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OBSERVATIONS ON THE BASKET STAR *ASTROBOA NUDA* (LYMAN) ON CORAL REEFS AT ELAT (GULF OF AQABA)

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ABSTRACT

The authors carried out night observations on the population of the basket star *Astroboa nuda*, on the coral reefs of Elat. Data are given on the distribution and density of population; their positions on the reef; their behaviour and reaction to strong illumination; and their mode of capturing of planktonic organisms. The stomach contents of a number of specimens were examined and the dimensions of the different food organisms were compared with the planktonic organisms collected simultaneously with a fine net.

It was found that the animals keep regular night activity positions, and during daylight hide in nearby shelters. The time of emergence from, and return to the hiding places is specified. It is suggested that *A. nuda* might be found in abundance also on other coral reefs in the Red Sea and in the Indian Ocean.

INTRODUCTION

Until recently, members of the order Euryalae were attributed to a group typical of deep waters, although Grieg (1900) had already found the northern species *Gorgonocephalus arcticus* (Leach) between 0—1504 m. More recently, with increasing use of SCUBA equipment, and by nocturnal observations new data have been collected, showing that various species of Euryalae, and particularly some of those living in tropical seas, are present also in shallow waters.

Nocturnal appearances of different gorgonocephalids on coral reefs were mentioned by Hess and Clark (1938), Baissac et al. (1962), Schroeder (1964), and by Cousteau (1964), but their description is very short and the information scant.

According to Döderlein (1927), the Indopacific basket star *Astroboa nuda* (Lyman) was collected near the Japanese, Philippine (type locality) and the Indonesian shores, and a few specimens of its dark variety (*A. nuda* (Lyman) var. *nigra* Döderlein) were collected also near Zanzibar and Suez.

All the specimens were dredged from depths of more than 20 m, from sandy or shell bottoms, and in one instance *A. nuda* was brought up from a depth of 113 m (Döderlein 1927 p. 43). Thus far, no specimens of *A. nuda* from coral reefs or shallow waters have been described.

The purpose of this paper is to contribute to the understanding of the life habits of this basket star found abundantly on the reefs of Elat.

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METHODS

Observations were made at depths down to 8 m, during various hours of the night, with SCUBA equipment, or by masks and snorkels only. At first, a powerful electric torch (30,000 Lux) was used, but in later observations weaker underwater torches (7,000 Lux) were used which did not disturb the usual activity of the basket stars. A number of specimens were marked by small numbered plastic labels tied to the proximal part of one of the arms. This enabled us to follow the movements of these specimens and their location during different hours of the day or night. A few specimens were collected and preserved during different hours of the night for the examination of their stomach contents. They were collected manually from the reef, placed immediately in large polyethylene bags and killed by the addition of concentrated formaline. After short fixation, the specimens were preserved in 70% alcohol, until dissection for examination of stomach contents. In order to compare the organisms appearing in night plankton with those eaten by the basket stars, plankton samples were collected directly above the location from which the preserved specimens were collected. The plankton was collected by means of 0.2 mm mesh hand nets.

Preserved basket stars from Elat were sent to Dr. A.M. Clark of the British Museum (Nat. Hist.) London, for determination.

OBSERVATIONS

Active specimens of *A. nuda* were first observed on October 6, 1959 during night diving on coral reefs, south of the oil port of Elat. After repeated observations during a number of years, it may be stated that the basket stars are active on reefs in the dark during all seasons.

Because of their position on open and protruding points on the reef, and chiefly because of their large size, the basket stars form a prominent element of the night fauna of the coral reef.

Seven specimens were measured. The largest had a disc of 55 mm diameter and the maximal length of one of its arms reached 50 cm. The smallest specimen measured had a disc diameter of approx. 12 mm and the maximal length of one of its arms reached 15 cm. The latter specimen was the smallest observed, but it had the appearance of an adult. No juvenile specimens have been found thus far.

The colour of most of the observed specimens is violet-black to brown-black, in accordance with Döderlein's (1927) description of *A. nuda* var. *nigra*, but approximately 30–40% of the population has a lighter coloration — pale-yellow to brown-yellow. All the light-coloured basket stars seen thus far were large specimens, the diameter of their discs being over 40 mm.

No difference in morphology and behaviour was found between the light-coloured and the darker specimens, which were often found close to each other, in the same locality.

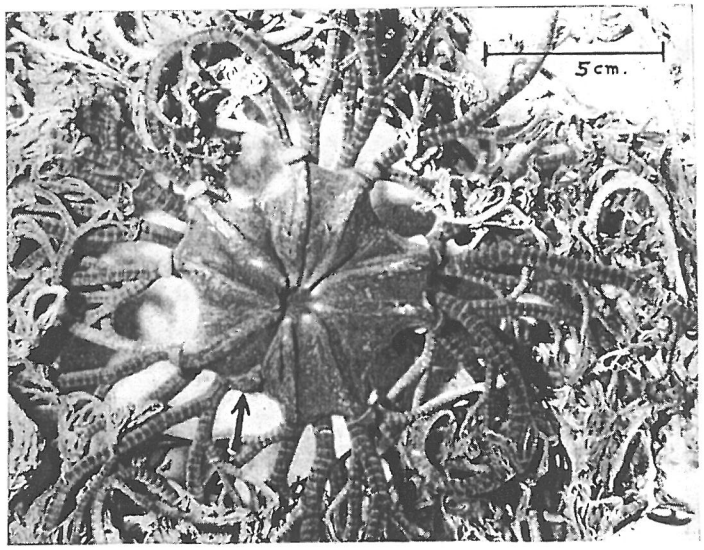

Figure 1

Aboral side of a preserved specimen of *Astroboa nuda* (Lyman). The arrow points to a rudiment of the 10th radial shield.

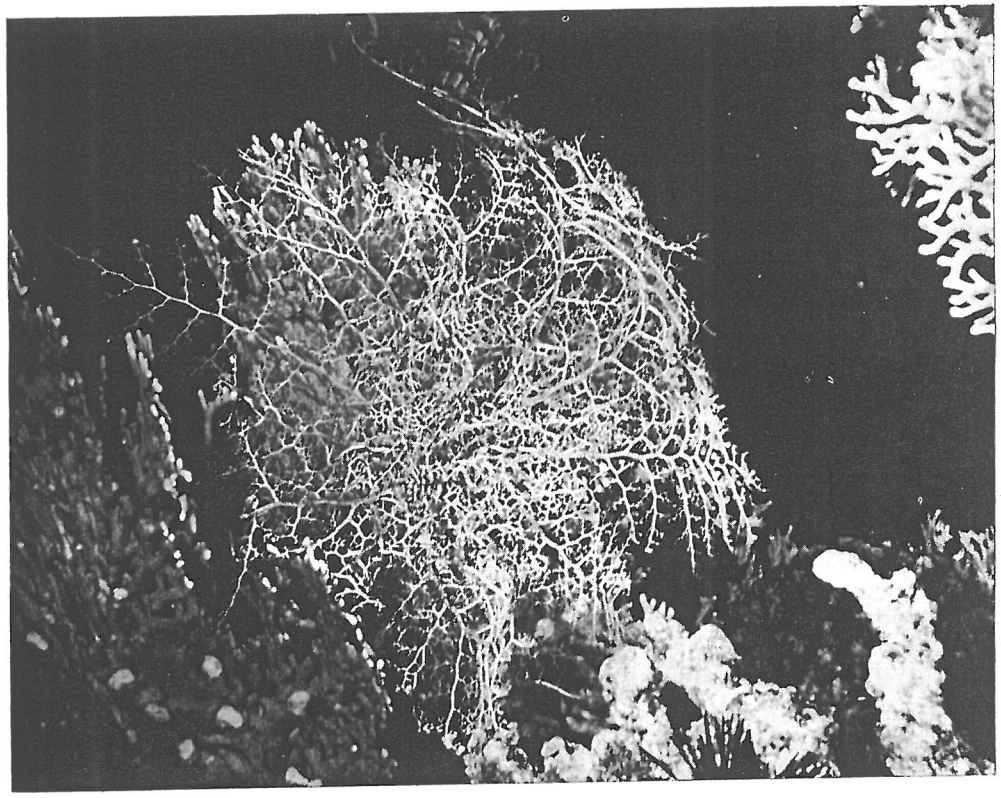

Figure 2

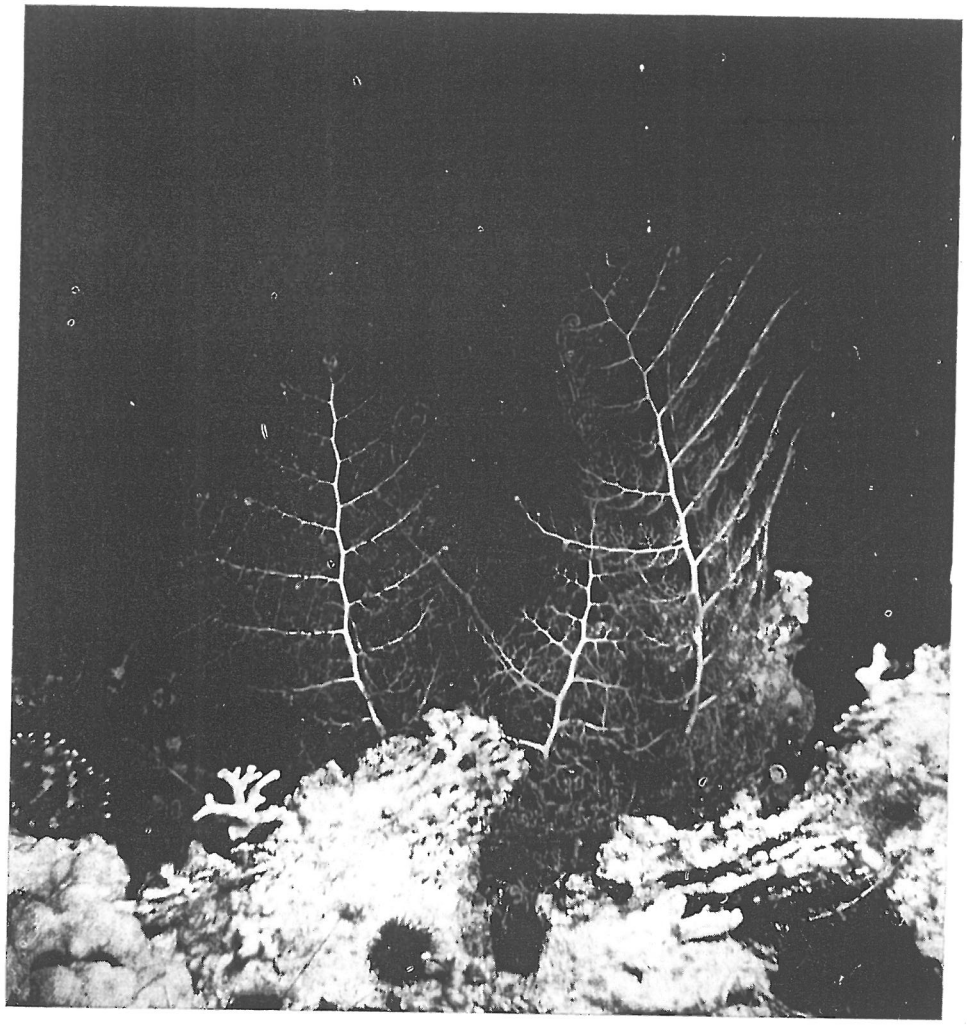

Figure 3

Astrcboa nuda (Lyman).

Specimen with spread branched arms, to collect planktonic organisms by "filtering" the slightly disturbed water. Because of the movement of the water, it kept its disc hidden among coral masses instead of attaching it (as it does on calm nights) on exposed points on the reef. Approxim. 1/6 natural size. (Depth 2 m).

TABLE I

MEASUREMENTS OF *A. nuda* FROM ELAT

Cat. No.	*Diameter of disc**	*Maximal length of arm*
	mm	*cm*
Eury. 1	51	48.5
Eury. 2	37	44
Eury. 4	55	50
Eury. 6	45	46.5
Eury. 8	40	42
Eury. 9	52	48
— —	~ 12**	~ 15

* Diameter of disc measured from base of arm to edge of opposite interradius.

** This specimen was not collected, but was measured under water — hence the approximation.

In three, out of 11 specimens of *A. nuda* collected at random, one of the radial shields is in a rudimentary form. The disc (Figure 1) is therefore slightly deformed.

With the aid of an electric torch, we could observe at times 12—13 of these large animals, attached to protruding masses of coral, along a 150 m long strip of the reef. The specimens of *Astroboa* appear at a depth of 0.5—5.5 m, although most of them were found at depths of no more than 2—3 m. The distribution of *A. nuda* at depths greater than 8 m has not been examined.

Generally, the basket stars appear singly; more rarely in groups of 2—4 specimens. These are found mainly on masses of the reef at depths greater than 1.5 m, and somewhat apart from the main body of the fringing reef running paralel to the shore of Elat.

During activity, *A. nuda* is attached to the reef, with the oral side facing the substrate, and the ramified arms spread sideways at vertical angles of 30—70°. Some of the shorter branches of the proximal forkings of the arms serve to fasten the animal to the substrate.

The active animals are attached to the seaward margins of the reef flat, or to protruding masses on the upper part of the seaward slope. They seem to prefer points exposed to water which had not previously moved over other organisms on the coral reef, or filtered by them. In slightly disturbed water the basket stars were not on their usual exposed positions, but attached themselves, with their discs hidden, behind coral heads or other protrusions of the reef, apparently for shelter. Nevertheless, their arms were spread as usual (Figures 2 and 3). On nights in which the water is strongly agitated — most basket stars tend to remain hidden in their daytime shelters.

In many instances we observed that the arms facing the sea are more upright and spread, their oral side facing the currents, while the arms facing the reef tend to be bent or only partly spread. When the water is considerably disturbed, the arms are also fully spread and even in them, minor ramifications curl around small planktonic organisms.

The arms, whose thin ramifications have captured the prey, curl from time to time and bend gradually downwards towards the disc. They remain in this position for a few minutes, before spreading once again. Even when the arms are spread, a number of the thin branches of their proximal forkings are folded before the disc and spread over the oral surface.

Quick detachment of an active specimen from the substrate, revealed that the edges of these thin branches are mostly curled, apparently carrying prey. In one instance one of these thin "tendrils" enfolded a Crustacean (Mysidacean?) of approximately 1 cm length. It is therefore possible, that these short branches, bent under the disc, obtain in some way the food from the capturing arms and convey it to the mouth. No mucus secretion was observed on the arms or in the vicinity of the mouth.

Thus far we have not been able to observe the manner of transfer of the prey from the capturing arms to the mouth. It seems that this problem will be solved only by observations of specimens of *A. nuda* kept in aquaria with transparent bottoms.

The stomach contents of four specimens collected at different hours of the night consisted of different planktonic organisms and particularly calanoid copepods, Mysidacea, larvae of decapods, larvae of stomatopods, many fragments of polychaets, some nectophores of Siphonophora, chaetognaths, etc. In the stomach contents there were also found some embryos of fishes (the membranes of the eggs may have been torn during capture, or digested).

In the stomach of two specimens, a few Tanaidacea were found. The fact that the Tanaidacea are not a planktonic group suggests that the basket stars may also be capable of obtaining food from the surface of the substrate. The food in the stomachs was sometimes embedded in a gelatinous secretion and in a specimen collected towards dawn, part of the prey was in an advanced state of digestion. The size of the organisms found in the stomach varies from 450—8500 μ); in the stomach of one specimen a chaethognath of 11.4mm (11,400 μ) was found.

In the plankton samples collected from the vicinity of the killed basket stars, organisms of wider range of size were found: 360—16,800 μ. It appears that the food of *A. nuda* includes different planktonic elements collected from the water without qualitative selection, but whose approximate size is 0.5—11 mm.

In view of the fact that the size of the spaces between the branches of the arms is much greater than that of the prey, their efficiency in capturing tiny organisms coming in touch with them is surprising. It appears that the arm hooks and the transformed spines (Figure 4) found on the curling distal parts of the branches, play an important role in the efficiency of the catching mechanism.

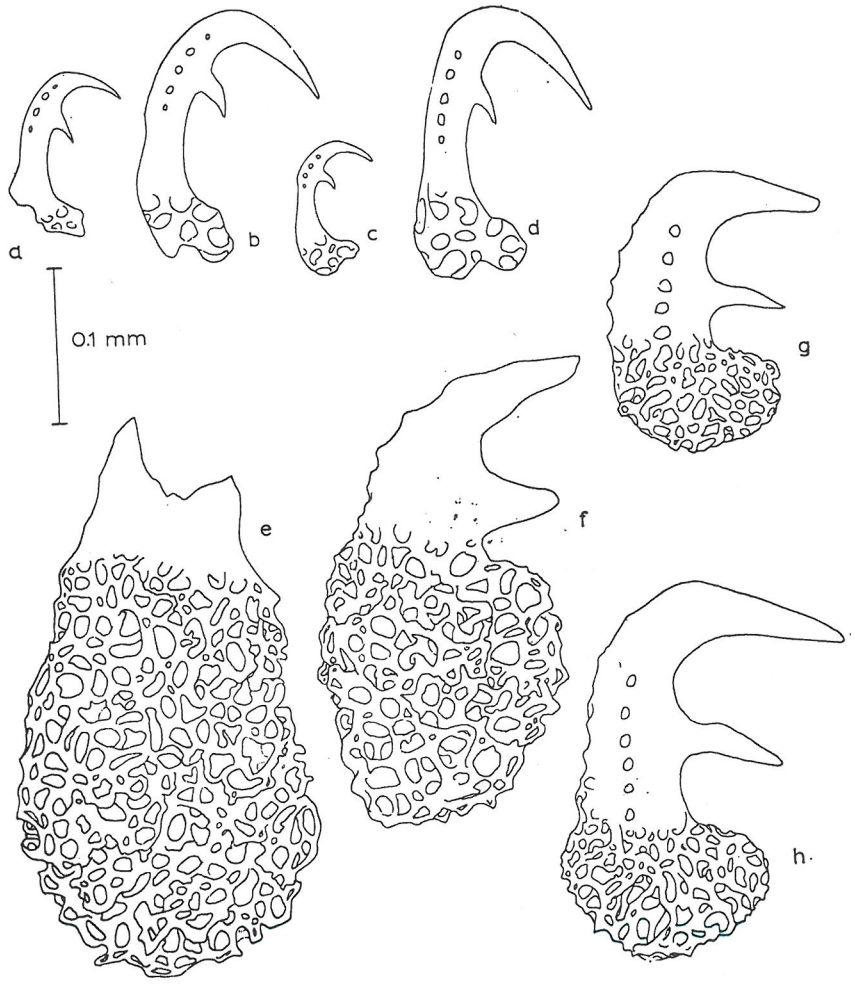

Figure 4
Astroboa nuda (Lyman) var. *nigra*.
a–d: "arms hooks" from distal parts of arms. e–f: spines from proximal parts of arm
g–h: transformed spines from distal parts of arms.

Cyclopoid copepods (family Asterocheridae) were found in the stomach of a examined specimens. They were found always undigested and they are apparentl commensals of *A. nuda*.

From observations carried out on labelled specimens on serval consecutive night it was found that each animal returns every night to the same location on the ree and hides during daylight in a fixed shelter, in one of the cracks of the reef, n more than 30–60 cm below the regular spot of its activity during the night.

Specimens of *A. nuda* begin to emerge from their hiding places 70–80 minutes after sunset. They reach their appointed position on the reef after an additional 30–50 minutes of slow crawling, a number of their arms being spread in the water. All the arms are spread, as described above, only when the animals reach their usual positions on the reef. Then, 45–60 minutes before sunrise they begin to move in the direction of their shelters, and after an additional 10–30 minutes, they are all hidden, with their arms bent over the disc. This behaviour of the basket stars is similar to that of crinoids which appear at night in large numbers on the reefs in Elat. Most of the crinoids however begin their activity earlier, after sunset, and return to their hiding places later than the *Astroboa.*

A. nuda is much more sensitive to light than the crinoids. The reaction of active specimens to abrupt illumination (by means of photographic flash bulbs or of a powerful electric torch, 30,000 Lux) from a distance of 0.4—0.8 m was a quick bending of the arms over the disc. The first to fold were the foremost thin lateral branches of each external branch in its third forking. Then most of the other branches followed, covering the disc. The basket stars remain in this position several minutes after the light is removed, and then they slowly spread their arms to their normal position of activity. When the light was kept on for a long time, or after flash bulbs were used the animals began to move quickly in the direction of their shelters. Weaker illumination by underwater torches did not cause the above reaction and the animals continued their regular activity, even under prolonged illumination.

The appearance of a remarkable number of *A. nuda* on the coral reefs of Elat might suggest that this animal is also common on other coral reefs of the Red Sea and of the Indian Ocean but that it has not been found there because of the rarity of night observations. To support this, it may be mentioned that in the collections of the Israel South Red Sea Expedition there is a single specimen of *A. nuda* var. *nigra* (No. E 62/10082, leg J.H. Stock) which was collected near Umm Aabak (Dahlak Archip.) on 23 March, 1962. This specimen was found (inactive) at noon, under a coral rock, at a depth of 0.5 m. Another specimen was observed (but not collected) in the vicinity, under similar circumstances (Z. Yaron, Tel-Aviv University, personal communication).

It is also suggested that the distribution of this species may be much more continuous and dense along the shallow coastal waters of the Indopacific area than has been believed thus far.

ACKNOWLEDGEMENTS

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