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PHOTOSYNTHESIS OF A NATURAL PHYTOPLANKTON POPULATION
 MAINLY COMPOSED OF A COLD DIATOM, *THALASSIOSIRA*
HYALINA, IN HAKODATE HARBOR, MARCH 1962*

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Observation

In shallow water of Hakodate Harbor major part of phytoplankton population was composed of a cold water species of diatoms, *Thalassiosira hyalina*, in early spring 1962 (Table 1). Photosynthesis and chlorophyll *a* of this population were observed on board the "Oshoro Maru" lying at anchor in the harbor on March 7, 1962.

The water was very turbid, showing only 2 meters of Secchi disc reading. Underwater light intensities were observed by the third writer using a submarine photometer, Murayama Denki B type covered with neutral filter glass, at 10.00-11.00 a.m. on that day. The incident light was largely extinct in the water, becoming only 50 per cent of solar radiation at 0.3 m (Fig. 1). Solar radiation on the deck was 46 Klux at noon, 34 Klux at 1.00 p.m., 29 Klux at 2.00 p.m., 14 Klux at 3.00 p.m., 8.7 Klux at 4.00 p.m. and 0.5 Klux at 5.30 p.m. It was expected that the shallow water in the harbor would be well mixed because the water was subjected to the wind. Temperature gradient was very small, 5.0°C being recorded at the surface and 5.2°C at 5.5 m depth. Chlorophyll *a* as measured photometrically was 0.34 mg/m³ at the surface, 4.0 mg/m³ at 1.5 m depth and 0.37 mg/m³ at 3.5 m

Table 1. Composition of phytoplankton population in Hakodate Harbor on March 7, 1962

Component	Cells per m ³			Percentage		
	0 m	1.5 m	3.5 m	0 m	1.5 m	3.5 m
<i>Thalassiosira hyalina</i>	240 × 10 ⁴	600 × 10 ⁴	1840 × 10 ⁴	80	70	85
<i>Chaetoceros debilis</i>	30 × 10 ⁴	+	+	10		
<i>Fragilaria</i> sp.	30 × 10 ⁴			10		
<i>Nitzschia seriata</i>	+	240 × 10 ⁴			30	
<i>Donkinia</i> sp.			80 × 10 ⁴			4
<i>Navicula</i> sp.			240 × 10 ⁴			11

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depth, indicating the uniformity of the water, although some differences in phytoplankton composition with depth were indicated (Table 1).

Water was sampled from the surface (100 % light), 1.5 m (20 % light), 3.5 m (5 % light) and 5.5 m (1 % light) depth with a Van Dorn Sampler. Each sample was transferred into two light bottles and one dark bottle, all 100 cc in capacity, to which 1 cc of ^{14}C isotope (4.99×10^4 cpm) was added. Bottles were suspended

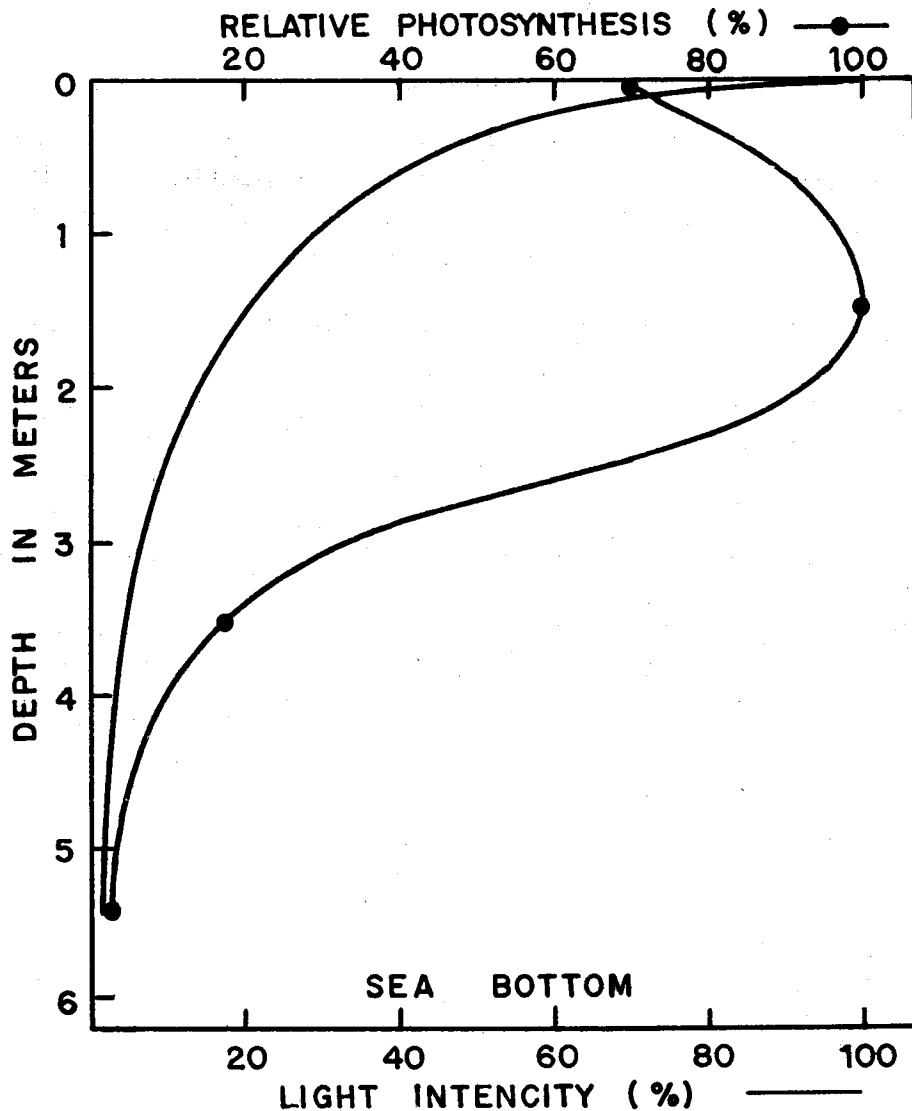


Fig. 1. Underwater light intensities and relative photosynthesis in Hakodate Harbor on March 7, 1962

in the sea from the ship at respective depths of sampling during about 6 hours from meridian passage of the sun (11.48 a.m.) to sunset (5.34 p.m.). Relative photosynthesis was highest at 1.5 m among samples from 0 m, 3.5 m and 5.5 m. At the surface it was as low as 70 % of that (12.3 mgC/m³/day) at 1.5 m. It became abruptly almost negligible between 1.5 m and 3.5 m (Fig. 1).

Discussion

It will be permissible to say that the species, *Thalassiosira hyalina*, represented the population present in the water investigated at that time. The geographical distribution of this species has been studied by Smayda (1958). It is arctic form inhabiting mainly all the major polar currents. It has been recorded from the high latitudes of the Atlantic Ocean, and also from the Japan Sea at temperature below 10°C, excepting one record of occurrence obtained in Pusan in November when the sea temperature was 15.6°C. The species inhabiting high latitudes are thought to have characters of shade forms to some extent. Generally speaking, Ik is low in shade species inhabiting the water of low temperature. Winter population in Danish waters is considered to be shade forms showing 2.5-3.6 Klux (Steemann Nielsen and Hansen, 1956, 1961), and shade populations of Lake Fukami were reported as having 1-2 Klux of Ik (Ichimura, 1960 a, b). Although no tank experiment was carried out in the present observation, if average solar radiation on the deck (18 Klux) is taken for 1.00 p.m. (35 Klux)-3.30 p.m. (10 Klux), Ik of the population is estimated about 2.5 Klux, very similar value to those of shade forms obtained by the previous workers.

Carbon uptake per one mg of chlorophyll *a* is calculated 2.0 mgC at the surface, 2.4 mgC at 1.5 m and 0.6 mgC at 3.5 m. Steemann Nielsen and Hansen (1959) obtained a value as low as about 1 mgC/mgChl.-*a* of shade phytoplankton in Danish waters in winter. Generally speaking, the assimilation number is lower in winter population than in summer population, and lower in shade population in deep layer than in sun population near the surface. However, the assimilation number obtained by Ichimura and Saijo (1959) in the Kuroshio area is rather low (below 2 mgC/mgChl.-*a*).

Total daily production in the present case is estimated about 33.0 mgC/m²/day. This amount of production is much less compared with that on the Pacific coast of central Japan (300-500 mgC/m²/day), in the Kuroshio region (70-150 mgC/m²/day) (Ichimura and Saijo, 1959) and in the northwestern Pacific (200-300 mgC/m²/day) (Saijo and Ichimura, 1960) all measured in summer.

In conclusion, *Thalassiosira hyalina* which supplies the major part of the plankton population in Hakodate Harbor in early spring is probably of shade

form in photosynthetic activity; Ik is roughly estimated 2.5 Klux.

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