Diatom Flora and Environmental Factors in Some Fresh Water Ponds of East Ongul Island

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東オングル島のケイ藻植生と水質環境

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要旨: 第15次南極地域観測隊の環境科学系の研究の一環として，東オングル島内の池沼群について藻類，とくにケイ藻植生調査と若干の理化学的な調査を行った．調査期間は1974年1月7日から21日までであった．

理化学分析の結果，島の東南から南部にかけての地域に散在する池沼群は，塩素イオン濃度その他の値が高く，他の地域の池沼群と異なっていた．また，基地近くにある池沼も他の池沼群とは異なっていた．

ケイ藻植生調査の結果，今回の調査で23 taxaを見出し，特に *Navicula muticopsis* が多く見出された．また新たに記録されたのは，*Gomphonema olivaceum* v. *tenellum* 等3 taxaであった．ケイ藻植生調査からも，理化学調査の結果と同様に，島の東南から南端部にかけての地域と島の西部地域とで植生が明らかに異なり，植生から計算した類似度 (C_λ 法) でも明らかだった．

Abstract: Diatom flora and chemical factors of water in sixteen ponds of East Ongul Island, which are 10–100 meters in diameter and less than 2 meters in depth, were investigated from January 7 to 21, 1974.

The obtained results are as follows;

pH value — 6.7–7.2,
chlor ion concentration — 49.0–860 ppm,
chemical oxygen demand — 2.34–8.71 ppm and
biological oxygen demand — 0.4–4.2 ppm.

Twenty-three taxa of diatoms were identified including newly found three taxa, *Navicula obiculata, Navicula seminulum* v. *hustedtii* and *Gomphonema olivaceum* v. *tenellum.*

The *Navicula muticopsis,* the *Stauroneis anceps* and the *Pinnularia braunii* association were distinguished. It was of interest to note that the *Nav. muticopsis* association was distributed in the eastern and the southern coastal area of the Island, which seemed to be influenced by seaborn salts.

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1. Introduction

Taxonomical studies of the diatoms in East Ongul Island were made by AKIYAMA (1967), FUKUSHIMA (1959a, 1959b, 1961, 1967), FUKUSHIMA *et al.* (1973, 1975), HIRANO (1959, 1961) and NEGORO (1961). The diatom flora of the soil in this Island was reported by AKIYAMA (1968). However, the data on the relationship between diatom flora and chemical factors of pond water were not sufficient. Therefore, the present report deals with the relation between diatom flora and chemical factors of pond water.

The field works were carried out by one of the authors, KARASAWA, who participated in the summer party of the 15th Japanese Antarctic Research Expedition (1973–1974) and the taxonomical examinations of diatoms were done by both FUKUSHIMA and KARASAWA.

2. Methods

A sampling station was selected in each of sixteen ponds (Fig. 1). Almost all of the ponds in East Ongul Island were 10–100 meters in diameter and less than 2 meters in depth.

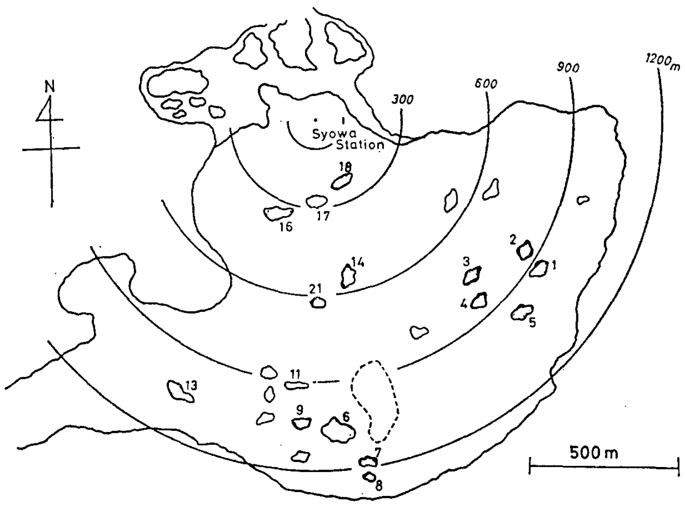

Fig. 1. Sketch map of East Ongul Island showing sampling stations.

Air temperature, water temperature and pH were measured *in situ*. The pH was determined colorimetrically. The chemical analysis of pond water was carried out in a laboratory of Syowa Station. Chemical analyses were done according to the procedures suggested by the Standard Method of Analysis for Hygienic Chemists (Pharmaceutical Society of Japan 1973).

Four stones which settled on the bottom of 30–50 cm in depth were collected from an area about 100 cm^2. The epilithic algae was brushed out from a 5×5 cm quadrat set on the upper surface of four stones. The volume of algae was measured after settling for 24 hours in precipitation tubes. Then the algae was preserved for counting of cells. The sub-samples collected from the area adjacent to the quadrat were used for the identification of diatom species.

The relative abundance of diatom species was examined and the similarity of the flora was compared by C_λ value according to MORISITA (1959).

3. Results

The physical and chemical factors of pond water were shown in Table 1. While air temperature was between 0.8 and 6.0°C, pond water was warmed by solar radiation and the water temperature was higher than the air temperature in almost case. At St. 14, it was 17.0°C at 17: 30 on January 18, 1974.

Table 1. Physico-chemical properties of each sampling station.

Station	Time	Air temp. (°C)	Water temp. (°C)	pH	DO (ppm)	DO (%)	$KMnO_4$ (ppm)	BOD (ppm)	Cl^- (ppm)
1	Jan. 15 10:00	3.1	11.0	—	11.9	112.5	6.65	0.8	860
2	〃 10:30	2.2	9.8	—	11.8	108.2	3.76	2.2	134
3	Jan. 16 08:00	0.8	4.0	7.0	11.5	91.0	5.08	1.8	514
4	〃 09:30	4.0	6.8	6.6	11.0	93.7	7.04	2.5	112
5	〃 11:00	5.0	6.5	6.7	12.0	101.0	3.16	1.5	108
6	〃 13:00	6.0	9.0	7.0	12.0	107.4	6.00	2.7	117
7	Jan. 18 09:00	4.0	11.2	6.7	11.8	110.7	4.01	0.4	110
8	〃 10:00	5.8	12.0	7.2	13.5	130.0	5.78	4.2	400
9	〃 14:30	5.0	11.0	6.6	11.9	111.7	3.03	1.7	117
11	〃 16:15	6.0	10.8	6.8	12.5	117.3	2.34	2.1	96.3
13	〃 15:15	3.5	11.8	6.7	11.1	106.5	2.84	0.6	89.9
14	〃 17:30	4.5	17.0	4.6	9.8	104.8	8.71	0.7	178
16	Jan. 21 10:30	2.8	5.0	6.8	14.0	113.3	4.10	3.0	84.2
17	〃 09:45	3.8	7.1	6.4	12.8	109.1	3.16	2.8	105
18	〃 09:00	4.0	3.8	6.2	13.9	109.5	2.84	2.7	49.0
21	〃 19:00	4.5	16.9	7.3	10.0	170.2	7.23	1.0	420

The pH value was between 6.2 and 7.3 at 13 ponds except for St. 14, where it was 4.6. It was observed that the bottom mud of this pond was soft and covered with white substances.

Chlor ion concentration was high as pointed out by previous workers. It was 860 ppm at St. 1, 514 ppm at St. 3 and 400 ppm at St. 8. In general, the saline ponds were distributed in the eastern and the southern coastal area of the Island (Fig. 1 and Table 1). One of the authors, KARASAWA and his co-workers recognized high chlor ion concentration in the soil of the same areas of the Island (KARASAWA *et al.*, 1977). It seems that high chlorinity in both soil and pond water depends on the seaborn salt.

Dissolved oxygen concentration (DO) was between 10.0 ppm and 14.0 ppm except for 9.8 ppm at St. 14. The saturation percentage of dissolved oxygen exceeded 100 per cent except for St. 3 and St. 4, where it was 91.0 per cent and 93.7 per cent, respectively.

Values of the chemical oxygen demand (COD) varied from pond to pond. The COD value was 2.34 ppm at St. 11 and 8.71 ppm at St. 14. Generally, the high COD value was detected from the saline ponds of the eastern part and the southern part of the Island. Therefore, high COD value in these ponds may be caused by not only organic substances but also chlor ion.

Biochemical oxygen demand (BOD) ranged from 0.4 ppm to 4.2 ppm. Higher BOD value than 2.5 ppm was found at Sts. 4, 6, 8, 16, 17 and 18. Among them, at St. 6 and St. 8, south polar skuas (*Chatharacta maccormicki*) were often seen, and Sts. 16, 17 and 18 were situated near the Station buildings.

The settled volume of epilithic algae varied from 0.6 m*l*/100 cm^2 to 9.3 m*l*/100 cm^2 (Fig. 2). High value of the settled volume of algae were found at Sts. 1, 6, 8 and 11,

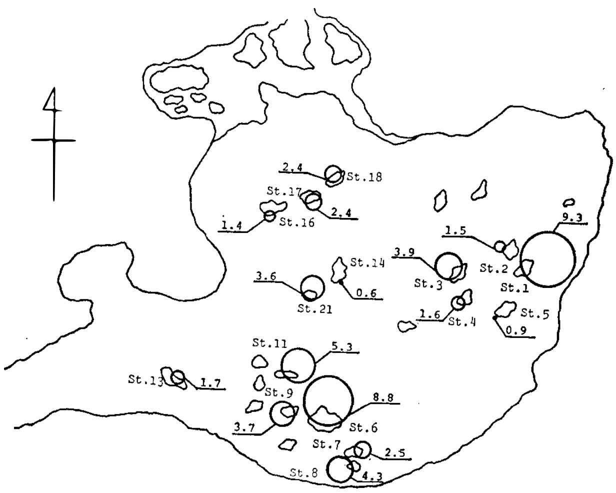

Fig. 2. Volume of epilithic algae at each sampling station (ml/100 cm^2).

where the volume of blue-green algae was superior to that of diatoms. Especially, at St. 6, large masses of blue-green algae scattered along the shoreline of the pond. The south polar skua was seen at St. 1 as well as Sts. 6 and 8. Therefore, it is considered that the high volume of epilithic algae depends on the eutrophication by the south polar skuas.

As shown in Fig. 3, except for Sts. 7, 13 and 16, number of diatom cells exceeded 40 cells/mm^2. Although 11 taxa of diatoms were observed at St. 7, cells were scanty. At St. 13, blue-green algae, *Oscillatoria* and *Chrocooccus* dominated the epilithic associa-

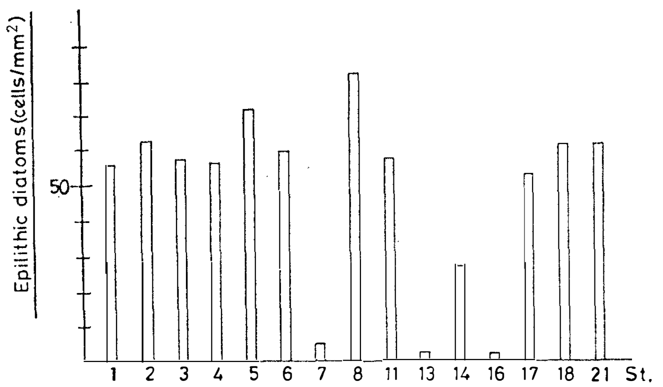

Fig. 3. Number of individual epilithic diatoms at each sampling station (cells/mm²).

tion, which was poor. The shortage of diatom cells at St. 16, where sand had been collected for the construction of the Station building, was thought to be caused by the disturbance of the bottom sand and stones.

Twenty-three taxa of diatoms were found in the present work which were the followings;

Achnanthes brevipes v. *intermedia*
Achnanthes lanceolata
Achnanthes sp.
Cymbella sp.
Gomphonema angustatum
Gomphonema olivaceum v. *tenellum*
Gomphonema sp.
Hantzschia amphioxys
Navicula gregaria
Navicula muticopsis
Navicula orbiculata
Navicula seminulum v. *hustedtii*
Navicula viridula v. *capitata*
Navicula sp. 1
Navicula sp. 2
Navicula sp. 3
Nitzschia dissipata
Nitzschia dubia v. *australis*
Nitzschia palea
Nitzschia acicularis
Pinnularia braunii
Pinnularia borealis
Stauroneis anceps

Among them, *Navicula orbiculata, Navicula seminulum* v. *hustedtii* and *Gomphonema olivaceum* v. *tenellum* are newly found in the present investigation but the other twenty taxa had been reported by previous workers from the Island.

In order to compare the species composition of associations, the percentage of each constituent species to total cells in a given sample was calculated, and the relative abundance of the species in the association was compared each other. However, only remarkable species are illustrated in Fig. 4 (a) to 4 (c).

Nav. muticopsis appeared in all ponds and dominated the association of Sts. 1, 2, 3, 4, 5, 6, 8, 18 and 21, among which Sts. 1, 2, 3, 4, and 5 were distributed in the eastern part of the Island. Sts. 6 and 8 were distributed in the southern part. They were

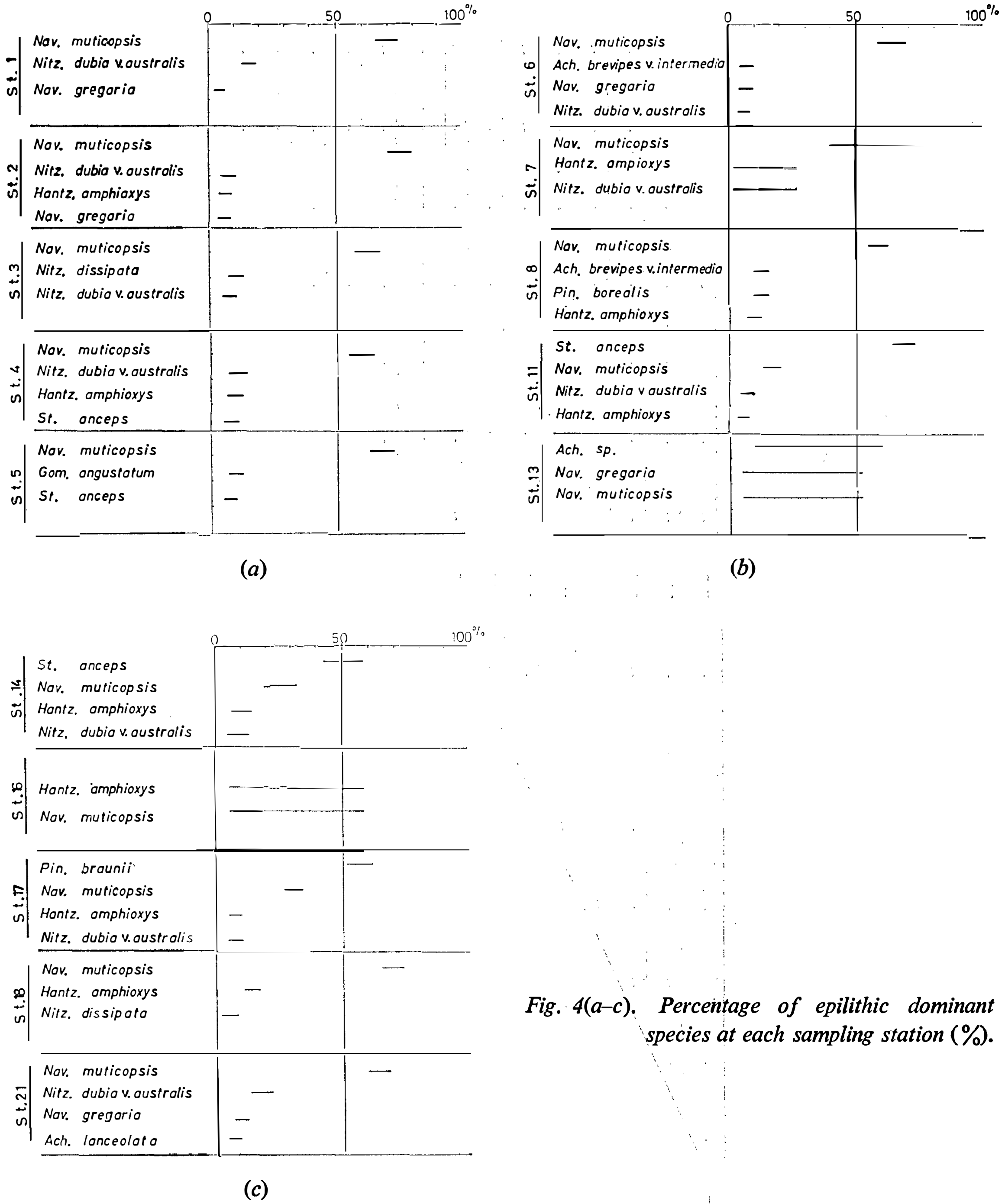

Fig. 4(a–c). Percentage of epilithic dominant species at each sampling station (%).

eutrophicated and *Achnanthes brevipes* v. *intermedia* occurred characteristically. St. 21 was situated in the central part of the Island but this pond was saline (Table 1). St. 18 was located in the northern part and was dominated by *Nav. muticopsis* in spite of its low chlor ion concentration. Sts. 11 and 14 were characterized by *Stauroneis anceps* and St. 17 was dominated by *Pinnularia braunii.* At Sts. 13 and 16 no major species

Table 2. Comparison of C_λ value among sampling stations.

Station	1	2	3	4	5	6	7	8	9	11	13	14	16	17	18	21
1	—	0.970	0.982	0.988	0.995	0.995	0.984	0.948	—	0.214	0.464	0.510	0.424	0.485	0.984	0.966
2			0.966	0.967	0.995	0.986	0.995	0.940	—	0.228	0.470	0.422	0.628	0.454	0.988	0.975
3				0.972	0.970	0.987	0.999	0.940	—	0.227	0.545	0.397	0.713	0.458	0.978	0.966
4					0.990	0.986	0.999	0.962	—	0.332	0.547	0.543	0.770	0.464	0.886	0.987
5						0.984	0.999	0.948	—	0.314	0.483	0.510	0.671	0.454	0.979	0.976
6							0.999	0.973	—	0.226	0.549	0.434	0.257	0.486	0.977	0.981
7								0.985	—	0.240	0.596	0.469	0.843	0.548	0.999	0.999
8									—	0.218	0.173	0.427	0.755	0.446	0.965	0.939
9										—	—	—	—	—	—	—
11											0.068	0.953	0.180	0.124	0.245	0.303
13												0.284	0.831	0.251	0.541	0.534
14													0.410	0.217	0.450	0.508
16														0.661	0.716	0.670
17															0.482	0.473
18																0.969

were found. At St. 9 it was failed to get the suitable sample for numerical examination, however, *St. anceps* was found to be dominated and *Nitz. dubia* v. *australis* and *Nav. muticopsis* were recognized.

In order to ascertain the results compared above, the C_λ method (MORISITA, 1959) was used. High value of C_λ among Sts. 1, 2, 3, 4, 5, 6, 7, 8, 18 and 21 showed the similarity of both species composition and numerical one of these stations (Table 2), which was compatible with the results obtained by the comparison of the relative abundance of constituent species. Namely, *Nav. muticopsis* was found in all of the ponds of East Ongul Island and the *Nav. muticopsis* association dominated the saline ponds, which were distributed in the eastern and the southern part.

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