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On a Parthenopid Crab, *Zebrida adamsii* on the Sea Urchins from Suruga Bay, with a Special Reference to Their Parasitic Relations

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On a Parthenopid Crab, *Zebrida adamsii* on the Sea Urchins from Suruga Bay, with a Special Reference to Their Parasitic Relations[1)]

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Zebrida adamsii WHITE of the Parthenopidae is a rare crab with its curious formation of the carapace, chelipeds and ambulatory legs, being distributed in the Indo-West Pacific waters from Japan through the Malay Archipelago to the Gulf of Manaar. In Japan this species has hitherto been recorded from the west coast of Kii Peninsula, Sukumo Bay in Kochi Prefecture, and Kagoshima Bay (Fig. 1). Although this species is generally known to be found among the spines or on the surface of some species of sea urchins, there is no actual observation on the habits except for the brief description of MORTENSEN (1904) and only on the presumption this species has often been described as a commensal of the sea urchins. Since 1970 the senior author has been concerned with the ecological studies of the marine animals by the SCUBA diving along the coast of Uchiura in the inner part of Suruga Bay, and during three years from 1972 to 1974 obtained altogether 11 specimens of *Z. adamsii* attached to 5 species of sea urchins from the bottom of 3 to 28 m deep. The Suruga Bay is a new and northernmost locality for this crab, and in this short report some notes on the actual relations between the crabs and the sea urchins are also recorded on the basis of the field and aquarium observations.

We are greatly indebted to the staff members of the Marine Science Museum, Tokai University, for the generosities of providing us with the material on which the present observations are mainly based. Our special thanks are tendered to Mr. Yûsaku OKA who kindly collaborated in collecting the material and taking a photograph of the specimens reproduced in this paper.

Systematic Note

Zebrida adamsii WHITE, 1847

Zebrida adamsii WHITE, 1847, p. 121; ADAMS and WHITE, 1848, p. 24, pl. 7 fig. 1; HENDERSON, 1893,

1) Contribution No. 22 from Marine Science Museum, Tokai University.

p. 351; ALCOCK, 1895, p. 287; RATHBUN, 1910, p. 321; URITA, 1926a, p. 163; OZAKI, 1964, p. 43.
Zebrida longispina HASWELL, 1880, p. 454, pl. 27 fig. 3; 1882, p. 38.
Zebrida adamsi, ORTMANN, 1893, p. 419, pl. 17 fig. 3; LAURIE, 1906, p. 393; URITA, 1926b, p. 29; UTINOMI, 1969, p. 37, fig. 1.
Zebrida paucidentata FLIPSE, 1930, p. 81, fig. 44.

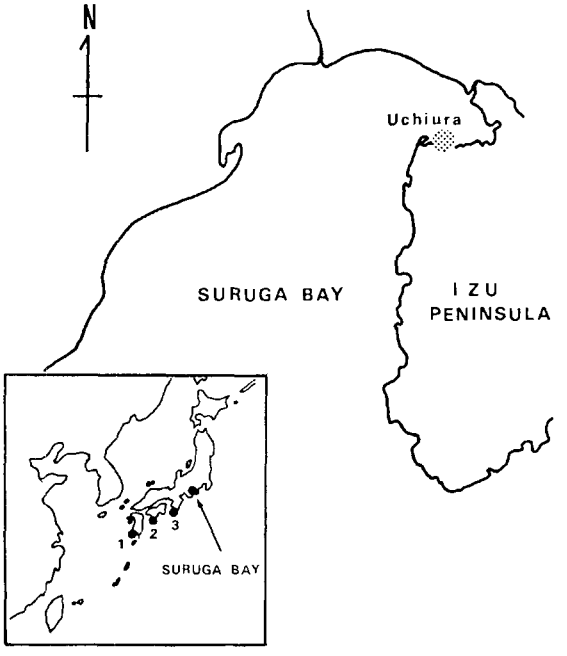

Fig. 1. Map showing the distribution of *Zebrida adamsii* in Japan (shown as solid circles) and the station (shown as a dotted circle) where the present collection was made. 1, Kagoshima Bay; 2, Sukumo Bay; 3, Coast of Wakayama Pref.

Material examined. Enashi, 25 m deep, Oct. 25, 1972, 1 ♂, MSM 72-029, from a *Diadema setosum* (LESKE).

Enashi, 28 m deep, Dec. 11, 1972, 1 ♂, MSM 72-066, from a *Tripneustes gratilla* (LINNAEUS).

Enashi, 20 m deep, 1 juv., MSM 73-005, Sept. 11, 1973, from a *Toxopneustes elegans* (DÖDERLEIN).

Kuryô, 3 m deep, Nov. 11, 1973, 1 young ♀, MSM 73-006, from a *T. gratilla.*

Enashi, 20 m deep, Mar. 3, 1974, 2 ♂♂, MSM 74-001, 002, from two *Asthenosoma ijimai* YOSHIWARA.

Enashi, 20 m deep, Mar. 20, 1974, 1 ♀ after spawn, MSM 74-003, from an *A. ijimai.*

Enashi, 21 m deep, May 13, 1974, 1 ♂, 1 ♀ after spawn, MSM 74-004, 005, from an *A. ijimai.*

Enashi, 5 m deep, May 13, 1974, 1 ♀, MSM 74-006, from an *A. ijimai.*

Enashi, 11 m deep, May 13, 1974, 1 ♀, MSM 74–007, from a *Toxopneustes pileolus* (LESKE).

Remarks. Among the specimens the largest is the female from Enashi (MSM 74–005), bearing the carapace width 15.4 mm and the length with 12.0 mm. In addition to the Suruga Bay specimens we examined a large male from Gobo in the west coast of Kii Peninsula kindly donated by Mr. Takashi KURODA of Gobo high school.

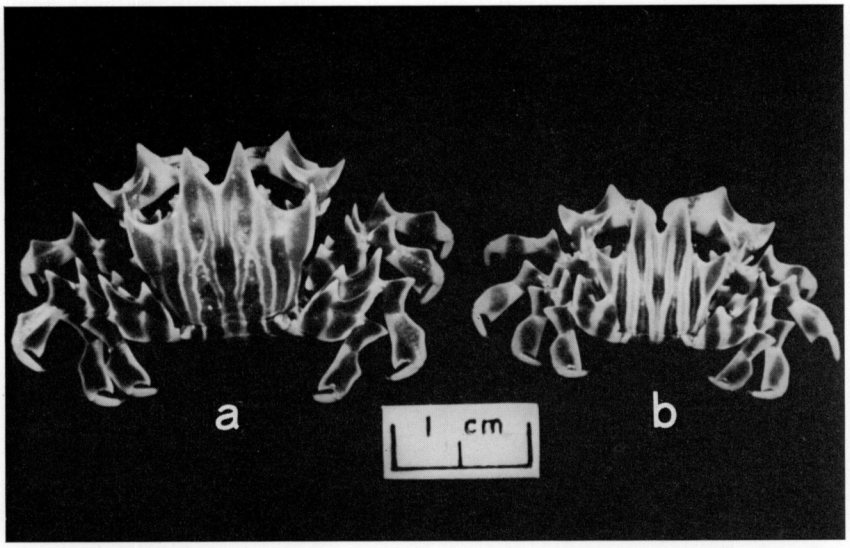

Fig. 2. *Zebrida adamsii* WHITE. A pair from an *Asthenosoma ijimai*. a, ♀ (MSM 74–005); b, ♂ (MSM 74–004).

The genus *Zebrida* WHITE is quite distinctive in the Eumedoninae of the Parthenopidae, being represented by *Z. adamsii* WHITE, 1847, and *Z. paucidentata* FLIPSE, 1930, the validity of the latter of which is somewhat questionable as remarked in the following lines. It is readily distinguished from the related genus *Eumedonus* H. MILNE EDWARDS by having a lateral tooth of the carapace remarkably thin and strongly directed forward so as to be nearly parallel to the frontal teeth. The carapace is subrhomboidal with the flattened dorsum, the rostrum being formed by two large laminar teeth. The orbit is circular with the inner canthus filled by part of the antennal peduncle. The antennule is folded very obliquely. The chelipeds are stout, equal and short, being armed with laminal teeth. The ambulatory legs are strongly compressed and subchelate with the propodi and dactyli. The male abdomen is composed of seven segments.

In *Z. adamsii* the dorsum of the carapace is flattened, but in reality the gastric, cardiac and branchial regions are traceable more or less distinctly in some larger specimens. In the cheliped the merus is trigonal with the laminar upper and lower edges which end each in a sharp tooth, its distal margin being armed with three lobular

teeth. Three laminar teeth on the upper surface of the carpus are disposed in a triangle and directed toward the different directions. The upper edge of the palm is distally produced into a high laminar tooth. In the ambulatory legs the upper border of the merus is armed with a triangular tooth in the middle and with a high narrow one at its distal end. The upper border of the carpus is also triangularly produced, while that of the propodus is raised and rather angulated in some specimens and only weakly convex in the others. The propodus is enlarged distally, and the talon-like dactylus articulating with the distal upper half of the propodus is held against its lower half in the manner of a subchela.

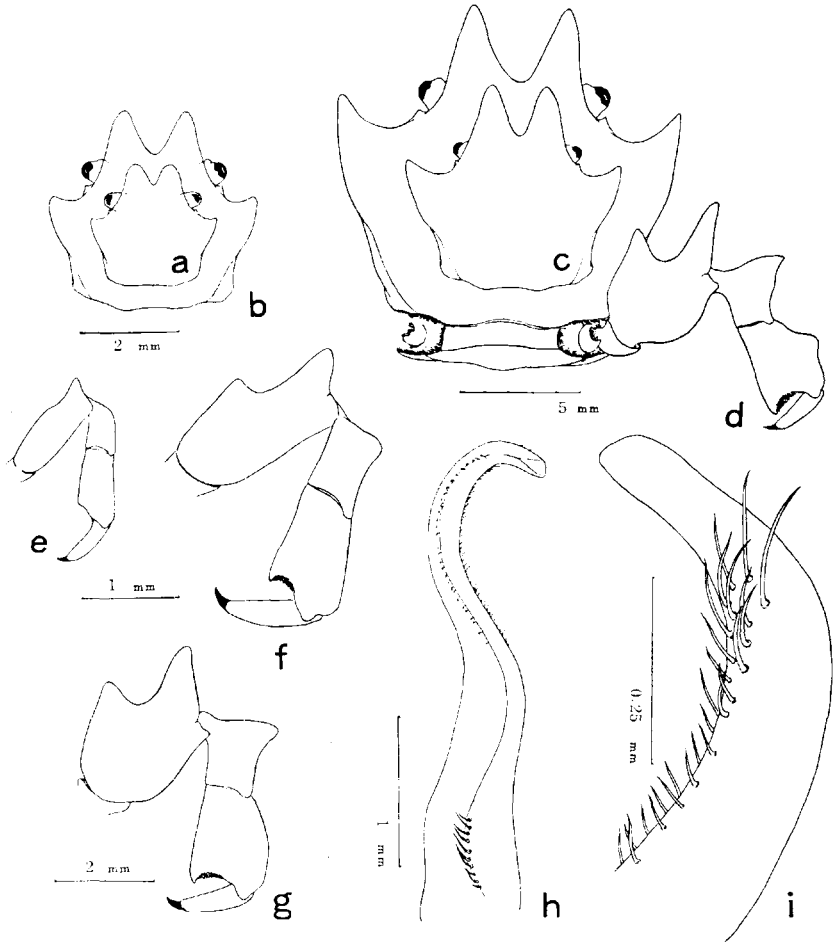

Fig. 3. *Zebrida adamsii* WHITE. a–d, carapace; e–g, right last leg; h and i, male first pleopod of left side, abdominal and sternal view, respectively. a and e, juv. (MSM 73–005) from *Toxopneustes elegans*; b and f, young ♀ (MSM 73–006) from *Tripneustes gratilla*; c and g, ♀ (MSM 74–006) from *Asthenosoma ijimai*; d, ♀ (MSM 74–005) from *A. ijimai*; h and i, ♂ (MSM 74–001) from *A. ijimai*.

In *Z. adamsii* the carapace is ornamented with purplish brown longitudinal, rather parallel bands and alternating streaks, and the chelipeds and ambulatory legs with broad somewhat oblique cross-bands. Even if this color pattern may be more or less simple and indistinct in the smaller specimens, it is characteristic of this species.

Apart from some individual variations, in the different developmental stages the shape of the carapace, chelipeds and ambulatory legs is fairly variable (Fig. 3). In the young specimens the lateral and frontal teeth of the carapace are comparatively short, and also all the teeth on the chelipeds and ambulatory legs are smaller and obtuse. In a juvenile specimen with carapace width ca. 2.3 mm, as already noted by RATHBUN (1910), the frontal teeth are short and blunt, only the apex of each lateral tooth of the carapace is directed forward, and the ambulatory legs are almost unarmed except for the distal ends of the meri of the last pair. The propodus of the last ambulatory leg bears a feeble projecting point on its lower border. It must be noted that this juvenile form is quite exactly agreeable with the description of *Z. paucidentata* which is based on a male with carapace width 3 mm from Makassar, 25–30 m deep. *Z. paucidentata* FLIPSE, 1930, is in all probability synonymized with *Z. adamsii* WHITE, 1847, representing a juvenile stage of the early known species. The genus *Zebrida* is therefore monotypically represented by the type-species.

Distribution. This species has hitherto been recorded from Japan, Borneo, Gulf of Siam, Torres Straits, Sri Lanka and Gulf of Manaar. Its recorded bathymetric range is from 10 to 55 m.

Ecological Note

Altogether 11 specimens of *Z. adamsii* were found among the spines of 5 species of sea urchins rather large and commonly found in Suruga Bay, viz., *Diadema setosum* [Japan. name: Gangaze], *Tripneustes gratilla* [Shirahige-uni], *Toxopneustes pileolus* [Rappa-uni], *T. elegans* [Kurosuji-rappa-uni], and *Asthenosolma ijimai* [Ijima-fukuro-uni], all of which were collected individually by the SCUBA divers during the years 1972–1974. As readily known from the list of the materal examined, it is remarkable that only one individual of the crab was found each on one sea urchin in 10 of 11 cases. In a residual case held on 13th May, 1974, a pair of the crab attached to an *A. ijimai*, and the female after spawn with carapace width 15.4 mm is the largest in all the specimens and the male with carapace width 11.5 mm is the largest in all the males at hand (Fig. 2). In the field it was confirmed in two hosts, *T. pileolus* and *A. ijimai*, that the crab was usually found at the ambitus or sometimes near the oral side. According to the aquarium observations, however, the crab took its place rather aboral side (Pl. 1), sometimes moving freely on the surface beyond the spines of the host. All of spines and tubercles of the sea urchins accompanied with the crab disappear, and in many cases the test of the host is quite naked and almost smooth. In altogether 6 cases confirmed, one of which is concerned with *T. pileolus* and the other 5 with *A. ijimai*, the crab attaches only to

the interambulacral zone of the host, and the injured part is extending along the radial axis toward both the oral and the aboral sides. The width of injured part is usually equal to the span of both chelipeds of the crab, tapering toward both extremities. On close observation this part takes the greatest width at the ambitus, but in some severe cases this part is much wider and almost reaches two thirds the width of the interambulacral zone. The ambulacral zones and the tube feet are always normal and the injured part is not extended across the radial axis beyond the ambulacral and interambulacral zones without an exception. The injured part is usually only one in a host, but in some cases there are two or three naked places. It is remarkable that the apparent damages by the crabs are restricted to the interambulacral zones of the test and that the crabs neither form the so-called galls in the body cavity nor perforate the test of the host.

Fig. 4. Injured interambulacral zone of *Tripneustes gratilla*.

The dactylus of each ambulatory leg of *Z. adamsii* is curved backward to form the subchela together with the distal margin of the propodus, the crab grasping the spines of the host by this subchela. It is shortly remarked that the crab cannot walk normally on sandy flat in the aquarium, when it is removed from the host sea urchins. The smaller individual leaves the host immediately after such stimulation that the sea urchin is scooped up by a small net, while in the larger ones by some stimuli the crab brings down the carapace toward the test firmly grasping the spines of the host by the subchelae formed by the propodi and dactyli of the ambulatory legs. The crabs take some minute particles for food from the surfaces of the test and spines by the chelipeds, but during the present observation it is quite apparent that they didn't snap

off the spines or nip off the pedicellariae and tube feet. The sexual differences in the usual activities are not observed, so that it is almost impossible to know the sex of the crab on the host.

In a specimen of *A. ijimai* rearing 70 days in the aquarium after removal of the crab, a few miliary spines are regenerated on the injured part once damaged by the crab.

Discussion

The present observation revealed that *Z. adamsii* lives on 5 large species of sea urchins from Suruga Bay, and that there are no particular interspecific relations between this crab and some host sea urchins along the coast in question. Consulting literature this species has been recorded from some species of sea urchins, viz., *Toxopneustes pileolus* (LESKE) and *Salmacis bicolor* AGASSIZ (RATHBUN, 1910), *Anthocidaris crassispina* (AGASSIZ) (URITA, 1926a), *Acanthocidaris* sp. (BALSS, 1956), *Asthenosoma ijimai* YOSHIWARA (DOKI, 1972) and *Tripneustes gratilla* (LINNAEUS) (YAMAMOTO, 1973). In the last case kept in an aquarium it is briefly mentioned that the crab first found on *T. gratilla* afterward changed the host to *Diadema setosum*, but it seems to be somewhat curious that no report on such observation recorded at present has hitherto been made at all. Although up till now the life history of this crab has not been studied, it is highly probable that the crab in a certain juvenile stage reaches a sea urchin of good size without special selection.

All of 4 specimens collected in 1972 and 1973 are not fully matured and exclusively collected during four months from September to December. This fact indicates that *Z. adamsii* may be one of the representatives of the pseudofauna of Suruga Bay, in which some juvenile crabs transported every year by the warm current from the southern district have died out in the winter. In the spring of 1974, however, some larger adults were collected, and it became apparent that a few or some individuals of this warm water species can tolerate the winter season at least in the good oceanographial condition.

As a result of the present observation it is decidedly concluded that *Z. adamsii* is not a commensal of the sea urchins, but without doubt a parasitic species inflicting damage on the host, as already mentioned by MORTENSEN (1904). We take no particular exception to MORTENSEN's conclusion, but his observation that the tube feet were damaged by the crab may be not correct, and in our observation the violent activities for the host as described by him were also not seen. Even if it is not sure the reason why the test of the sea urchin is not only exposed with the epidermis peeled off, but also all the spines are quite fallen off, it is rather difficult to think that the crab breaks off for food the large spines considering the result of our own observation and also the comparison between the sizes of the crab chelipeds and the host spines. When the sea urchins with the crabs are transferred to the aquarium, the spines are often abnormally fallen off. It is natural or reasonable that the autotomy

of the spines may take place by the certain stimuli of the crabs rather than suspecting that the crabs eat the muscle of the bases of the spines suggested by MORTENSEN (*op. cit.*).

Although *Z. adamsii* is much smaller than the host sea urchins and the damaged naked part of the test is usually rather narrow, an indeed harmful influence on the host may be heavier than the visual damage made by the crab. In addition to the naked part mentioned elsewhere, the color and activities of the sea urchins usually become somewhat abnormal so that the careful divers may be able to distinguish easily the normal and parasitised sea urchins. In one case of *A. ijimai*, for instance, its characteristic movement of the spines as the shadow reaction became remarkably inactive. The other large specimen of *A. ijimai* with a middle-sized female crab was found in the abnormally shallow water, 5 m deep, while the normal ones inhabit deeper than almost 20 m in our stations. In this specimen it was confirmed by the field and aquarium observations that the movement of the spines and the shadow reaction are very feeble. Even if it is not appropriate that all of these abnormalities are referred to the presence of the crabs, the crabs exert without doubt a certain harmful influence upon the hosts. In both cases of *A. ijimai* above mentioned, the ambulacral zones, especially the tube feet seem to be still nearly normal.

The Eumedoninae of the Parthenopidae are mostly represented by the specialized species associated with the sea urchins and comatulids. It is not sure and remains some doubts whether the relations between *Z. adamsii* and the host sea urchins already mentioned are applicable to some cases of this subfamily, e.g., *Echinoecus pentagonus* (A. MILNE EDWARDS), just as it is. *E. pentagonus* has hitherto been known as a commensal of some sea urchins with some doubts about this definition. MIYAKE (1939) who was of opinion that this species may be separated into some species and subspeices with two main types based on the ecological differences, one with the parasitic habit living in the anal tube of the sea urchins, and the other living among the spines to get the benefit of shelter. At the present knowledge all the species and subspecies hitherto distinguished having the seemingly quite different shape and habit are synonymized with *E. pentagonus*, and it may be a definite opinion that it is a parasite forming a so-called gall at the anal region of the host sea urchins in the tropical and subtropical regions, while along the warm Japanese coast it is usually found among the spines being designated as a commensal.

On 12th January, 1974, 6 ♂♂ and 4 ♀♀ of *E. pentagonus* from 48 of *Pseudocentrotus depressus* (AGASSIZ) [Japan. name: Aka-uni] and 1 ♂ from an *Anthocidaris crassispina* (AGASSIZ) [Murasaki-uni] were collected by Mr. Y. OKA at the depths of 2 to 3 m along the coast of Uchiura. The crabs are usually found near the oral side of the hosts, mainly resting on the vicinity of the peristome. As in the case of *Z. adamsii*, the spines of the hosts are fallen off and the damaged part of the test is naked due to the epidermal desquamation. According to the additional observation on them, the damaged naked parts are much smaller than those of *Z. adamsii* and nearly equal

to or only slightly wider than the size of the crabs. This fact may be partly due to the narrow range of usual movement of *E. pentagonus*, its habit being quite comparable with that of *Z. adamsii*. In both species its seemingly minor damage not fatal may be the reason why their true nature as the parasitic animals of the sea urchins has been overlooked. It is highly desirable to observe the ecology and life history of some other crabs and probably alpheid shrimps hitherto defined as the commensals of the sea urchins.

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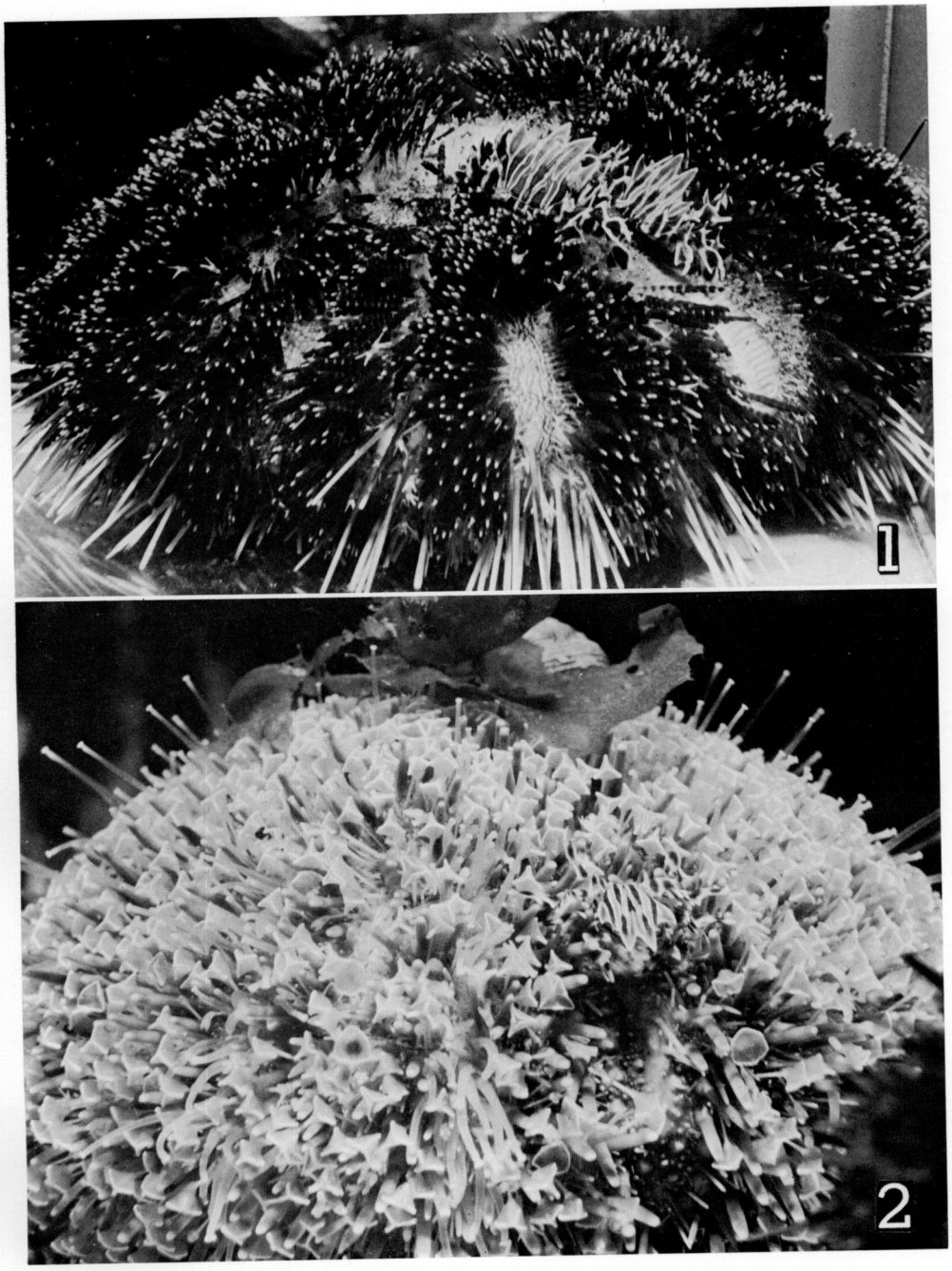
Explanation of Plate 1

Figs. 1 and 2. *Zebrida adamsii* on the host sea urchins, the naked parts being the interambulacral zones damaged by the crabs.

1. A pair (MSM 74–004, 005; male with 11.5 mm and female with 15.4 mm in carapace width) on *Asthenosoma ijimai*.
2. A female (MSM 74–007; 7.3 mm in carapace width) on *Toxopneustes pileolus*.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