Notes on the Effect of Low Salinity on an Actinian, *Diadumene Luciae*[1)]

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(*With 3 Text-figures*)

As was described by Uchida (1932, 1936), the sea-anemone, commonly found in environs of the Marine Biological Station, shows the intense hardness against the change of salinity and temperature. The writer, at the suggestion of Prof. T. Uchida, studied the resistance of the species to various salinities, particularly, to low salinities. The work has been carried on during the summer of 1950, at the Akkeshi Marine Biological Station. Before going further, the writer wishes to express his cordial thanks to Prof. T. Uchida and also to Asistant-professor Kiichiro Yamamoto, for their kind advices during the present work.

The actinians used in the experiment were collected from the Lake Akkeshi, which is openly connected with the Akkeshi Bay. The water of the lake, therefore, does not display the great fall of salinity, for instance, it retained the salinity of 30.10 parts per 1000 at the ebb tide on July 19 (This was calculated by the use of Knudsen's method). Of course the salinity may fall temporarily lower than this, as in case of heavy rain fall. The hydrogen ion concentration of the lake-water is relatively high, and is about 8.4 in pH. This lake is famous for its vast output of oyster and innumerable oyster-shells which are overlapped on the bottom of the lake, forming several oyster-eyots in the lake. The actinians are commonly found on oyster-shells near the tidal line. The water of various salinities was prepared by adding the buffered distilled water (1000, distilled water +2.3, 0.1 M $NaHCO_3$) into the filtered normal sea-water. The sea-water used in the present investigation was about 8.2 in pH, covering about 33.00 parts per 1000 in salinity. The sea-water was obtained from the sea-surface a half mile off the Marine Biological Station. The sea-water was diluted, without conspicuous change of the pH ; for instance, the pH of 1/8 sea-water was 8.0. The pH above mentioned was determined by colorimetric method using Thymol Blue and Cresol Red, and was not corrected of the salt-effect. The actinians were reared in these diluted sea-water until they

1) Contributions from the Akkeshi Marine Biological Station, No. 53.

Jour. Fac. Sci. Hokkaido Univ. Ser. VI, Zool. 10, 1951.

were killed. To detect the death-sign of the actinians reared in diluted water, the following method was employed : each set of the animals reared in diluted water was turned back to the normal sea-water with intervals of a day or several days. On turning back, the animals, when still alive, open the mouth, and stretch the tentacles and react to tactile stimuli.

When the actinians were submerged in the distilled water, 1/8 sea-water or 2/8 sea-water, they were killed sooner or later as shown in the following table.

	Duration of treatment (day)	Number of specimen	Mortality (%)
In buffered dist. water	1	10	0
	2	10	0
	3	20	85
	4	20	100
	5	20	100
In 1/8 sea-water	12	20	0
	13	10	60
	14	10	100
	15	10	100
In 2/8 sea-water	25	20	0
	37	20	65

On the other hand, the actinians reared in 3/8, 4/8, 5/8, 6/8 and 7/8 sea-water respectively survived until the end of the investigation, 63 days after the begining, and they showed the similar external appearances in every set. Though the size of the body became smaller on account of hard starvation and the color turned into brownish or blackish, the actinians were found opening their mouth, stretching from time to time their tentacles and displaying irritable reactions for tactile stimuli.

When the actinians were transferred into the water of lower percent of salinity than 4/8 sea-water, they immediately began to close the mouth and then contracted the body. The degree of contraction corresponds to that of dilution of sea-water. Even in the 5/8 sea-water, the mouth is often closed. The actinians treated in the 3/8, 4/8 and 5/8 sea-water, however, began to open the mouth again with the lapse of time ; in the 3/8 sea-water some animals began to open the mouth at the time after 5 to 10 hours from the beginning of the treatment. About a week afterward all the specimens which were treated in the higher percent than 3/8 sea-water had the mouth opened and the tentacles stretched. There could be seen no external difference between the specimens in the normal sea-water and those in 3/8 sea-water, except tentacles of the latter which seemed to be slightly contracted.

Judging from the fact that the specimens immersed into the 3/8, 4/8 or 5/8 sea-water showed at first the irritable contraction, and have recovered again with

the lapse of time, the actinians seem to be capable to be acclimatized to the range of salinity. On the other hand, in the 2/8, 1/8 or distilled water the acclimatization could not be observed. They showed a shrunk condition from the beginning to death (Fig. 1). When the specimens are still living, they become active after the turning back to the normal sea-water, though somewhat queer in shape (Fig. 2). It seems

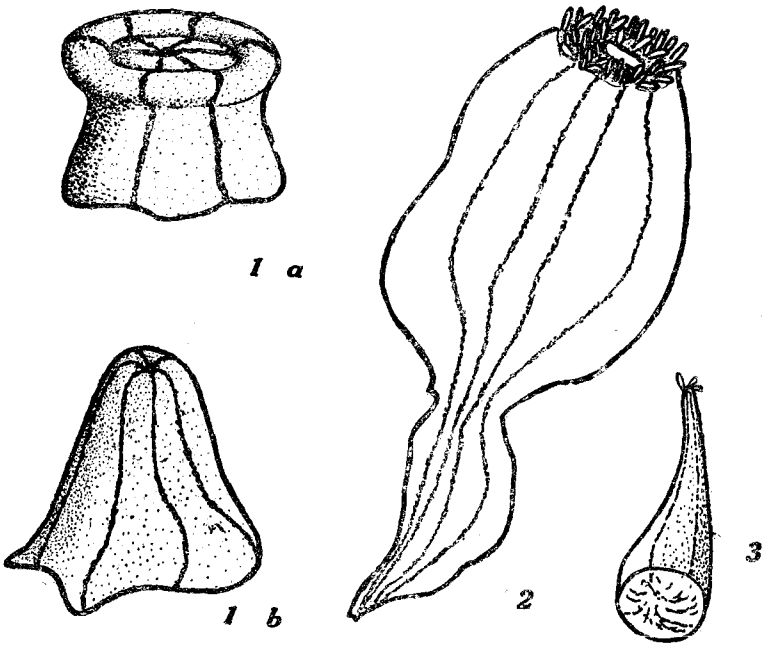

Fig. 1.a. Specimen treated in distilled water one day long. 1.b. Specimen treated in 2/8 sea-water for one day. Fig. 2. Specimen revived by turning back into the normal sea-water from 1/8 sea-water in which it had been reared for 2 days. Fig. 3. Specimens treated in twice condensed sea-water for 2 days.

to be noticeable that the animals treated by the 3/8 sea-water or of higher salinities remain adhered to the wall of vessels by the pedal disc as in nature, while in the 2/8 sea-water or of further lower salinities they scarcely remain adhered. From these facts, it is conceivable, that the critical point for acclimatizatoin lies between 2/8 sea-water and 3/8 one.

The secreted mucus seems to take part more or less in the resistance of the actinians to low salinity, because the animals immersed into extremely diluted sea-water were usually covered with mucus so much that one takes it granted for a capsule.

Judging from Uchida's report the actinians from Akkeshi Bay are fissiparous more often than those occurring in the warmer place. The frequency of fission in the experiment (at 14°C to 18°C) was observed as shown in the following numbers: in the normal sea-water none, in 7/8 sea-water 2 out of 15 specimens, in 6/8 sea-water 3 out of 15, in 5/8 sea-water 2 out of 15, in 4/8 sea-water 1 out of 15, in 3/8 and in the sets of lower than this none. The fission, therefore, seems to be partially induced by some unfavourable conditions as slightly lower salinity. On the other hand, two groups of the actinians, one reared in the normal and another in the 6/8 sea-water at 20°C to 27°C, both showed no fission for 27 days. The fission seems to be mainly attributable to temperature. The experiment will be performed in future.

Besides, the effect of high salinity on the actinians was examined. When the actinians were reared in twice condenced sea-water, all the specimens were alive for 4 days, and then 7 specimens out of 10 were dead after 5 days. The actinians were not changed in size and shape in the case of diluted sea-water experiment but in this case were markedly changed (Fig. 3). The result is possibly due to extreme dehydration. The actinians possessing the intense hardness for hypotonic solution, have less resistance for hypertonic one.

As a control, other species of sea-anemone, *Epiactis prolifera* was treated in 1/8 sea-water. 10 specimens were all killed after 3 days. Thence *Diadumene Luciae* shows an extreme acclimatization and resistance to low salinity.

Summary

1) *Diadumene Luciae* is capable to resist and acclimatize to wide range of low salinity; they can be acclimatized in 3/8 sea-water without any remarkable effect.

2) The species could not be acclimatized in 2/8 sea-water and more dilute ones.

Literature cited

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