遠洋水研報　第37号　45-48頁　平成12年3月
Bull. Nat. Res. Inst. Far Seas Fish., No. 37, 45-48, March 2000

Comparison of GF/F filters and 0.2 and 0.6 μm Nuclepore filters on the chlorophyll *a* retention

Shinji HASHIMOTO* and Akihiro SHIOMOTO*

We confirmed the retention capability of the Whatman GF/F filter (pore size: ca. 0.7 μm) with the results of chlorophyll *a* concentrations in the subarctic Pacific. The chlorophyll *a* concentrations measured with were about 20 % higher than those measured with the 0.6 μm Nuclepore filter as average. No significant difference was found for the concentrations between the Whatman GF/F filter and the 0.2 μm Nuclepore filter. Consequently, the retention capability of the Whatman GF/F filter is approximately equal to that of the 0.2 μm Nuclepore filter.

Key words: chlorophyll *a*, Whatman GF/F filter, 0.2 μm Nuclepore filter, 0.6 μm Nuclepore filter

Introduction

Phytoplankton biomass is represented as chlorophyll *a* concentration and the standing stock. Some comparative studies of the retention property of the Whatman GF/F and the 0.2 μm Nuclepore filter have been carried out in the tropical and subtropical regions. It has been reported that many of small-sized phytoplankton passed through the Whatman GF/F filters in the tropical and subtropical regions where picophytoplankton are a dominant fraction of the phytoplankton assemblage (Phinney and Yentsch, 1985; Taguchi and Laws, 1988; Dickson and Wheeler, 1993). Dickson and Wheeler (1993) reported that the chlorophyll *a* concentrations and the standing stocks measured with the 0.2 μm Nuclepore filters were higher than those measured with the Whatman GF/F filters from the subarctic (48° N) to the subtropical (28° N) North Pacific. Therefore, the 0.2 μm Nuclepore filters have been recommended for the measurement of the chlorophyll *a* concentration, although they are expensive and take a long time to filtrate seawater samples. If these results truly reflect the chlorophyll *a* retention property of the Whatman GF/F filter, it is a possibility that the Whatman GF/F filters lead to underestimate the chlorophyll *a* concentrations. However, Whatman GF/F filters have been extensively used to measure the chlorophyll *a* concentration by most biological oceanographers due to low cost and fast flow rates. Chavez et al. (1995) reported that the chlorophyll *a* concentrations measured with the Whatman GF/F and the 0.2 μm Nuclepore filters were little or no difference from 46° N to 28° S in the Pacific. Therefore, it is necessary to investigate whether we can use routinely the Whatman GF/F filters in order to measure the chlorophyll *a* concentrations.

It is said that the nominal pore mesh size of the Whatman GF/F filters is ca. 0.7 μm. However, Sheldon (1972) reported that the effective pore size of the GF/F filters was likely to be substantially smaller than 0.7 μm. Consequently, we confirmed the retention capability of the Whatman GF/F filter with the 0.2 μm and the 0.6 μm Nuclepore filters in the subarctic North Pacific.

Materials and Methods

Sampling was conducted during a cruise of the 'Kurosaki' at every 1° from 40° N to 43° N along 152° E in August 1999 (Fig. 1). Seawater samples were collected from the surface to 200 m depth at every 20 m using a Niskin sampler. The samples were filtered by Whatman GF/F filters and 0.2 and 0.6 μm Nuclepore filters respectively to determine the chlorophyll *a* concentrations. Volume filtered ranged from 200 to 250 ml and vacuum at the filtering ranged from 150 to 200 mm of Hg. The

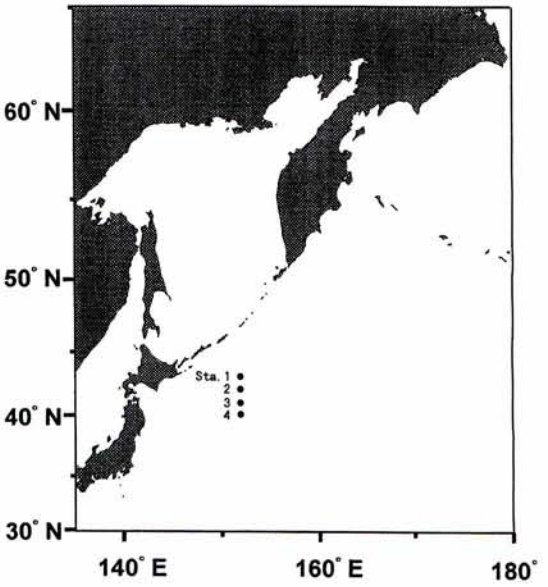

Fig. 1. Location of sampling stations

2000年3月21日受理　遠洋水産研究所業績　第406号
Accepted on March 21, 2000. Contribution No. 406 of the National Research Institute of Far Seas Fisheries
*遠洋水産研究所（National Research Institute of Far Seas Fisheries; 5-7-1, Orido, Shimizu, Shizuoka 424-8633, Japan）

filters were stored frozen at -20 ° C until analyses on land. The chlorophyll *a* concentration was measured with a Hitachi F-2000 fluorometer calibrated with commercial chlorophyll *a* (Sigma Chemical Co.) after extraction with 90 % acetone (Parsons et al., 1984).

Results and Conclusion

The chlorophyll *a* concentrations measured with the Whatman GF/F filters tended to be higher than those of the 0.6 μm Nuclepore filters at all stations (Fig. 2). The difference in the two filters was larger in the upper 100 m. The chlorophyll *a* concentrations measured with the Whatman GF/F filters were about 20 % higher than those measured with the 0.6 μm Nuclepore filters in the upper 200 m as average (Fig. 3a; y=0.85x-0.0034, n=44, r=0.98). On the other hand, the chlorophyll *a* concentrations measured with the Whatman GF/F filters were nearly equal to those of the 0.2 μm Nuclepore filters at all depths and stations (Fig. 2 and Fig. 3b; y=1.04x-0.0008, n=44, r=0.99). The chlorophyll *a* standing stock at a station was

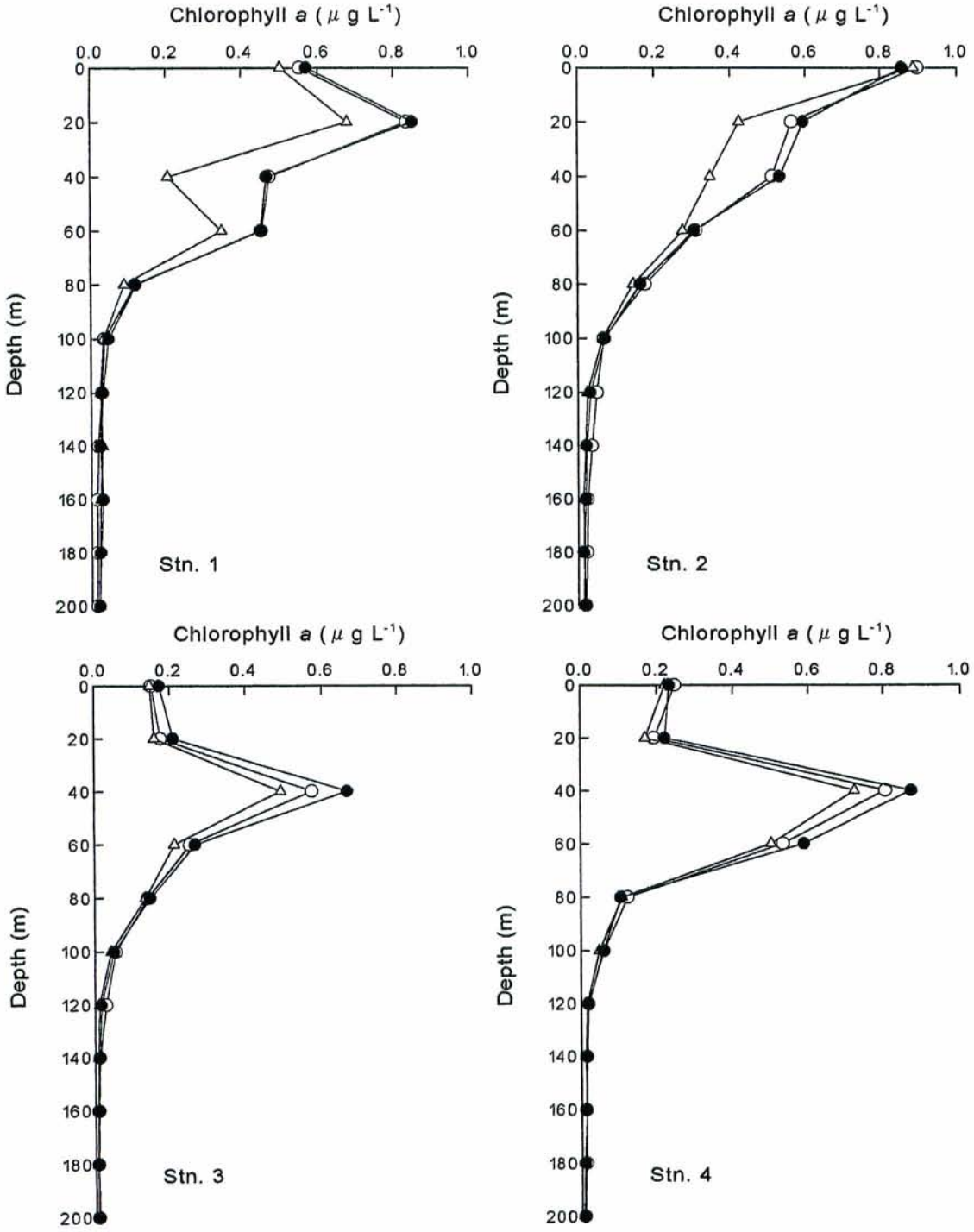

Fig. 2. Vertical profiles of the chlorophyll *a* concentrations obtained with the Whatman GF/F filters (○) and 0.2 μm (●) and 0.6 μm (△) Nuclepore filters

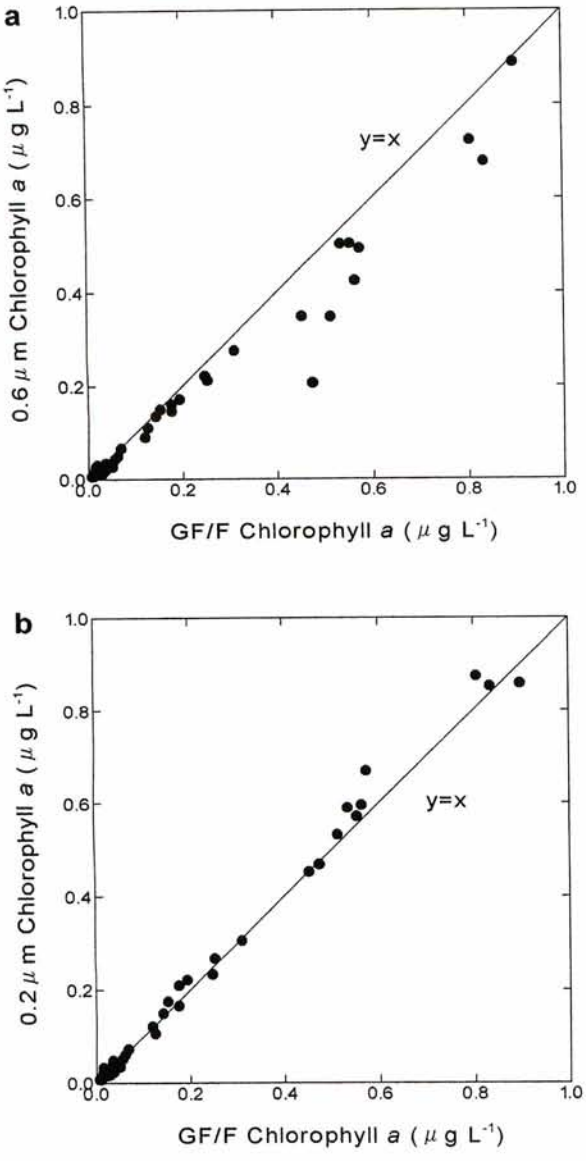

Fig. 3. Comparison of the chlorophyll *a* measurements made with the Whatman GF/F filters and the 0.6 μm Nuclepore filters (a), and with the Whatman GF/F filters and the 0.2 μm Nuclepore filters (b)

estimated by integrating the chlorophyll *a* concentrations in the upper 200 m. The chlorophyll *a* standing stock ranged from 30 to 47 mg m^{-2} with the 0.2 μm Nuclepore filters, from 27 to 46 mg m^{-2} with the Whatman GF/F filters and from 23 to 36 mg m^{-2} with the 0.6 μm Nuclepore filters (Fig. 4). The chlorophyll *a* standing stock with the Whatman GF/F filters was significantly higher by 20 % than that with the 0.6 μm Nuclepore filters (Mann-Whitney U-test, $p<0.05$). However, the chlorophyll *a* standing stock with the Whatman GF/F filters was not significant difference in those with the 0.2 μm Nuclepore filters (U-test, $p>0.5$)

From the above results, the retention capability of the Whatman GF/F filter (pore size: ca. 0.7 μm) is approximately equal to that of the 0.2 μm Nuclepore filter.

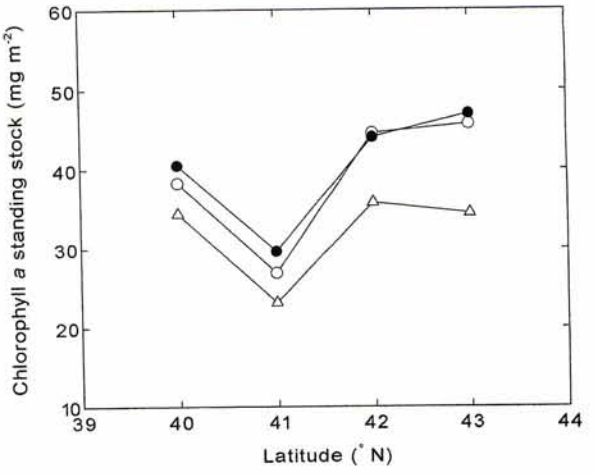

Fig. 4. The chlorophyll *a* standing stock integrated from 0 to 200 m between 39° N and 43° N along 152° E calculated from the chlorophyll *a* concentrations determined with the Whatman GF/F filters (○) and the 0.2 μm (●) and the 0.6 μm (△) Nuclepore filters

Acknowledgments

We thank the captain and crew of the 'Kurosaki' for their assistance with the sample collection during the cruise. We express our gratitude to Dr. Hongbin Liu, Nagoya University, for correcting the manuscript and his helpful comments.

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クロロフィル *a* 捕捉に関するGF/Fフィルターと0.2および0.6 μmヌクレポアフィルターとの比較

橋本慎治＊・塩本明弘＊

摘　要

孔径が約0.7 μmとされているワットマンGF/Fフィルターの植物プランクトン捕捉特性を亜寒帯太平洋におけるクロロフィル *a* 濃度の観測結果から検証した。ワットマンGF/Fフィルターの測定値は、0.6 μmヌクレポアフィルターよりも平均で約20%高かったが、0.2 μmヌクレポアフィルターを用いた結果とは有意な差は認められなかった。このことから、ワットマンGF/Fフィルターは0.2 μmヌクレポアフィルターと同等の捕捉能力を持っていることがわかった。

＊ 遠洋水産研究所（〒424-8633　静岡県清水市折戸5丁目7番1号）