BENTHIC FAUNA IN ZOSTERA MARINA BEDS OFF ASAMUSHI, NORTH JAPAN

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BENTHIC FAUNA IN *ZOSTERA MARINA* BEDS OFF ASAMUSHI, NORTH JAPAN[1]

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The benthic fauna in offshore *Zostera marina* beds at Asamushi, north Japan (40°53'N : 140°51'E), where reclamation of the foreshore and construction had been carried out up until 1986, was investigated by trawling in June, 1988. The results were compared with those of investigations conducted in 1961 before the reclamation and construction, and the change in the fauna before and after the reclamation and construction work was discussed. A large number of small animals were collected together with *Z. marina* and silky sea weed in 1988, and it was found that the number of recorded taxa had increased since 1961. However, almost all of the large animals, *i.e.*, megalobenthos, recorded in 1961 were also collected or observed in 1988, suggesting that benthic fauna in the *Zostera* beds off Asamushi had not been changed by the local reclamation and construction work.

Introduction

In naturally occurring *Zostera* beds, certain species of benthic animal are abundant, and these are understood to constitute a characteristic fauna (*e.g.*, Kikuchi, 1966 : Orth *et al.*, 1984). Some species of fish spawn in these beds, and the hatched juveniles grow there (*e.g.*, Harada, 1962 : Kikuchi, 1966). Clarification of the composition of benthic fauna in *Zostera* beds is very important from viewpoints of both marine ecology and fisheries to determine the prey-predator relationships among benthic animals.

Off Asamushi, north Japan (40°53'N : 140°51'E), *Zostera marina* grows thickly, and forms beds scattered on the shallow sea bottom at a depth of less than about 10 m. Yusa *et al.* (1961) investigated the benthic fauna of two typical areas with and without *Z. marina*, and described the differences of species composition between them.

After the investigations by Yusa *et al.* (1961), the foreshore at Asamushi was reclaimed in order to built a bypass in 1972, and a yacht harbor in 1978. Moreover, a fishing park was constructed at the tip of the yacht harbor in 1986. The foreshore

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at Utoumai, where the fauna was investigated by Yusa *et al.* (1961), was also reclaimed to build a bypass in 1979. This reclamation of the foreshore and construction projects transfigured the topography of the seashore at Asamushi. This was considered to influence the density and growth of *Z. marina*, and consequently the benthic fauna, as a result of the changes in the physical environment, such as water current and water exchange.

The aim of this study was to clarify the species composition of benthic fauna in the *Zostera* bed off Asamushi, after the reclamation and construction work. Moreover, the transition of the fauna was clarified by comparison between the species compositions before and after the reclamation and construction.

Study Sites and Methods

Investigations of benthic fauna were conducted at the *Zostera* beds off Asamushi (40°53′30″N : 140°51′50″E) and Yunoshima Island (40°53′30″N : 140°51′20″E) (Fig. 1). *Z. marina* off Asamushi was about 50 cm in length, and scattered on the sandy sea bottom. The bottom was flat and approximately 5 m below the water

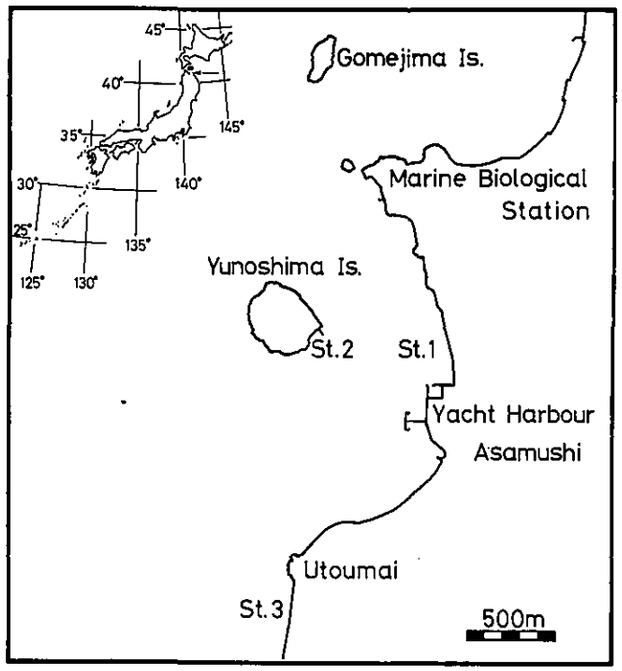

Fig. 1. Map of the seashore around Asamushi, Aomori prefecture. St. 1, 2 and 3 indicate the stations off Asamushi, Yunoshima Island and Utoumai, respectively, where benthic fauna in *Zostera marina* beds was investigated.

surface.

Off Yunoshima Island, *Z. marina* was about 3 m in length, and distributed abundantly. The bottom had a gentle slope, and the depth from the water surface changed from about 1 m to 5 m further offshore. Many round stones lay on the bottom.

Benthic animals were collected by trawling (net size : height=50 cm, width=150 cm, depth=200 cm, mesh size=3.6 mm). Trawling was carried out for approximately 300 m along the *Zostera* beds off Asamushi on 16 June, 1988, and for about

Table 1.
Lists and individual numbers of vertebrates collected by trawling (mesh size=3.6 mm) in *Zostera marina* beds off Asamushi (St. 1), Yunoshima Island (St. 2) and Utoumai (St. 3), north Japan. * and ** indicate published (1961) and unpublished data obtained by Yusa *et al.*, respectively.

Taxa	1988 June		1961 May*		1961 June**		1961 July**	
	St. 1	St. 2	St. 1	St. 3	St. 1	St. 3	St. 1	St. 3
OSTEICHTHYES								
Aulichthys japonicus	18	7						
Syngnathus schlegeli	5		5	28	8	18		9
Hypoptychus dybowskii						9		
Opisthocentrus ocellatus	19	71	1	30		6	3	1
Opisthocentrus zonope						7		
Enedrias nebulosus	1							
Pholis ornatus			2	11	1	5	5	7
Gobius gymnauchen							1	1
Acanthogobius lactipes							1	
Acanthogobius flavimanus							12	
Chaenogobius heptacanthus				2			85	2
Gobiidae sp.					15			
Fugu vermiculare							1	
Fugu poecilonotum						3		
Sebastes inermis						3		
Sebastes schlegeli					3	1	3	1
Sebastes oblongus			1	1			1	3
Hexagrammos otakii	2			11	1	17	1	10
Pseudoblennius percoides	8				2	20	6	6
Bero elegans			4	6		1		
Pallasina eryngia						1		
Paralichthys olivaceus					2		2	
Limanda punctatissima			1				1	
Limanda yokohamae	1		2	6	2	1		
Kareius bicoloratus	1		1		1		8	

Table 2.
Lists and individual numbers of invertebrates collected by trawling (mesh size = 3.6 mm) in *Zostera marina* beds off Asamushi (St. 1), Yunoshima Island (St. 2) and Utoumai (St. 3), north Japan. * and ** indicate published (1961) and unpublished data obtained by YUSA *et al.*, respectively.

Taxa	1988 June		1961 May*		1961 June**		1961 July**	
	St. 1	St. 2	St. 1	St. 3	St. 1	St. 3	St. 1	St. 3
PROTOZOA								
Foraminiferida spp.	40	37						
CNIDARIA								
Cladonema uchidai	3	13				9		5
Gonionema oshoro	1	2				15		5
Haliclystus auricula	1							
PLATHELMINTHES								
Polycladida spp.	1	2						
NEMATODA								
Nematoda spp.	667	114						
MOLLUSCA								
Lepidozona albrechti	5							
Ischnochitonina spp. (juv.)	4							
Nordotis discus	1							
Notoacmea schrenckii (juv.)	2							
Patellacea sp. (juv.)	1							
Cantharidus jessoensis	11	754						
Homalopoma sangarense		1						
Temanella turrita	4612	1479						
Stenotis cariniferus	1113	675						
Angustassiminea satsumana		34						
Reticunassa japonica	16	2		3		3		1
Gastropoda sp. A		104						
Gastropoda sp. B	47	67						
Gastropoda sp. C	2	5						
Gastropoda sp. D		6						
Episiphon makiyamai						1		
Mytilidae spp. (juv.)	102	64						
Patinopecten yessoensis (juv.)	71	100						
Hiatella flaccida	1	3						
Idiosepius pygmaeus	32	14		29		15		3
ANNELIDA								
Ammphinomorpha spp.	51	1						
Nereimorpha spp.	172	72						
Spiomorpha spp.	16	5						
Drilomorpha spp.	4							
Terebellomorpha spp.	1921	16353						
Serpulimorpha spp.	31	185						
Polychaeta spp.			4	1		2	2	2
Piscicolidae spp.	4							
ARTHROPODA								
Pycnogonida spp.	2	1		1		5		
Ostracoda spp.	57	16						
Lepeophtheirus goniistii		1						
Copepoda spp.	1569	272						
Siriella watasei	54	3	29	159	15	262		72
Mysidacea spp.	1		10	22	5	38		3
Cumacea spp.	9							
Tanaidacea spp.	9	5						
Paranthura japonica	14	1	1	1		1		
Janiropsis longiantennata	2	1						
Idotea ochotensis	1							

Table 2.
(continued)

Taxa	1988 June		1961 May*		1961 June**		1961 July**	
	St. 1	St. 2	St. 1	St. 3	St. 1	St. 3	St. 1	St. 3
Dynoides dentisinus	1							
Cyproniscus ovalis	7	14						
Isopoda spp.	7				1	1		
Anonyx ampulloides	4	1						
Harpinia miharaensis	1							
Stenothoe valida (?)	15	3						
Pontocrates altamarinus	9							
Pleustes panopla	22	5						
Pontogeneia rostrata	27	1						
Melita dentata	32							
Maera spp. (?)		28						
Paradexamine barnardi	57	29						
Hyale grandicornis (?)		6						
Eurystheus japonicus	566	15						
Ampithoe spp.	108	115						
Jassa falcata	146	25						
Corophium spp.	92	10						
Ericthonius pugnax	7	11						
Cerapus tubularis	30							
Gammaridea spp.	6		11	32		19		17
Caprella spp.	420	79	13	38		24		2
Heptacarpus pandaloides	36	129						
Heptacarpus geniculatus		2						
Heptacarpus spp.			112	734	131	1047	30	306
Eualus spp.			5	27	1	113		7
Crangon affinis	21	1	11	17	8	3	3	5
Paguristes japonicus	1							
Pagurus middendorffii	10	4						
Pagurus ohotensis	1							
Paguridea spp.								3
Telmessus acutidens	2		2	14		1	3	7
Charybdis japonica	1	1						
ECTOPROCTA								
Gymnolaemata spp.		8						
BRACHIOPODA								
Atremata sp.						1		
ECHINODERMATA								
Gnathophiurida sp.	1							
Astropecten scoparius							3	
Asterina pectinifera			17	3	27	1	16	1
Aphelasterias japonica								1
Asterias amurensis	1			2	2	36		9
Glyptocidaris crenularis					3		1	
Temnopleurus hardwicki					1			
Strongylocentrotus intermedius	2							
Strongylocentrotus nudus					2			
Echinocardium cordatum							1	
PROCHORDATA								
Ciona intestinalis	4							
Ascidiacea spp.	1	5						

150 m along the beds off Yunoshima on 21 June, 1988. All specimens after collection were preserved in 10% formalin solution. Benthic animals collected were sorted, identified and counted in the laboratory. Identification of the specimens was done mainly according to descriptions in the "New Illustrated Encyclopedia of the Fauna of Japan (1965)".

Results and Discussion

Taxa and individual numbers of benthic animals collected in June, 1988 are shown in Tables 1 and 2, together with published (1961) and unpublished data obtained by Yusa *et al.*

All vertebrates collected were Osteichthyes (Table 1). The number of species of bony fish collected at the *Zostera* beds off Asamushi did not change markedly between the investigations in 1961 and 1988. Among eight species collected in 1988, six *i.e.*, *Syngnathus schlegeli*, *Opisthocentrus ocellatus*, *Hexagrammos otakii*, *Pseudoblennius percoides*, *Limanda yokohamae* and *Kareius bicoloratus*, were recorded in 1961. Gobies, collected abundantly in July 1961, did not appear in June 1988. According to the results of the investigations in 1961, they showed a tendency to be more numerous toward summer, suggesting that they arrive and become distributed in the *Zostera* beds seasonally. From the data of the 1988 investigation, they probably were not distributed in the beds. In 1988, two species, *Aulichthys japonicus* and *Enedrias nebulosus*, were newly recorded and seven species, *Pholis ornatus*, *Fugu vermiculare*, *Sebastes schlegeli*, *Sebastes oblongus*, *Bero elegans*, *Paralichthys olivaceus* and *Limanda punctatissima*, were not collected. Nevertheless, all the above species were observed in both years. These results indicated that the bony fish community did not change between 1961 and 1988 at this site.

Flatfish had a tendency to be collected more frequently in the beds off Asamushi than in those off Utoumai and Yunoshima. This result may be related to the patchy distribution and low density of *Z. marina* on the sandy bottom off Asamushi, since the flatfish collected generally inhabit sandy soft bottom areas (Yusa *et al.*, 1961). Flatfish were collected in both 1961 and 1988 at the beds off Asamushi, confirming that *Z. marina* was relatively scarce there before the reclamation and construction work. At the beds off Yunoshima, only two species, *A. japonicus* and *O. ocellatus*, characteristically inhabiting the *Zostera* beds (Yusa *et al.*, 1961), were collected. The small number of species of bony fish may be related to the abundant *Z. marina*. On the other hand, the beds off Utoumai disappeared after reclamation to built the bypass in 1979.

The number of invertebrate taxa collected during the investigation in 1988 was considerably increased in comparison with that in 1961, especially Mollusca, Annelida and Arthropoda. Almost all of the animals newly recorded in 1988 were so small that they could have passed through the trawling net (mesh size=3.6 mm).

These animals included, for example, Foraminiferida spp., Nematoda spp., *Temanella turrita*, *Stenotis cariniferus*, *Angustassiminea satsumana*, Terebellomorpha spp., Copepoda spp., Gammaridea spp., and so on. In the 1988 investigation, a great quantity of silky sea weed was collected together with *Z. marina*, especially off Yunoshima. The above small animals were considered to have been collected along with these silky sea weeds.

Megalobenthos, such as *Cladonema uchidai*, *Gonionema oshoro*, *Reticunassa japonica*, *Idiosepius pygmaeus*, *Siriella watasei* and Decapoda, were recorded in both 1961 and 1988. On the other hand, the numbers of individuals and taxa of Echinodermata collected in 1988 were lower than those in 1961. Nevertheless, other species except for *Glyptocidaris crenularis* were often observed on rocks and boulders in 1988. These facts suggested that the invertebrate community had not changed widely, as in the case of vertebrate.

The number of taxa of benthic animals collected in the beds off Asamushi was higher than that collected off Yunoshima. In the beds off Asamushi, large shells of *Saxidomus purpuratus*, which inhabits sandy bottoms, were collected together with *Z. marina* and silky sea weeds, indicating that the trawling was adequate for collecting items on the bottom. On the other hand, in the beds off Yunoshima where round stones lay on the bottom, no stones were collected, suggesting that the trawling net did not reach the bottom due to the large quantity of *Z. marina* and silky sea weeds. This difference as to whether or not the net reached bottom may be related to the higher number of taxa of benthic animals recorded in the beds off Asamushi than that off Yunoshima. On the other hand, in the beds off Yunoshima, many animals inhabiting the intertidal zone, *e.g.*, *Cantharidus jessoensis* and *A. satsumana*, were collected. Exposure of long leaves of *Z. marina* on the water surface was considered to create the conditions of the intertidal zone where these animals inhabit.

As mentioned above, although the number of taxa of benthic animals recorded by the investigation in 1988, due to the numerous small animals collected, was higher than that in 1961 on the *Zostera* beds off Asamushi, the megalobenthos community did not change between the two years. These results suggest that the fauna was not changed by the local reclamation and construction work.

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