TOXICITY OF THE ASTEROID LINCKIA LAEVIGATA (L.) TO THE DAMSELFISH DASCYLLUS ARUANUS (L.).—The blue coral reef asteroid *Linckia laevigata* is commonly found exposed in the reef flat habitat. It has been observed that fish occasionally die in aquaria occupied by *Linckia laevigata*. It was postulated that this starfish contains a toxin in its body since some asteroids, e.g., *Asterina pectinifera* and *Asterias amurensis*, are known to contain toxins (Feder and Christensen, 1967). Different body parts of *L. laevigata* were therefore tested for toxicity.

All specimens of *L. laevigata* were collected from the outer reef flat of Asàn reef on the leeward coast of Guam. They were brought to the University of Guam Marine Laboratory and were kept in a 500-liter holding tank until tested.

The common reef flat damselfish *Dascyllus aruanus* was used in all experiments. Fish were caught at Asan reef and Tumon Bay with the aid of nets and plastic bags and transferred to the University of Guam Marine Laboratory, where they were kept in a 20-liter holding tank. The fish were allowed to acclimate for one day to overcome shock caused by capture and transport. The size of fish used was between 1.9 and 3.0 cm in total length.

Six 8-liter aquaria were used in the experiment. Each aquarium was filled with five liters of sea water and aerated overnight. Five damselfish were then put into each aquarium. No aeration was used during experiments. Temperature of the water varied between 27.0 and 29.5°C, salinity ranged between 30.0‰ and 33.3‰ and pH decreased from 7.8 to 6.9. This change in pH indicates an increase in CO_2, but no anoxia was observed in the control aquarium.

Preliminary experiments were conducted with intact starfish, but no mortality of fish was observed. Separate body parts including pyloric caeca, ovaries, tube feet and hard body parts were then tested. Pyloric caeca and ovaries were found to cause mortality and it was decided to continue experimentation using pyloric caeca.

A technique was developed to obtain a clear filtrate from a known weight of pyloric caeca. Pyloric caeca of *L. laevigata* were excised and

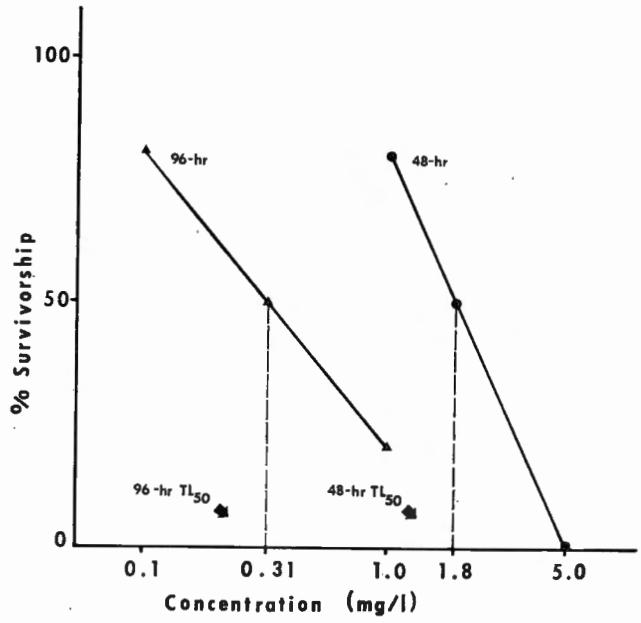

Fig. 1. Percent survivorship of fish vs. concentration (mg wet weight/l) of pyloric caeca solution, plotted on a semilog scale.

aliquots weighed of 30.0, 6.0 and 0.6 mg (wet weight), respectively. A mortar and pestle was used to homogenize pyloric caeca in seawater. Sea water was added to bring the volume of the homogenized suspension to one liter. This mixture was filtered through filter paper (Munktell's No. 206). The clear filtrates were added to three aquaria containing fish, making the volume of sea water in each aquarium 6 liters.

Aquaria were checked every 12 hours and dead fish were removed. During the first 12 hours behavior of the fish was closely observed.

Control fish behaved in a uniform manner, exhibiting casual swimming and little aggression. An entirely different behavior was observed in experimental tanks. Approximately 30 minutes after the addition of pyloric caeca filtrate the fish in each aquarium displayed a "huddling" reaction.

Responses caused by the pyloric caeca extract consistently affected smaller fish first. The fish suddenly darted across the aquaria, careening to one side. Continuing to dart about the aquarium in a random manner, the fish finally came to a stop at the bottom of the aquarium, either upright or lying on one side. Respiration rate, determined by observation of gills, was noticeably higher at this time.

After the initial reaction, the fish remained quiescent in either a vertical or horizontal position for up to 15 minutes. A second random darting movement then occurred, after which the fish sank to the bottom and stopped respiring. Some responses lasted as long as 30 seconds, but there was variation among individuals.

From the data obtained, percent survivorship of fish vs. concentration of pyloric caeca solution is plotted on a semilog scale, to obtain a straight-line graphic interpolation of TL_{50} values. A TL_{50} value is a concentration at which 50% of the experimental animals survived. A 48-hours TL_{50} value of 1.8 mg/l and a 96-hour value of 0.31 mg/l can be seen in Fig. 1.

The pyloric caeca of *L. laevigata* appears to contain a very toxic substance. A heat-stable substance, saponin, found in some asteroids is known to be toxic to fish. It is not known at present if the supposed toxin in *L. laevigata* is also a saponin.

Further investigation is desirable to check ovary and sperm toxicity. In preliminary testing, ovaries were found to be toxic within the first 12 hours.

The toxin in the pyloric caeca of *L. laevigata* has a 96-hour TL_{50} value of 0.31 mg/l. A *L. laevigata* with mean arm radius of 91.0 mm contains approximately 3.22 g pyloric caeca. The extract from a single *L. laevigata* may thus kill one half of *D. aruanus* in 10.4 cubic meters of sea water within 96 hours.

Reference Cited

Feder, F., and A. M. Christensen. 1966. Aspects of asteroid biology. p. 87–127. *In* R. A. Boolootian (ed.), Physiology of Echinodermata. Interscience Publishers, New York.

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