A Small Corer for Sampling of Bottom Water and Surface Sediment in Shallow Ponds and Lakes

IWASAKI Atsuko*, FUKUDA Minako*, and SATAKE Ken-ichi*

Keywords: core sampler, sediment, bottom water

Introduction

Many bottom corers have been used in lakes and ponds to collect sediments for the investigation of vertical and horizontal distribution of nutrients and other chemicals (Livingstone, 1955, 1967; Mackereth, 1958, 1969; Hopkins, 1964; Walker, 1967; Fowler and Kulm, 1968; Davis and Doyle, 1969; Hamilton et al., 1970). However, there are few corers that are both handy and do not disturb the uppermost sediment, which is very important when considering the relationships between bottom water and sediments.

Satake (1983) devised a small handy corer for sampling of lake surface sediment. This corer is designed for the sampling of fresh deposits for both chemical analysis and microorganisms distributed in the surface sediment. The corer incorporates a steel ball that is used to prevent both contamination and discharge of the core from the sampling tube. The total corer weight including the sampling tube was 380 g, and the length was 65 cm. This handy corer enabled sampling of surface sediment at many stations within several hours in lakes and ponds less than 10 m deep, and disturbance of surface sediment was minimal because of the small diameter of the core tube (0.8 cm), although additional weight was necessary to overcome water friction when sampling at greater depths.

However, in spite of the merits of this corer, some improvement of the steel ball system was necessary because of the weight and rusting of the ball, which interfere with the incorporation of the core and its discharge from the sampling tube. In addition, a core sampler that allows collection of bottom water lying just above the sediment, along with the surface sediment itself, is required in order to reveal the chemical relationships between bottom water and surface sediment. For these reasons, a new improved core sampler that causes only minimal disturbance of water and surface sediment has been devised.

Description and operation of the new core sampler

The new core sampler (Fig. 1) consists of a core tube holder (a) that consists of a brass outer cylinder (a-1), a Teflon inner cylinder (a-2) with a Teflon valve (a-3), a stainless steel stem (b), an aluminum wing (c) and an acrylic core tube (d). The total weight of this core sampler is 1.2 kg.

In this system, the Teflon valve having eight holes in the Teflon inner cylinder is important as a stopper. The Teflon valve, weighing 5 g, moves up with inflow of water in the Teflon cylinder (Fig. 2a). This movement enables smooth incorporation of bottom water and surface sediment in the core tube, and then the Teflon valve moves down to prevent the discharge of both water and sediment samples (Fig. 2b).

This inner diameter of the core tube (1.2 cm) exceeds that of the former one (0.8 cm) and the core tube (50 cm) is longer than the former one (16 cm), the length changeable according to need.

This core tube enables sampling of 30-40 cm of bottom water and 10-20 cm of surface sediment.

*Faculty of Geo-environmental Science, Rissho University

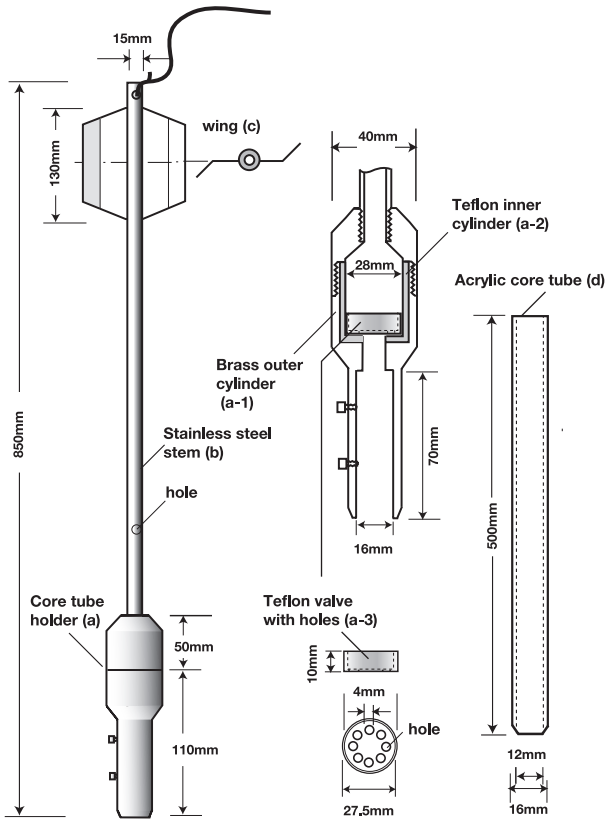

Fig. 1 Construction of the core sampler

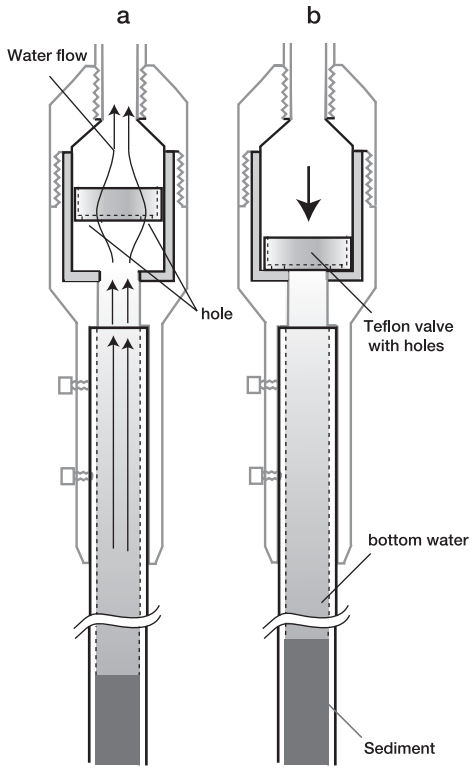

Fig. 2 Operation of the core sampler (a: incorporation of bottom water and surface sediment, b: holding of the sample in the core tube.

Example of sampling with analytical data

The core sampler was used in a typical irrigation pond, Yamada-Onuma (Kami-ike and Shimo-ike), located in Japan, having an area of 10,000 m^2 and a mean depth of 1.5 m. Kami-ike is eutrophicated by feces of a fish-eating water fowl, the common cormorant (*Phalacrocorax carbo*). About 1000 cormorants have nests on the trees around the pond, and the feces of these birds gradually flow into the pond. Therefore, the concentrations of nitrogen compounds (NO_3, NH_4) and phosphorus in this pond are extremely high (Iwasaki et al. in preparation). Fig. 3 a, b shows the vertical profiles of chemical constituents in bottom water collected in July 2005 and December 2006. Although this pond is relatively shallow, slight stagnation of the pond water is observed, as shown in the vertical profiles of Na^+, Mg^{2+}, Ca^{2+} and NH_4^+. Especially NH_4^+ increases exponentially at the boundary layer between the bottom water and surface sediment (Fig. 3a). This suggests massive production of NH_4 from decomposition of deposited algal particulates and uric acid supplied from cormorant feces. Also it is interesting to note the slight increase of NO_3 from the bottom water to the surface water, suggesting nitrification. In contrast, the vertical profile of the chemical constituents Na^+, Mg^{2+} and Ca^{2+} shows complete mixing of the pond water in the circulation period, whereas the vertical profile of NH_4^+ suggests supply of NH_4^+ from the bottom sediment. The concentration of NO_3 was about twice that in the period of stagnation.

The nitrogen content in the surface sediment was relatively stable to show 7-9mgg-1 (d.w.) in the stagnation and circulation periods.

This improved core sampler operated successfully and was shown to be useful for collection of both water and surface sediment at many stations within several hours in shallow ponds and lakes.

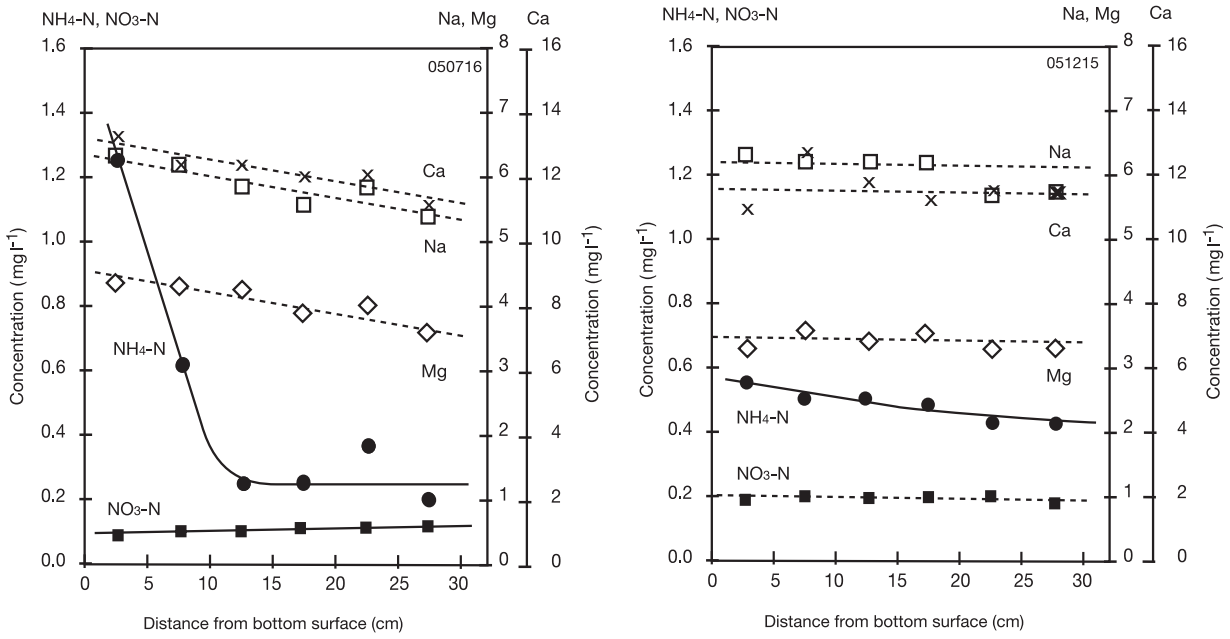

Fig. 3 Vertical profiles of the concentration of Na^+, Ca^{2+}, Mg^{2+}, NH_4^+ and NO_3^- in the bottom water in Kami-ike (a: Vertical profiles of the chemical constituents in the stagnation period, b: Vertical profiles of the chemical constituents in the circulation period.

References

Davis, R. B. & R. W. Doyle, 1969. A piston corer for upper sediment in lakes. Limnology & Oceanography 14: 643-647.

Foler, G. A. & L. D. Kulm, 1968. A multiple corer. Limnology & Oceanography 13: 630-633.

Hamilton, A L., W. Burton & J. F. Flannagon, 1970. A multiple corer for sampling profundal benthos. Journal of Fisheries Research Board of Canada 27: 1867-1869.

Hopkins, T. L., 1964. A survey of marine bottom samplers. In M. Sears (ed.), Progress in Oceanography Vol.2: 213-256.

Livingstone, D. A., 1965. A light weight piston sampler for lake deposits. Ecology 36: 137-139.

Livingstone, D. A., 1967. The use of filament tape in raising long cores from soft sediment. Limnology & Oceanography 12: 345-348.

Mackereth, F. J. H., 1958. A portable core sampler for lake deposits. Limnology & Oceanography 3(2): 181-192.

Mackereth, F. J. H., 1969. A short core sampler for subaqueous deposits. Limnology & Oceanography 14:145-151.

Satake, K. & Y. Saijo, 1978. Mechanism of lamination in bottom sediment of the strongly acid lake Katanuma. Archives fur Hydrobiologie 83: 429-442.

Satake, K., 1983. A small handy corer for sampling of lake surface sediment. Japanese Journal of Limnology 44: 142-144.

Saijo, Y., 1957. Koshochosaho, Kokonshoin.: 307

Walker, B., 1967. A diver-operated pneumatic core sampler. Limnology & Oceanography 12: 144-146.

A Small Corer for Sampling of Bottom Water and Surface Sediment in Shallow Ponds and Lakes

IWASAKI Atsuko*, FUKUDA Minako*, and SATAKE Ken-ichi*

***Faculty of Geo-environmental Science, Rissho University**

Abstract:

A handy core sampler for sampling of surface sediment and bottom water in shallow lakes, ponds and rivers is described. The core sampler consists of a core tube holder with a Teflon valve, stem and wing. The total weight of the core sampler without the core tube is 1.2 kg. The core sampler is useful for sampling of surface sediment and bottom water with minimum disturbance at many stations within several hours.

keywords: core sampler, sediment, bottom water

湖沼の底質および底質表層水採取用小型コアサンプラー

岩嵜　厚子*・福田未奈子*・佐竹　研一*

***立正大学地球環境科学部**

要　旨：

湖沼の底質および底質表層水採取用小型コアサンプラーを製作した。

この小型コアサンプラーは内径1.2㎝のコアチューブとテフロン製バルブを持つコアチューブホルダーを有し、短時間のうちに多地点で表層底質および底質表層水の採取に役立ち、総重量は1.2kgである。

キーワード：コアサンプラー、底質、底層水