barkudensis* tolerated salinities from 2.5 to 30%. Long term survival is possible in *E. barkudensis* in wide range of salinities. The low survival values in fresh water may be due to its inability to adapt to fresh water because of its brackish water inhabitancy at the local harbour. High survival salinity range of 15 to 30% compares favourably with those of other euryhaline enchtraeids. Salinity tolerance capacities of *E. barkudensis* also match with those reported for *P. bermudensis*.

Distribution of several oligochaete species in the field was also explained by their salinity preference. The euryhaline oligochaetes, *A. monospermatecus* and *M. preclitellochaeta* preferred salinities 2.5 to 6% and 0.2 to 2.5% respectively, which were in agreement with the habitat salinities at the time of their collection. A salinity preference of 3% of *M. southerni* was attributed to its abundance in mid to lower shores. In an enchtraeid, *Lumbricillus reynoldsoni* a salinity preference of <15.5% was attributed to its restricted distribution in the upper shore, exposed to rain fall and low salinities. In contrast *L. lineatus* exhibited no such preference over a wider range of salinities from distilled water to 45% and showed a wider distribution.

Present results clearly show high survival capacities of *E. barkudensis* in salinities 15-30% and their preference to higher salinities. These results also reflect the distribution of the worm above mid water mark showing a distinct demarkation from the less tolerable tubificids which occupy low water mark at the southern lighter channel, Visakhapatnam Harbour. The quantitative samples indicate that there is a gradual decline in abundance towards low water mark as well as towards the point of lower salinities.

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References