

## Observations on the Salinity Tolerance of the Hydroid of *Eutima commensalis*

## Beobachtungen zur Salinitätstoleranz des Hydroiden von *Eutima commensalis*

## Observations sur la Tolérance à la Salinité de la Méduse hydroïde d'*Eutima commensalis*

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**Abstract:** The hydroid of *Eutima commensalis* is endocommensal on the gill lamella of the shipworms in the estuaries and backwaters of the south west coast of India. The seasonal incidence study showed that this hydroid was absent during the very low saline monsoon period. This prompted an enquiry into the salinity tolerance. It was found that though it can endure a wide range, the optimum salinity range was from 15 to 20 ‰.

**Zusammenfassung:** Die Hydroiden von *Eutima commensalis* leben als Endokommensalen auf den Kiemenblättchen von Bohrmuscheln in den Flutmündungen und Lagunengewässern der indischen Südwestküste. Während der durch sehr niedrige Salinitäten gekennzeichneten Monsunperiode fehlen diese Hydroiden, was auf eine stationäre Salinitätstoleranz hindeutet. In entsprechenden Gradientversuchen zeigte sich, daß *E. commensalis* zwar einen weiten Salinitätsbereich ertragen kann, daß aber das Salinitätsoptimum zwischen 15 und 20 ‰ liegt.

**Résumé:** La méduse hydroïde d'*Eutima commensalis* est un endocommense des lamelles branchiales du taret dans les estuaires et les eaux stagnantes de la côte sud-ouest des Indes. L'étude de son incidence saisonnière a montré que cette méduse hydroïde était absente pendant les périodes de très faible salinité correspondant à la mousson. C'est cette observation qui nous a engagé à entreprendre une étude sur la tolérance de cette forme à l'égard de la salinité. Il a ainsi été noté que, bien qu'elle puisse supporter des taux très différents, l'optimum de salinité pour la méduse hydroïde d'*Eutima commensalis* se situe entre 15 et 20 ‰.

### Introduction

A study of the influence of the various environmental factors on the life and activity of the marine and backwater animals is of interest from an ecological point of view. Salinity is one of the most important physical factors that affects the organisms in the estuarine habitat. Variations in the salinity of the sea water may affect the organisms through specific gravity control and variations in osmotic pressure. This factor is very

important in the habitat of the mollusc *Nausitora hedleyi*, the chief host of the commensalic hydroid of *Eutima commensalis*, in the Cochin backwaters on account of the seasonal monsoons and heavy discharge of fresh water which considerably affects the salinity of the medium. Salinity may affect directly the functional and structural properties of organisms and indirectly by modifying the species composition of the ecosystem, that is, by changing certain biotic conditions of the over-all ecological situation (KINNE, 1964). PANIKKAR (1950) has discussed in detail the physiological aspects of adaptation of organisms to estuarine conditions. In this estuary, the changes in the salinity of the medium are rapid and the salinity continues to be very low for a long period of time. These circumstances suggested that some environmental control of the commensalic organisms might exist in this area especially when great fluctuations of salinity occur. Since information on the physiological behaviour of commensalic organisms in general and that of timber-destroying organisms in particular of tropical estuarine habitats is lacking, these studies were initiated to observe the behaviour of the commensals of these organisms occurring in the Cochin harbour in different salinities. These observations are of particular importance since the salinity in this area undergoes rapid fluctuations. The annual range of water temperature in this locality is small. The salinity fluctuations are experienced chiefly by the animal and plant communities inhabiting the littoral area since the deeper layers are not subjected to as great a dilution as the surface layers. The wharf-pile fauna comes under this category experiencing this stress. Here, there is the influence of the South-West monsoon during the period May-August and that of the North-East monsoon later during November-December. During the peak of the monsoon, the reason for the apparent absence of the hydroid of *Eutima commensalis* in this locality has not yet been determined. Its appearance during the post-monsoon period when the salinity of the ambient water shows an upward trend and its continued existence, growth and reproduction throughout the period of the post-monsoon as well as the pre-monsoon until about June and their apparent disappearance from its host during the month of June consequent on the onset of heavy rains suggested the overriding influence of salinity of the medium on this organism. This prompted an enquiry into the reactions of this hydroid to this physical factor of the environment.

### Material and Methods

Host specimens for the present study were collected from infested fest panels (15 x 10 x 5 cm) installed at the quay of the Oceanographic Laboratory in the Ernakulam channel.

Water of different grades of salinity ranging from 0‰ to 35‰ were used for the experiments. Sea water collected from the Ernakulam channel was filtered through Whatman No. 43 filter paper and suitably diluted by the addition of distilled water and used for the tests. In order to obtain higher grades, a stock solution of crude common salt with lake water was prepared and diluted with aerated distilled water. The salinity of each grade was tested by Knudsen-Mohr's method. The containers (Petri-dishes) used for the experiments were cleaned in a mixture of alcohol and hydrochloric acid, rinsed several times in tap water followed by distilled water, and dried. The solutions of different grades of salinity were aerated once in every two hours during the daytime. Pieces of etenidia from healthy shipworms containing the hydroids were placed in the Petri-dish and kept at room temperature (27° - 30 °C). To avoid evaporation the containers were covered with glass plates. Any loss by evaporation was made up by the addition of distilled water.

Five indices were employed to determine the condition of the hydroids during the progress of the experiment.

1. **Colonies disintegrated.** Polyps which were apparently dead lost their distinct outlines by disintegration and may even disappear as a result of dissolution.
2. **Colonies dead.** Colonies were recorded as dead when the polyps became inactive without showing any movement even after replacement in natural sea water.
3. **Colonies inactive.** Such colonies showed only feeble movements, the polyps were not fully relaxed and tentacles only gently waving. The movement of food particles within the coenosarc, too, was slow. Colonies were somewhat contracted and reacted only slightly to teasing with a needle.
4. **Colonies less active.** Colonies under this category showed signs of movement and were sensitive to disturbance and teasing with a needle. The stress of an unfavourable condition was evident from the nature of activity which was less than that in colonies in natural conditions.
5. **Colonies active.** Active colonies appeared fresh and healthy, the hydrocaulus was fully extended, also the stalk, the polyp and the tentacles etc. All the polyps of the colony exhibited characteristic feeding movements with quick response to any external disturbance. The movement of the food particles inside the coenosarc was rapid and could easily be seen.

In all the experiments the reactions of the colonies were examined at the end of 1, 2, 6, 18, 24, 42, 72, and 96 hours.

For these tests the hydroid colonies of *Eutima commensalis* were collected during December when the salinity of the medium in the habitat ranged from 15 to 22 ‰. The colonies were tested against the following salinity grades: 0, 5, 10, 15, 17, 20, 25, 30, and 35 ‰.

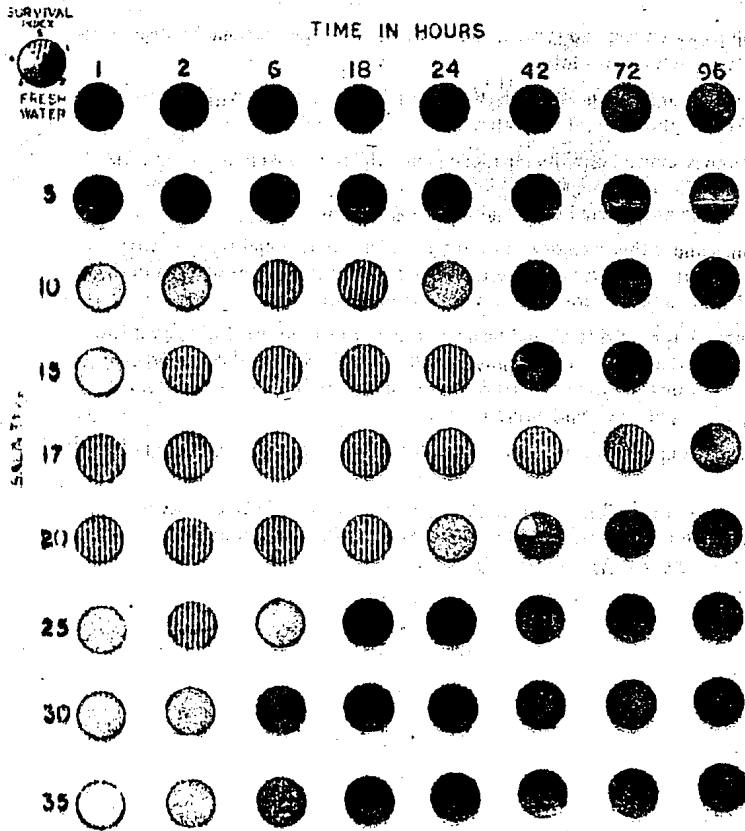
## Results

The results of the survival of the hydroids are illustrated in Fig. 1.

Under normal conditions in control sea water hydroids exhibited full extension of the hydrocaulus, stem of the polyp, tentacles etc. They showed active feeding movements, high sensitivity to disturbance caused by outside agents. The movement of the food particles was also evident with the coenosarc. These facts provided the most readily observable criteria for normal activity in these organisms.

It was observed that colonies transferred to distilled water were greatly contracted with no sign of any movement. Their outlines became hazy and the tentacles lost their form. The colonies apparently became lifeless within as brief a period as 5 minutes, a process of disintegration was noticeable within a period of 45 minutes and complete disintegration was evident after two hours.

When colonies exposed for 15 minutes to distilled water were transferred to control sea water the process of disintegration was still evident, and the colonies underwent dissolution within 3 hours.



● Figure 1. Survival of the hydroids of *Eutima commensalis* after varying periods of exposure to different grades of salinity. Survival Index signifies number of surviving colonies out of 5 used in each experiment

● Bild 1. Anzahl überlebender Kolonien der Hydroiden von *Eutima commensalis* nach verschieden langem Aufenthalt in verschiedenen Salinitäten. Der Überlebensindex gibt die Anzahl überlebender von jeweils 5 in jeden Versuch genommenen Kolonien an

When colonies were transferred to 5‰ a sudden contraction of the polyps was evident. Tentacles were considerably contracted, their sensitivity greatly reduced and the general response to disturbance was feeble. After one hour the colony was apparently lifeless, within 6 hours it showed signs of disintegration, and at the end of 18 hours this process was complete, the hydroids undergoing complete dissolution in the medium.

In order to understand the rate of recovery, if any, after one hour of exposure to this grade, colonies were transferred to control sea water. It was interesting to note that

hydroids thus transferred slowly extended their tentacles and responded though feebly to disturbance after about an hour. Even after 6 hours in the control medium they were in stage 4. But after that they began to contract and this condition persisted until about 42 hours when their condition deteriorated to stage 2. In this lifeless condition the colonies persisted until about 96 hours when subsequent disintegration and dissolution were rapid and the colonies disappeared into the medium.

Upon transfer to a salinity of 10 ‰ the tentacles of the polyp as well as the hydrocaulus seemed to contract. After 45 minutes slight movements of the tentacles were seen. At the end of one hour the polyps seemed to respond to disturbances. No noticeable difference was seen in the case of gonophores. After 6 hours all tentacles, and in fact the whole colony, showed signs of relaxation and all the polyps were apparently active. A curious process of eversion was noticed in some of the polyps. During this eversion, a mass of material was extruded from the coelenteron of the polyp and within a period of one minute normal position was restored. After about 24 hours in this apparently normal state the colonies showed signs of stress and passed on to the condition described under stage 4. At the end of 42 hours the activity showed a further decline to reach the condition described under stage 3. The constant stress of this unfavourable medium was evident since, at the end of 72 hours, all colonies had reached the condition of stage 2 and continued to be so even after 96 hours.

The effects of transfer to control sea water after 24 hours of exposure to this grade were also noted. On the 2nd day a peculiar type of polyp began to develop from the basal disc of the colony. At first a small bud-like protuberance of the basal disc was noticed. This primordium eventually developed into an abnormal polyp with an elongated body, 4 long and slender tentacles devoid of intertentacular membrane and without a characteristic hypostome. Nevertheless, this was apparently a transient phase since these curious polyps attained the shape of normal polyps by the 4th day. Their tentacle number steadily increased from 4 to 10 and later to 12, the tentacles decreased to their normal length and an inter-tentacular membrane made its appearance and a hypostome also developed. During this period the colonies, however, contracted and progressively passed on to a state of "depression".

Colonies exposed to a salinity of 15 ‰ exhibited a general contraction as well as lack of sensitivity soon after the transfer but after 2 hours of exposure they apparently became quite normal (stage 5) and continued to be so even after 24 hours. The abnormal type of polyps noticed in the earlier grade had been noticed in this grade also after 24 hours. After 96 hours of exposure the condition of the colonies deteriorated to stage 2.

A salinity of 17 ‰ was apparently suitable for this hydroid. They showed active feeding movements in this grade. On the second day even medusae were liberated. A salinity of 17 ‰ was most suitable for the hydroids collected during this time of the year. This is evident from the fact that a liberation of medusae was noticed only at this particular grade. Their inability to liberate medusae in other salinities suggests the stress of unfavourable salinity in the other grades tested. In this grade also the development of a few abnormal polyps had been noticed (4 polyps from the base of one colony). Except one, all

colonies were active till the end of 72 hours. After 96 hours the colonies were less active (stage 4) but continued to survive for 7 days. But even from the 5th day onwards signs of "depression" were evident. After 7 days, reduction in size of the colonies was quite evident. On the 8th day they lost their characteristic shape and contracted into a rounded mass.

Though the hydroids showed slight contraction in the 20‰ grade, they recovered at the end of one hour, regained their vigour and become quite active until 48 hours. Development of the curious polyps mentioned above was noticed in this grade also. But after 24 hours they became less active and after 42 hours 4 colonies out of 5 became inactive and one colony was in stage 4. After 72 hours and 96 hours respectively, 4 colonies reached stage 2, and 1 was in stage 3. After 96 hours signs of disintegration were evident.

When colonies were transferred from this grade to normal sea water they were active for about 72 hours. After 72 hours they showed signs of stress and reached the condition in stage 3 and continued to be so until 96 hours, reaching stage 2 thereafter.

Hydroids in a salinity of 25‰ showed sudden contraction but within 2 hours they regained and were active for a period of one hour. Soon their activity declined and after 18 hours in this medium all except one colony were dead. Within 42 hours rapid disintegration was discernible the colonies becoming almost invisible as a result of disintegration.

After 24 hours of exposure to this grade colonies were transferred to control sea water. But there was no apparent improvement in their condition even though they remained visible until 72 hours in stage 2 when rapid "depression" was evident.

In the 30‰ grade the hydroids were greatly contracted though assignable to stage 4. After 6 hours all were apparently in stage 3 and the process of "depression" started before 24 hours. At the end of 42 hours they were almost invisible.

Transfer from this grade after 24 hours of exposure to control sea water had apparently no effect, all being dead.

In 35‰ salinity, colonies survived with very feeble movements for about two hours. Within 18 hours, "depression" had set in and after 24 hours all the colonies had disappeared.

After 18 hours of exposure the colonies were transferred to control sea water. None survived confirming 100 per cent death, and these had undergone "depression" within 24 hours.

## Discussion

Observations on the variations in the salinity of the Cochin backwaters show that this region is a typical tropical estuary where the seasonal as well as tidal variations in salinity are considerable. The present study reveals the fact that the hydroid of *Eutima commensalis* occurring in this locality shows a narrow range of salinity tolerance. It is known that tolerance to narrow salinity variations may be due to the inability for effective regulation of osmotic pressure within the body. It is evident from Fig. 1 that fresh water is lethal to this hydroid. A salinity of 5‰ is tolerated only for a brief period.

Nevertheless, in a salinity of 10 ‰, the hydroid can apparently live without serious discomfort for a period of about 24 hours. A salinity range between 15 ‰ and 20 ‰ seems to be the most suitable for this species. The optimum salinity was found to be around 17 ‰. In this grade the polyps were well extended and exhibited active movements, and even the liberation of medusae was noticed. Salinities of 25 ‰, 30 ‰ and 35 ‰, too, were apparently unsuitable for this hydroid. However, in an experiment conducted during high salinity in the habitat it was noticed that even in as high a salinity as 35 ‰, the hydroids were found to exist without much discomfort. The specimens for this test were collected during February when the salinity of the ambient water was nearly 32 ‰. This suggested that gradual acclimatisation in its natural environment probably enables the species to endure even higher salinities than those noticed in the present investigation.

Another noteworthy feature observed during the tests was that during the high saline period, the hydroid colonies were considerably smaller in size than those noticed during the period of low salinity in the habitat. Salinity has been shown to modify the growth, shape and reproduction of the hydroid *Cordylophora caspia* (KINNI, 1964). In this species it was noticed that sexual and asexual reproduction are both affected by the salinity. At 17 °C to 19 °C gonophores were found in salinities ranging from that of fresh water to 30 ‰. Within this range, intensity of gonophore production reaches its maximum in the lower and middle part. Even the size and number of gonophores per polyp as well as the size and number of eggs per gonophore are subjected to changes: in fresh water and in 30 ‰ not more than one gonophore per secondary polyp were found and the eggs contained in them numbered only 2 or 3 eggs. These experiments suggest that extreme salinities reduce the reproductive performance.

Tests conducted in these experiments suggest that even though the hydroid of *E. commensalis* apparently has only a narrow salinity tolerance it seems to have the ability to withstand and exist in the gradually increasing salinity of the post-monsoon and the high salinity of the pre-monsoon periods through acclimatization. The production of peculiar abnormal types of polyps was noticed in such suitable grades as 15 ‰, 17 ‰, and 20 ‰. This phenomenon has been observed in the colonies which were kept even in control sea water as well, representing the natural condition. One possible explanation for the occurrence of such peculiar polyps is that unfavourable environmental conditions other than the stress of salinity may be inducing them to produce such polyps. It is not altogether improbable that the formation of such polyps may be a normal phase in the life history of these hydroids. In this context the observations that "upon recovery from depression, hydras often regenerate doubled parts or other abnormalities and these lead to fission process" is of interest (see HYMAN, 1940). This suggests that abnormalities of the polyps do occur occasionally among hydroids.

Their inability to tolerate a wide range of salinity, especially the very low grades, is in conformity with the occurrence of the hydroid (SANTHAKUMARI and NAIR, 1969) and that of its medusae (VANNUCCI et al., 1970) during the pre-monsoon and post-monsoon periods in this locality, and their apparent disappearance during low saline periods of the monsoon. From these tests it is clear that they are unable to tolerate very low salinities especially when these occur suddenly.

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