

A Multilayer Surface Zooplankton Sampler

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Abstract

For the study of the microdistribution of zooplankton in a vertical section a multilayer sampling device was designed and tested at sea. Five cylindro-conical nets of 104.5 cm in side length with a mouth cylinder (20 cm long, 20.2 cm in diameter) each, which is movable and kept horizontal by means of water flow during tow, are attached inside a II-shaped rectangle frame iron pipe of 2.2 cm in dia. with 187 cm × 22.5 cm in the clear. The assembly can sweep 5 layers between the surface and 1 m depth with a towing speed of 1-3 knots. The filtering rate of the net counts for 0.78, and the amount of water filtered by each net ranged from 20 to 30 m³ during 10 minutes' towing.

The fauna just below the interface of air/sea water is defined as "neuston" ("hyponeuston" in a strict sense, ZAITSEV 1964). Many apparatus have been designed and used for collecting neustonic organisms (DAVID 1965, BIERI and NEWBURY 1966, SAMEOTO and JAROSZYNSKI 1969, BEN-YAMI *et al.* 1970, ZAITSEV 1971, KOMAKI and MORIOKA 1975, MATSUO *et al.* 1976). It is of great interest, however, to observe the surface fauna in relation to that of the subsurface layers, and some of gears mentioned above are able to sweep not only the very surface but also layers adjacent to it. DELLA CROCE and SERTORIO (1959), CHAMPALBERT (1969), and ELLERTSEN (1977) devised multilayer sampling gears for collecting zooplankton which inhabit the surface down to a 1 meter depth. A gear made by DELLA CROCE and SERTORIO (1959) is simple and may be successful for small boats. The last two have floats for buoyancy and to keep the gear stable during tow. But HEMPEL and WEIKERT (1972) are afraid that the floating neuston net may overestimate the abundance of organisms, *e.g.* young fish which are tend to aggregate around floating subjects (HUNTER and MITCHELL 1968).

The sampling gear introduced here is a multilayer sampler of easy handling, without bridles in front of the filtering part and floats, and is employable even for relatively big vessels.

I. Description of the Gear

Five nets with a mouth cylinder of inner diameter of 20.2 cm, 20 cm long, made of polyvinyl chloride (0.6 mm thick) are attached inside a II-shaped rectangle frame iron pipe of 2.2 cm dia. with 187 cm × 22.5 cm in the clear. Each mouth cylinder has

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Fig. 2. An assembly of the Multilayer Surface Zooplankton Sampler on board the R/V Mizuho Maru.

is not used, the middle holes are used. A pair of third and final holes was of no use in practice.

The assembly with a 20 kg weight lead by way of 60 cm long biramous wire bridle and 2 m long rope is suspended by the same dimension of bridle (Fig. 2). The filtering portion is cylindro-conical and 104.5 cm in side length (cylinder 33 cm, cone 71.5 cm), and made of Sunline NIP filtering cloth #60 (0.33 mm × 0.36 mm mesh). The open area ratio of the net counted for 3.54. Replicated with-net and without-net vertical hauls in the waters off Sado in November of 1977 showed that the filtration rate is 0.78. The assembly weights 15 kg without lead. Its prototype was 25 kg which was made of iron pipe 3.4 mm thick with 25 cm long mouth cylinders, and was remodeled to the present one due to its heavy weight.

II. Method of Towing

An assembly is towed by a rope from a boom off the starboard or port side of the ship through a block. The length of rope paid out is adjusted to keep the top of the mouth of the uppermost net at the surface of the sea. The speed of the ship is adjusted to keep the angle of rope suspending the gear at about 50–55°.

III. Sampling Operation at Sea

1. Tsuruga Bay, September 7 and 9, 1976

A prototype of the gear was towed on board the research boat "Wakashio Maru" of 12 tons at a speed of 0.8–1.0 knot for 10 minutes on a calm sea. The angle of the towing rope in the air ranged from 50 to 55°. The volume of water filtered by the net was unknown due to certain troubles with the flow-meter. Fig. 3 illustrates the vertical distribution of two dominant species of copepod obtained along with the

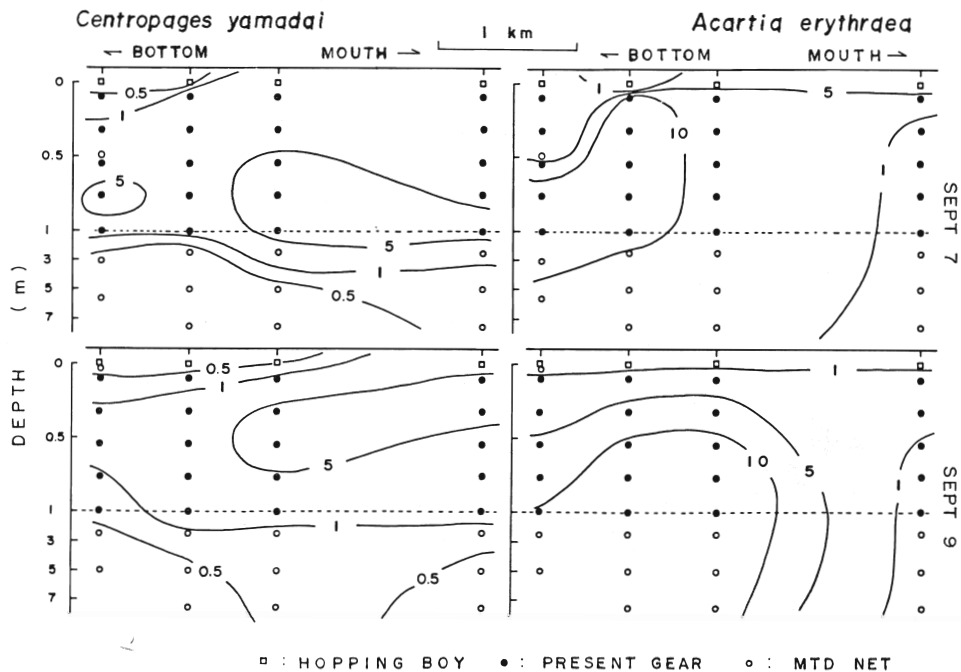


Fig. 3. Vertical distribution of relative abundance in calanoid copepods, *Acartia erythraea* and *Centropages yamadai*, in Urazoko Inlet of the Tsuruga Bay on September 7 and 9, 1976.



Fig. 4. The Multilayer Surface Zooplankton Sampler swimming in the Sado waters (being towed by R/V Mizuho Maru).

neuston net “Hopping Boy” (KOMAKI and MORIOKA 1975) and MTD net (MOTODA 1971) at a section from the bottom of Urazoko Inlet of the Tsuruga Bay of Fukui Prefecture to its mouth. It is shown that *Acartia erythraea* is more neritic than *Centropages yamadai*. The pattern of the vertical distribution in each species was similar between two operations held at a one day interval.

2. Sado waters, July 12, 1977

Replicated test tows were made again with the prototype on board the R/V “Mizuho Maru” of 79 tons to obtain certain information to reform it if necessary. The nets swam successfully at a speed of around 3 knots on a calm sea with a wind scale of 1. Samples were not obtained due to no

cod-ends. It is suggested from the results of the tows that the iron pipe must be thinner and the mouth frame shorter than that used in the present tows.

3. Sado waters, November 15, 1977

From the results of the preliminary tows mentioned above, the gear was improved and the present assembly was obtained and tested in the same manner as the preceding cruises. The weight of the gear was reduced by about 10 kg, and it made for easy handling. The tows were successful (Fig. 4), and daytime, twilight and night samplings were carried out at a speed of 3–4 knots under a condition of wind scale of 2–3 and swell of 1. The angle of the towing rope measured 60–65°. The amount of water filtered by each net ranged from 20 to 30 m³ at replicated tows for 10 minutes. Zooplankton was concentrated at the uppermost layer at dusk with a contagious distribution and its biomass amounted to 250 mg in wet weight per 1 m³ and 2.5 or more times as much as that at a depth of 50–80 cm (Fig. 5). On the other hand, pontellid copepods dominated by the advanced stages of *Pontella chierchiaie* were densely populated at the surface without marked diurnal change but with

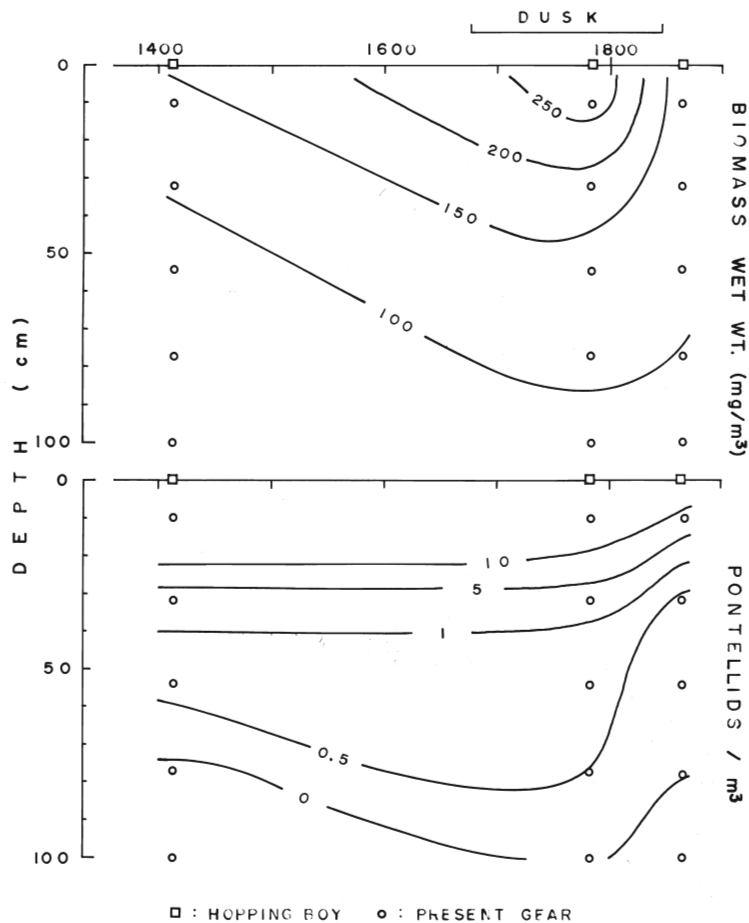


Fig. 5. Vertical and diurnal distribution of total zooplankton biomass and pontellid copepods in the Sado waters, November 15, 1977.

contagious occurrence throughout day and night (Fig. 5).

IV. Discussion

Some series of operation with the gear at sea were successful. Nevertheless, at the same time, a few shortcomings on the gear were also indicated. The angle of the frame may not be always equal to that of the towing rope above the sea surface, and the precise angle of frame in the subsurface layer is unknown. A light alloy may be used for reducing its weight. It may also be possible to make the present one smaller in frame and net mouth for collecting zooplankters. This is because the amount of each sample collected was enough to measure the total biomass and to analyse the zooplankton population ranging from 2 to 5g in wet weight per net for a 10 minutes tow in the sampling operations.

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表層多段プランクトンネットの試作

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要 旨

表層プランクトンの微細鉛直分布を研究するために表面から1 m程度の深さを細分して曳くプランクトンネットを試作した。内径20.2cm(肉厚0.6cm)、長さ20cmの塩ビ管を口輪とする全長104.5cmの円筒円錐形ネット(網地NIP #60, 網目0.33mm×0.36mm)5個を径2.2cmの鉄パイプ製長方形枠(内法187cm×22.5cm)の内側に上下一列等間隔に装着し、枠の傾度を約55度に保って曳く器具である。ネットの口輪は曳かれると水流で常に水平に保たれるようになっている。

敦賀湾および佐渡近海における試験曳網の結果、枠の水中での傾度が正確には分らないながら、定量的採集に充分たえることが判った。