ON THE STABILITY OF POPULATION COMPOSITION IN A FIXED ECHINID COLONY ON THE ROCKY SHORE OF HATAKEZIMA ISLAND[1)]

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With 3 Tables

After the attack of unusual cold of 1962–63 winter, the observation on the composition of sea urchin population has been made regularly once every year in the summer season at a fixed echinid colony on the west shore of the western reef of Hatakezima Island. The exact site and general aspect of the fixed echinid colony were given in my first paper dealing with the population composition of echinid colony (TOKIOKA 1963, p. 247, Text-fig. 2). These observations were done on the programme to learn how the recovery of population of *Echinometra mathaei* (BLAINVILLE), which had perished in 1962–63 winter, was achieved. After about two and half years some extent of the recovery of this sea urchin in that echinid colony was attained (TOKIOKA 1966) and the specimens in the colony seemingly reached the body size of sexual maturity (TAHARA and OKADA 1968, p. 48). Subsequent observations seem to show that the former population size of *Echinometra* has been restored and as seen in Table 1 the population is now nearly in a stable state, although none of the questions presented in my first paper (p. 246) as to the mechanism of regaining its former niche has been answered.

Seeing through the succession of population composition in the echinid colony, the steady decline of the *Echinostrephus* percent will attract our notice. The number, then inevitably the percent, of *Echinostrephus* in the fixed echinid colony will fluctuate according to the increase or decrease of not only the same species but also of other species in the region. The steady increase of *Echinometra* has been noted. The decline of *Echinostrephus* percent in 1964 was evidently attributable to the sudden unusual increase of *Mespilia* in that year (TOKIOKA 1966, Table 1). Thus I wondered what the most adequate index for the prosperity of *Echinostrephus* in the region was. The fluctuation of *Mespilia* is seemingly somewhat irregular. Moreover, this sea urchin has very weak adhesive power and its appearance in the intertidal zone may easily be

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Table 1. Population composition in the fixed echinid colony 1966–1968.

1966, July 19	Section 1 (SW)	Section 2 (NW)	Section 3 (SE)	Section 4 (NE)	Total	Percent
Anthocidaris crassispina	85	131	139	67	422	50.0
Echinostrephus aciculatus	52	165	68	53	338	40.0
Echinometra mathaei	9	16	8	11	44	5.2
Mespilia globulus	4	15	10	11	40	4.8
					844	100.0

1967, July 22	Section 1 (SW)	Section 2 (NW)	Section 3 (SE)	Section 4 (NE)	Total	Percent
Anthocidaris crassispina	79	93	94	61	327	50.4
Echinostrephus aciculatus	44	109	51	46	250	38.5
Echinometra mathaei	9	16	10	13	48	7.4
Mespilia globulus	3	8	2	9	22	3.4
Pseudocentrotus depressus		1			1	0.15
Stomopneustes variolaris				1	1	0.15
					649	100.0

1968, July 11	Section 1 (SW)	Section 2 (NW)	Section 3 (SE)	Section 4 (NE)	Total	Percent
Anthocidaris crassispina	106	77	144	114	441	56.8
Echinostrephus aciculatus	49	91	69	67	276	35.5
Echinometra mathaei	4	6	14	19	43	5.5
Mespilia globulus	3	2	6	3	14	1.8
Hemicentrotus pulcherrimus			1	1	2	0.3
Pseudocentrotus depressus		1			1	0.1
					777	100.0

Table 2. Succession of the population size of *Echinostrephus aciculatus* A. AGASSIZ in the fixed echinid colony 1963–68.

	1963	1964	1965	1966	1967	1968
Individual number	218	290	407	338	250	276
Percent	51.1	46.5	50.3	40.0	38.5	35.5
*E/A	1.06	1.13	1.09	0.80	0.76	0.63

* Number of *Echinostrephus*/number of *Anthocidaris*

affected by rough weather. The population of *Echinometra* seems to have reached already a stable state, but the size of population is too small as compared with those of *Echinostrephus* and *Anthocidaris*. Then, the ratio of the number of *Echinostrephus* to that of *Anthocidaris* (E/A) was calculated to be accepted as something like an index of the prosperity of *Echinostrephus*. The ratio shows a trend toward the decrease since 1966.

Now, generally speaking, *Echinostrephus aciculatus* A. AGASSIZ shows the seaward distribution against *Anthocidaris crassispina* (A. AGASSIZ) which is distributed widely and somewhat densely even in the inner parts of Tanabe Bay. *Echinostrephus* becomes apparently more abundant and denser on the rocky shore outside the bay, although the substratum must be provided with many hollows to harbour the population of *Echinostrephus*. Then, it is not impossible that the drop of E/A reflects the progression of the water pollution around Hatakezima Island caused by steadily increasing sewage from various kinds of facilities which are being rapidly extended along the coast of the southeast inner part of the bay. In expectation of some trend, the observation was repeated this year on July 2, and it was found very happily that E/A was recovered a little. If this can be accepted to show that the progression of pollution is at least not significant around Hatakezima Island, they will be much encouraged to make efforts for the conservation of nature of the sea in the region.

However, most echinids are nocturnal. Sea urchins in the fixed echinid colony will go out at night from respective hollows they occupy and most of them will probably come back next morning each to some hollow in the same colony. But a small part of the population must be exchanged with the individuals outside that colony. The accumulation of such daily slight exchanges will become very significant if the composition of echinid population outside that colony differs much from that in that echinid colony. Then, the result of observation made on July 2 will do nothing but only show a momentary aspect on that day and be of little significance. To see what the case was, the observation was repeated once more four weeks later on July 30 at the same colony. As seen in Table 3, the results of both observations agree with each other very satisfactorily. The result of respective observations may safely be accepted to show the general aspect of the echinid population in a considerably wide

Table 3. Population composition in the fixed echinid colony in July 1969.

1969, July 2	Section 1 (SW)	Section 2 (NW)	Section 3 (SE)	Section 4 (NE)	Total	Percent
Anthocidaris crassispina	88	90	144	82	404	52.3
Echinostrephus aciculatus	51	126	81	61	319	41.3
Echinometra mathaei	4	13	14	15	46	6.0
Mespilia globulus	1		2		3	0.4
					772	100.0
E/A=0.79						

1969, July 30	Section 1 (SW)	Section 2 (NW)	Section 3 (SE)	Section 4 (NE)	Total	Percent
Anthocidaris crassispina	107	107	151	73	438	51.8
Echinostrephus aciculatus	56	146	79	72	353	41.8
Echinometra mathaei	3	17	15	18	53	6.3
Mespilia globulus			1		1	0.1
					845	100.0
E/A=0.81						

range around the fixed echinid colony for a considerably long time-span.

The echinid census at the fixed station will be continued further to see whether or not the prosperity of *Echinostrephus* is really affected by pollution of the sea water in the region or to learn how the former is affected by the latter. From the biological point of view, the problems concerning the mechanism of securing respective nest hollows among different kinds of sea urchins are of great interest. Tracing of some individuals in the fixed colony by some marking and actual observations on the behaviour of respective species are to be made to answer such questions. The results of above-mentioned observations may be summarized as follows:

(1) The former population of *Echinometra* has seemingly been restored in the intertidal zone of Hatakezima Island since 1966–67.

(2) The size and composition of the echinid population at the fixed station on Hatakezima Island are seemingly not affected significantly by the water pollution in the region at least at present.

Notes on richness of some tropical animals:

Mespilia globulus (LINNAEUS) was met with rather sparsely in field observations made in the intertidal zone of Hatakezima Island from March to July 1966, but 40 specimens of this sea urchin were found in the fixed echinid colony on July 19. In 1967, however, *Mespilia* was not rare in field observations made on the same island from March to June. On March 29, eleven *Mespilia* were met with together with a single *Stomopneustes* in the time while 218 *Echinometra* were counted, and in May to June a considerable number of this sea urchin were found in shallow waters. But, only 22 specimens were counted in the fixed colony on July 22. Probably this is because a large number of *Mespilia* were destroyed by a stormy weather accompanied with heavy rain, which attacked this region around July 9. On July 10, a significant number of dead or dying *Mespilia* were found stranded on the southern sandy flat of the intertidal zone of the Hatakezima region. A similar phenomenon was observed near the boat slide on the north shore of the laboratory. The fewness of *Mespilia* in 1969 has been confirmed by underwater observations, too. Furthermore, the paucity of *Mespilia* in the two observations made on July 2 and 30 may partly be attributable respectively to heavy rain and stormy weather preceded those observations.

The former population density of *Holothuria leucospirota* (BRANDT) seems to have been restored already since 1966–67. This sea cucumber is met with rather rarely in the spring season, but it becomes common in June. In the summer season up to 15 specimens may be counted in the range of one's sight, though it is very scarcely found exposed after heavy rain. *Holothuria pervicax* SELENKA which was ever met with in this region frequently, though sparsely, is now rather rare. In the intertidal zone of Hatakezima Island, I could confirm the single specimen of this species only twice in 1966 to 1969.

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