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A BIOMASS ESTIMATION OF EPIFAUNAL MEGABENTHOS BY STEREOPHOTOGRAPHY AROUND SYOWA STATION, ANTARCTICA

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Abstract: Biomass estimation of epifaunal megabenthos was made with stereographic photographs which were taken at four stations in the Syowa Station area, Antarctica, in January 1984. The size of individuals was measured with reading of photographs and then it was converted into the wet weight based on the size-weight relationship for each species. The values of the equilibrium constant and the initial growth index were computed for the direct measurement of size and weight of preserved samples.

The total biomass estimated at the station of 16 m in depth in the Kita-no-seto Strait, the stations of 40 and 80 m in depth in the Kita-no-ura Cove and the station of 200 m in depth in the Ongul Strait was 791 ± 138, 2834 ± 655, 1984 ± 492 and 423 ± 110 g/m^2, respectively. These were considered reasonable figures for the epifaunal megabenthos in the Antarctic coastal waters. Application of underwater stereophotography is considered to be one of the effective methods for the biomass estimation of epifaunal megabenthos.

1. Introduction

Due to the sea ice cover and low water temperature, the fieldwork on the benthos in the Antarctic coastal waters is difficult. Although several works on the benthos were carried out (USHAKOV, 1964; GRUZOV *et al.*, 1968; DAYTON *et al.*, 1970; PROPP, 1970; HARDY, 1972; WHITE and ROBINS, 1972; PLATT, 1980; NAKAJIMA *et al.*, 1982), they were of local. The collection of further data on the distribution of benthic species and the estimation of their biomass are necessary to make detailed discussion on the general ecology of Antarctic benthos.

To fulfill these requirement, improvements of techniques in the field observation is essential.

To make the physiognomical observation of benthic communities, the authors had used a remotely operated vehicle system, consisting of a submarine TV camera and a stereo still camera, in the Syowa Station area. The faunistic account of the benthic communities observed with this system and the detailed information of the remotely operated vehicle were given in HAMADA *et al.* (1986).

In this paper, results of the biomass estimation of the benthic communities by means of the stereophotographs are reported.

2. Material and Method

For the present study, 38 pairs of stereophotographs which were taken in the period of January 6 to 20, 1984 at four stations around Syowa Station, were used (Fig. 1).

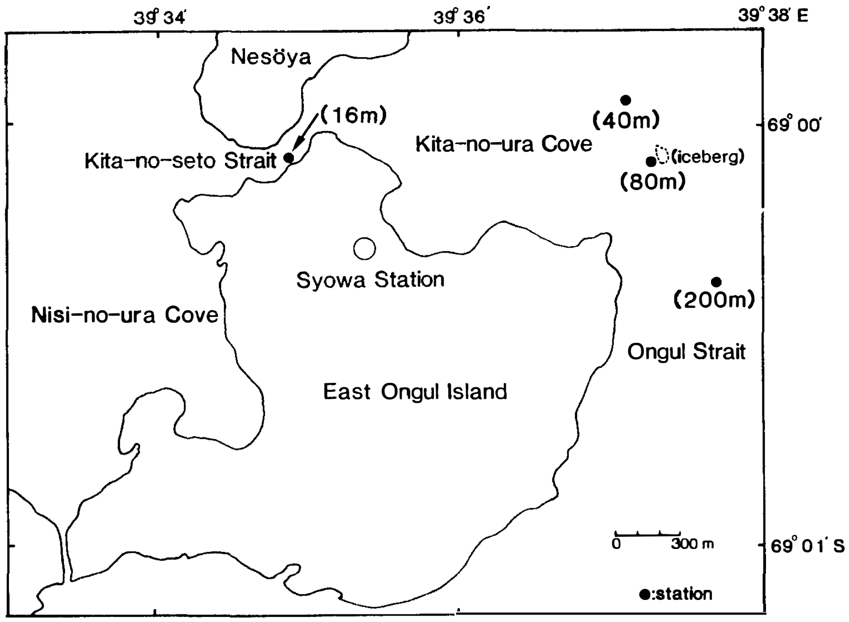

Fig. 1. A map showing four observational stations near Syowa Station.

The remotely operated vehicle system used in this study was the DLT-300 manufactured by QI Co., Ltd., Tokyo. The remotely operated vehicle was equipped with a color TV camera and a stereo still camera. The underwater still photo camera used was a pair of full automatic cameras (Autoboy, Canon Ltd.), but the automatic focus was fixed at the distance of 1.2 m in water, the minimum distance for this lens. The cameras were placed along with a strobo light in a watertight case. The watertight case was fixed to the bottom front of the vehicle. While the TV camera monitored approximately the same scenes as the still cameras, photographs were taken by sending down shutter release signals at the appropriate time from above the ice.

The size of organisms in the photographs was estimated as follows: The stereo photographs obtained from both the left and right cameras were enlarged 8 times and prints made. Using a digitalizer, the positions of organisms photographed in the still shots were converted into values which were fed into the microcomputer. The size of the object was obtained from the distance between two ends on the position. In urchin, for example, the size between the farthest left end and the farthest right end was taken. As a result of the accuracy verification experiment, error in measurement was ± 2.8 mm.

Individual wet-weight of organisms stereophotographed was determined through the specific size-wet weight conversion formula that was obtained by actual measurement of wet weight and size of the organism. The specimen used had been collected by traps, longline, or scuba diving near Syowa Station. In weighing the specimen containing the preserves, 70% alcohol was regarded as the wet weight of a species. The adult fish preserved in frozen state were weighed excluding stomach contents after melt. However, stomach contents of juvenile fish which has been preserved in 10% formalin solution were included in weighing.

The relationship between size and wet weight of each species examined could be represented by such regression formula as

$$W = aL^b,$$

where W is wet weight and L a parameter expressing body size, diameter, length, height or width of body, and a and b are constants for a species.

Constants for each species examined are listed in Table 1. The wet weight of constituent species was calculated according to the formula for the species. The range of wet weight of constituent species was calculated according to the standard deviation. The biomass of a community was expressed as the total of the wet weight of each constituent of the community.

Table 1. The initial growth index and equilibrium constant of regression curves used to estimate the wet weight of representative megabenthos around Syowa Station, Antarctica. The relationship between wet weight in g (W) and dimension in cm (L) was approximated by a curve of the form, $W=aL^b$. The notation n represents the number of samples, corr. the correlation coefficient, and $r(n-2, p=0.05)$, the r-test.

Species		a	b	n	corr.	$r(n-2, p=0.05)$	L (dimension)
Porifera	sp. 1	0.5265	2.965	17	0.989	0.482	body height
Octocorallia	sp. 1	0.0036	2.180	9	0.929	0.666	body length
Polychaeta	sp. 1	2.1004	2.978	14	0.865	0.532	diameter of tube
	2	15.0689	3.032	8	0.876	0.707	diameter of tube
Bryozoa	sp. 1	0.0078	2.180	8	0.969	0.707	body length
	2	0.1105	1.237	6	0.912	0.811	body length
Opisthobranchia	sp.	0.0625	2.637	7	0.977	0.754	body length
Ophiuroidea							
Ophionotus victoriae		0.3058	2.631	17	0.992	0.482	disc diameter
Echinoidea							
Sterechinus neumayeri		0.3209	2.901	174	0.986	0.174	test diameter
Holothuroidea							
Cucumaria spatha		0.1402	2.597	14	0.967	0.532	body length
Ascidiacea	sp. 1	0.5142	2.580	5	0.970	0.878	body height
	2	0.3785	2.466	7	0.930	0.754	test diameter
	3	4.1072	1.358	4	0.964	0.950	body width
Pisces							
Trematomus bernacchii		0.0099	3.319	44	0.986	0.297	standard length
(juvenile)		0.0111	2.632	4	0.968	0.950	standard length

3. Results

The wet weight of each constituent of the four communities is shown in Table 2. In the Kita-no-seto Strait, seven constituents appeared. The total biomass of these constituents was $791 \pm 138\,\mathrm{g/m^2}$, of which *Sterechinus neumayeri* accounted for as much as 528.6±70.6 g/m², occupying 67% of the total. This was followed by Ascidiacea sp. 1, being 208.3±57.8 g/m² (26%).

At the station of 40 m in depth in the Kita-no-ura Cove, 10 of 25 species were constituents. The total biomass was 2834±655 g/m², which included 1287.3±262.9 g/m² Ascidiacea sp. 1 biomass and 1233.6±311.9 g/m², of Porifera sp. 1, biomass. The two species occupied 89% of the total biomass. On the other hand, the biomass of *S. neumayeri*, which was dominant in the Kita-no-seto Strait, decreased to 44.8 g/m², less than 1/10 of that in the Kita-no-seto Strait.

At the station of 80 m in depth in the Kita-no-ura Cove, main constituents were 8. The total biomass was 1984±492 g/m², in which the biomass of Porifera sp. 1 was dominant, amounting to 1699.4±429.6 g/m² and occupying 86% of the total.

In the Ongul Strait, main constituents were 6. The total biomass was 423±110 g/m², in which the biomass of Porifera sp. 1 was dominant.

Table 2. Biomass (wet wt; g/m²) estimated at each station.

Station Water depth (m)	Kita-no-seto 16	Kita-no-ura 40	Kita-no-ura 80	Ongul Strait 200
Porifera sp. 1	—	1233.6±311.9	1699.4±429.6	374.1±94.6
Octocorallia sp. 1	—	0.2± 0.1	—	9.9± 2.8
Polycheata sp. 1	6.0± 2.6	0.3± 0.1	1.7± 0.6	0.6± 0.3
sp. 2	16.4± 3.5	45.3± 9.7	2.8± 0.7	5.3± 1.1
Bryozoa sp. 1	—	8.4± 1.8	2.3± 0.5	—
sp. 2	—	—	—	0.9± 0.2
Opisthobranchia sp.	0.2± 0.1	—	—	—
Ophiuroidea				
Ophionotus victoriae	24.5± 2.4	—	—	—
Echinoidea				
Sterechinus neumayeri	528.6±70.6	44.8± 5.7	48.0± 5.9	—
Holothuroidea				
Cucumaria spatha	—	204.5± 58.9	149.8± 44.3	31.9±10.5
Ascidiacea sp. 1	208.3±57.8	1287.3±262.9	—	—
sp. 2	—	5.2± 1.1	4.8± 1.0	—
sp. 3	—	4.7± 0.4	—	—
Pisces				
Trematomus bernacchii	6.5± 0.8	—	75.3± 9.5	—
(juvenile)	0.4± 0.1	—	—	—
Total	791±138	2834±655	1984±492	423±110

4. Discussion

According to GRUZOV *et al.* (1968), the biomass of epi-benthos in the shallow waters, 6–25 m in depth, of the Davis Sea was 455 g/m² (Table 3), and an urchin, *S. neumayeri*, occupied 90% of the biomass. In the present study, at the station of the Kita-no-seto Strait, *S. neumayeri* was the majority of the biomass, and its biomass, 528.6 g/m² (Table 2), seemed to be comparable to the result of the Davis Sea. However, the biomass of the Kita-no-seto Strait was higher than that of the Davis Sea due to the occurrence of Ascidiacea sp. 1, whose biomass was 208.3 g/m².

Table 3. Biomass (wet wt; g/m²) of nearshore epi-benthos at four Antarctic locations.

Location	This study East Ongul Island	NAKAJIMA *et al.* (1982) East Ongul Island (Nisi-no-ura)	GRUZOV *et al.* (1968) Davis Sea	USHAKOV (1964) Sabrina Coast
6-25 m	791±138	77-438	455	—
25-30 m	—	—	900-1000	—
30-55 m	2834±655	—	3000	—
80 m	1984±492	—	—	—
200 m	423±110	—	—	183-1363

The biomass at the stations in the Kita-no-ura Cove seemed to be comparable to the figure of 3000 g/m², which was reported from the Davis Sea (GRUZOV *et al.*, 1968). Moreover, the biomass of 423 g/m², at the station of the Ongul Strait was in the range of figures (183–1363 g/m²) reported as the biomass of benthos from the bottom between 200 and 300 m in depth in the Sabrina Coast (USHAKOV, 1964). The data of biomass of epi-benthos estimated with stereophotographs are reasonable.

It is well known that species composition and biomass of benthic communities vary not only with the depth but also with such small-scaled environment as configuration, texture of bottom and others. NAKAJIMA *et al.* (1982) reported 77–438 g/m² as the biomass of epi-benthos in the Nisi-no-ura Cove of the Syowa Station area. This variation in biomass depended on the species composition in conjunction with the bottom condition. The wide variation in the biomass of epi-benthos in the Sabrina Coast is considered as a result of variation in the bottom condition. However, at the present stage of our knowledge of the Antarctic benthic community, it is difficult to make detailed discussion on the relationship between animal distribution and bottom conditions. The acquisition of more detailed information on the Antarctic benthos in expected and the stereophotography seems to be useful for this purpose.

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