

# Notes on the Morphology, Ecology and Distribution of *Thelenota anax* H. L. Clark (Holothuroidea: Stichopodidae)

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**Abstract.**—The previously little-known holothurian *Thelenota anax* was found in relative abundance at Enewetak Atoll, Marshall Islands, and additional reports of its occurrence were obtained from Australia, the Society Islands, the Caroline and Marshall Islands and Guam. Specimens were found primarily on sand and rubble at depths of 5–30 m, and ranged in size from 300×70×70 mm to 550×100×100 mm. Tentacles numbered 19–20, gonads were paired and equal, and a color pattern of reddish black lines was observed in the integument. Associates included the crab *Lissocarcinus orbicularis*, the parasitic snail *Balcis acicula*, and the pearl fish *Encheliophis (Jordanicus) gracilis*. Gut contents consisted of sand and organic matter, and a caterpillar-like mode of locomotion was observed.

## Introduction

The holothurian *Thelenota anax* (Family Stichopodidae) was originally described by H. L. Clark (1921) on the basis of a single specimen from Mer, Murray Islands, Torres Strait, Australia. The species was included by Clark (1946) and Clark and Rowe (1971) in lists of echinoderms from Australia, based on the original description. Yamanouti (1939) recorded it from Palau, but only mentioned it in a table and did not discuss it in the text of the paper. Recently *T. anax* has been reported from the People's Republic of China by Yulin (1975), who found one specimen from Nansa Island in the Xisha Islands. Rowe and Doty (1977) reported it from Guam. These are the only known published records of the occurrence of the species. The only specimens in major museums contacted were the holotype at the Museum of Comparative Zoology and a portion of a specimen at the Australian Museum. The discovery of the species at Enewetak Atoll, Marshall Islands, was therefore an exciting find, and provided an opportunity to learn more about it than has been previously reported.

## Observations

The information on *Thelenota anax* from Enewetak (Fig. 1) is based on 63 recorded field observations by the author and other scuba divers at the Mid-Pacific

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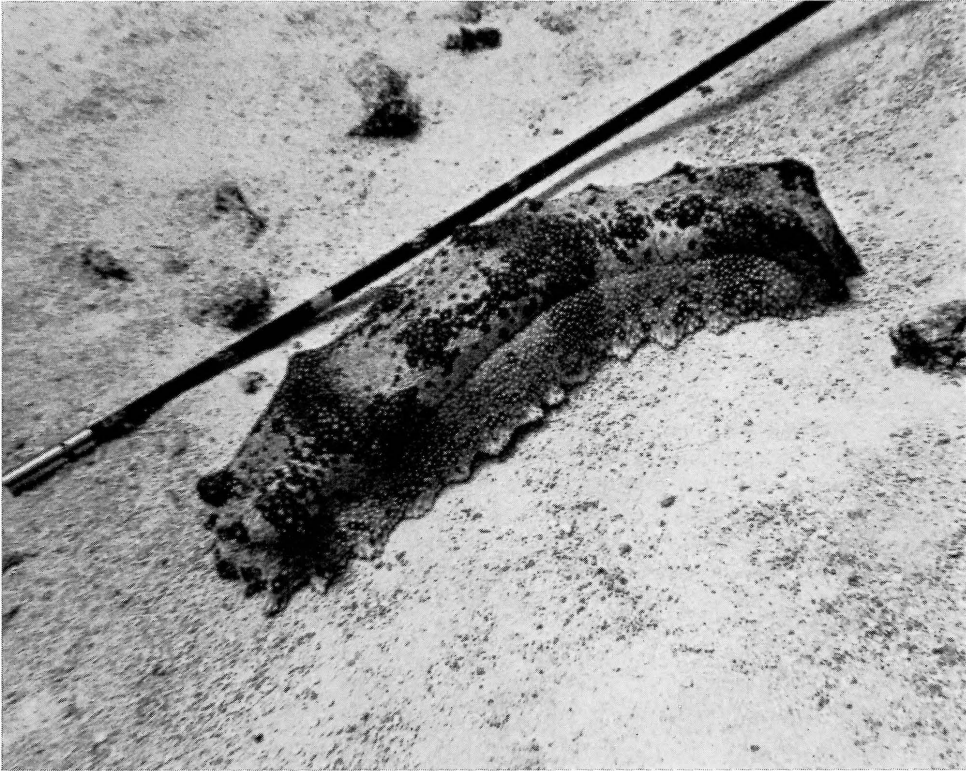


Fig. 1. A “banded” specimen of *T. anax* from 10 m at Cucumber Patch, Enewetak lagoon. This specimen was about 550 mm in length.

Marine Laboratory. About 20 specimens were collected, and some were held alive in the laboratory’s sea tables with running seawater for over eight months. Some specimens were sent to various museums for their collections.

#### PHYSICAL DESCRIPTION

Specimens of *T. anax* collected at Enewetak Atoll ranged in size from  $300 \times 70 \times 70$  mm to  $550 \times 100 \times 100$  mm, smaller than Clark’s (1921) original specimen which measured  $725 \times 100 \times 80$ – $85$  mm. Enewetak specimens are squarish in cross section, ventrally flattened, blunt and lumpy in appearance. The mouth is ventrally directed and there is no indication of anal teeth. Tentacles number 19 to 20. The ventral surface is covered with pedicels, and along the dorsal and lateral surfaces are numerous small conical papillae and some larger papillae. In the Enewetak specimens the larger conical papillae are only 6–8 mm at the base and about 5 mm high, smaller than those described for Clark’s original specimen. Often, however, several papillae are joined together on a common raised base, contributing to the lumpy appearance of the holothurians.

The ground color of living Enewetak *T. anax* is a light grey or yellowish grey. Densely scattered over this base color are minute tan or brown spots with reddish

centers. These merge into large irregular brown patches with minute reddish spots over the dorsal and to a lesser degree the lateral surfaces. The smaller of these brown patches are centered around one or more of the larger conical papillae, especially on the sides. In some specimens the minute tan or brown spots are crowded together along the sides in a suggestion of a broad banding pattern (Fig. 1).

There is a deep reddish black colored line running in folds along the middorsal and midlateral lines which may be continuous in some specimens, broken or nearly absent in others. It continues in a broken pattern from the midlateral lines to the middorsal line between the large "lumps," and sometimes down to the lower edge of the sides. Traces of the line also sometimes appear on the ventral surface around the mouth. This pattern of lines was not mentioned in Clark's (1921) description of *T. anax*, nor was it visible in his figure of the anterior end of the holothurian, but it is quite striking in Enewetak specimens. Similar dark reddish lines also appear in Enewetak specimens of *Thelenota ananas*, running laterally across the dorsal surface between the large star-shaped papillae. The pattern is also visible in a photograph of *T. anax* from Guam taken by R. H. Randall (cf. Rowe and Doty, 1977: Fig. 5f).

The ventral surface of *T. anax* from Enewetak is light grey or yellowish grey with minute reddish spots, and is sometimes flushed with yellow or gold anteriorly. The ventral pedicels are golden yellow or reddish gold, with the fronds of the tentacles of the same color. The dorsal papillae usually have a light grey area around

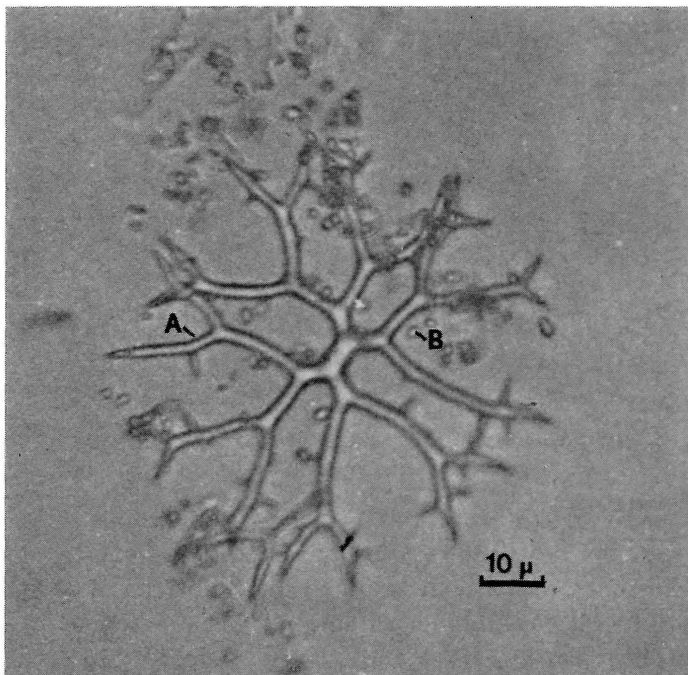


Fig. 2. Spicules of *Thelenota anax*. A, dichotomously branched rod, and B, minute granules of the dorsal integument.

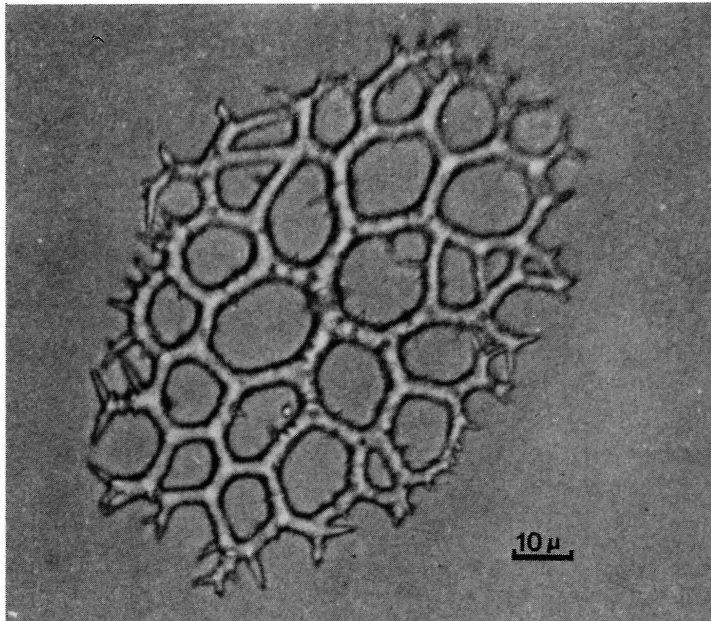


Fig. 3. Spicules of *Thelenota anax*, continued. Anastomosing plate of the tentacles.

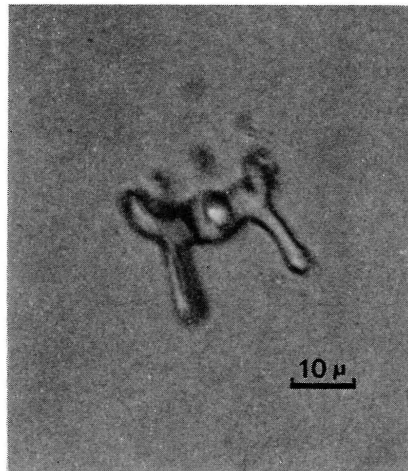


Fig. 4. Unusually branched spicule of the dorsal integument of *T. anax*.

the base, and tan to reddish brown tips. There is no indication in Enewetak specimens of the blue color described by Clark in the holotype.

The interior lining of the body wall and the epithelium of all internal organs are densely stained with a deep reddish purple pigment described by Clark (1921) and also present in *T. ananas*. The tufts of gonads, which were in too poor condition in Clark's original specimen to be examined, are definitely paired and in our specimens are approximately equal. Gonads were 70 mm long in a 500 mm specimen collected

27 January 1977, and 77–80 mm in two similar sized specimens collected 5 May 1977.

Spicules of the dorsal integument, pedicels and tentacles are illustrated by Yulin (1975). The dorsal integument contains dichotomously branching rods (Fig. 2a) and minute granules (Fig. 2b) as described by Clark (1921). The tentacles contain irregular anastomosing plates (Fig. 3). Also seen in the dorsal integument of Enewetak *T. anax* as well as in Yulin's (1975) specimen were a few thick branched rod spicules in which the second branching took place at right angles to the first branching (Fig. 4). These spicules (degenerate tables) have also been seen in *T. ananas* (Panning, 1944).

#### HABITAT

Specimens of *T. anax* have been observed at Enewetak at depths ranging from 5–30 meters. They have been found inside the lagoon on pinnacles and patch reefs or sand bottom between the islets of Enewetak and Ananij (Fig. 5) within 4.5 kilometers of the passes. They have also been seen in channels in the interisland reef flat south of Biken and on the vertical reef slope oceanside of Biken on the leeward side of the atoll. This distribution undoubtedly reflects diving effort rather than true distribution. In general, however, it was noted that the holothurian is most common on lagoon pinnacles and patch reefs at depths of 10–20 m. Of the recorded observations, 73% were on coarse sand or rubble and 11% on dead coral. Substrate was not recorded in 8% of observations, and of the remainder, 5% were on live coral, one individual was on live alcyonarian, and one was upside down on the

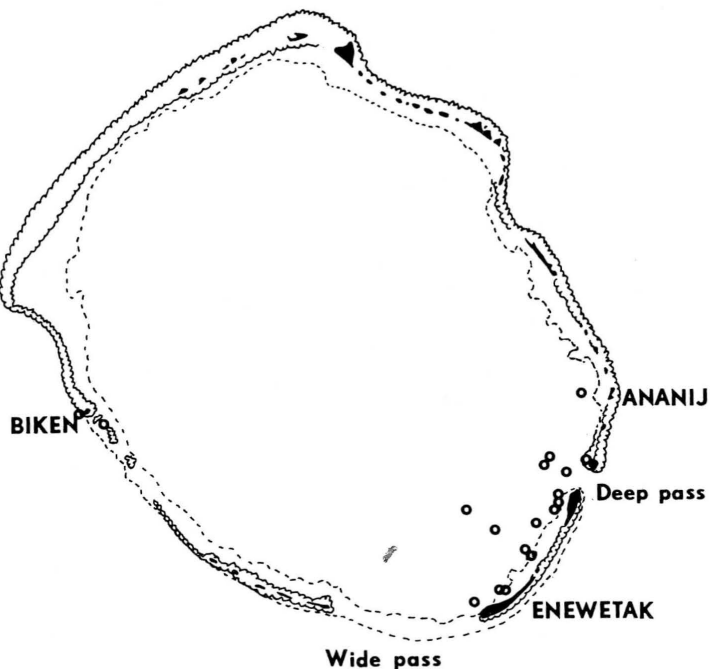


Fig. 5. Outline map of Enewetak Atoll showing recorded locations of *Thelenota anax*.

roof of a small cave. Several of the specimens on sand-rubble were under coral overhangs, and others were well camouflaged by a thin layer of fine sediment which had settled on them.

#### ASSOCIATES

Crabs, snails and fish were observed with many of the collected specimens. One or more individuals of the spotted crab *Lissocarcinus orbicularis* Dana could be found well camouflaged against the similarly spotted dorsal or ventral surface of the holothurian, or seeking refuge among the tentacles. Many of the specimens of *T. anax* were infested with several melanellid snails, *Balcis acicula* (Gould) imbedded in the buccal membrane at the base of the tentacles. One had a commensal carapid fish, *Encheliophis (Jordanicus) gracilis* (Bleeker), which came out when the holothurian was frozen prior to preservation.

#### GUT CONTENTS

The diet of *T. anax* appears to be organic matter in the sediment it ingests. The gut contents and fecal pellets consist of coarse sand, bits of shell and *Halimeda* fragments, algal filaments, forams and small molluscs. The holothurians held in the laboratory sea tables ingested detritus that settled out of the incoming seawater. They survived on this for over eight months but gradually became smaller and their body walls became more "rubbery."

Regeneration was rapid and complete in specimens which were extensively damaged externally when collected. Two specimens tagged in the laboratory with Floy FD-68B anchor tags (Floy Tag and Mfg., Inc.) lost them by regeneration of the body wall surrounding the tag, which was gradually rejected in about one month. Evisceration was observed only once, in a laboratory specimen which died shortly afterwards in water which had become fouled.

#### BEHAVIOR

*T. anax* moves along its substrate in a "giant caterpillar" manner like that described for *Stichopus panimensis* by Parker (1921). The pedicels and ventral surface are lifted from the substrate in a successional wave beginning at the posterior end and advancing anteriorly. At times the anterior end is lifted and moved from side to side as the animal appears to test its environment. This activity is often followed by a change in the direction of movement. The holothurian will move up and down vertical aquarium walls to the surface of the water. If turned over, *T. anax* will immediately right itself with a twisting and bending motion of the body, as will *T. ananas*. In an area of wave action or strong current, *T. anax* may bend its body laterally so that it is C-shaped rather than straight. This seems to help prevent it from rolling downstream. If a bit of the epidermis is cut from the surface, as for spicule preparation, the holothurian will writhe and twist for some time.

#### DISTRIBUTION

Published records and correspondence with divers showed *T. anax* to be widely distributed throughout the western Pacific. The original specimen was from Mer Island, Torres Strait, and the Australian Museum has the posterior portion of

a two-foot specimen collected from 8 m on coral rubble at John Brewer Reef, near the edge of the Great Barrier Reef northeast of Townsville in 1974. M. Pichon (pers. comm.) has seen several specimens from other parts of the Great Barrier Reef. Yamanouti (1939) recorded the species from Palau (his Table 17) in a lagoon passage with strong current, on sand bottom. Yulin (1975) found one specimen from the Xisha Islands, Guangdong Province, China, which measured  $600 \times 80$  mm, or slightly larger than Enewetak specimens. R. H. Randall photographed a specimen from 10 m on an *Acanthaster* devastated semi windward reef front at Tanguisson Point, Guam in 1973. Neither Randall nor J. E. Doty, who works with echinoderms in Guam, has seen another specimen there. Two specimens were seen in the Society Islands by P. Lamberson and one was photographed. They were on sand at 7–9 m depth, lagoonward of the islet of Motu Ahi, which is on the barrier reef on the southeast side of the island of Moorea. The specimen photographed was somewhat larger than Enewetak specimens, and it exhibited a similar color pattern, including the red line.

*T. anax* appears to be fairly common in the Marshall Islands. Several divers at Kwajalein Atoll have reported that they have seen it there. O. K. Davis (Pers. comm.), a tropical fish collector at Majuro Atoll, reports that *T. anax* is more common than *T. ananas* there. He has found it from 2–37 m depth, usually in sandy areas, but occasionally in staghorn coral, and says it seems to come into shallow water more when the moon is full. Davis also reports that someone at Majuro had looked into fishing *T. anax* commercially, but found there was little market for them. Albert Lorenji of Ujelang Atoll, says that he has seen *T. anax* in about 5 m at Ujelang, and also at Ponape.

### Museum Specimens

The following museums are known to have specimens of *T. anax* in their collections. Those marked with an asterisk (\*) were sent from Enewetak.

American Museum of Natural History, AMNH 2738\*

Australian Museum, Aust. Mus. No. J8068, J9887\*

Bernice P. Bishop Museum, BPBM 1976.54\*

British Museum (Natural History), BM 1976.11.4.1\*

Museum of Comparative Zoology, MCZ No. 1068 (Holotype)

United States National Museum, USNM E16898\*

The species is also represented in the Mid-Pacific Marine Laboratory (MPML) Reference Collection at Enewetak.

### ACKNOWLEDGMENTS

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