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A new corer for sampling sand and moraine bottom meiofauna

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The heavy "Perämeri corer" has been constructed at the Perämeri Research Station for sampling the hard sand and moraine bottoms especially common in the Bothnian Bay. The inner diameter of the corer tube is 47 mm. The equipment is described in detail. Capture efficiency was tested at two stations. There were no statistically significant differences in total numbers of individuals between the samples obtained with the corer and by a SCUBA diver using the same tubes as a standard. The capture efficiency of the corer calculated on this basis was 109 % at Station I and 98 % at Station II.

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1. Introduction

Several models of meiofauna corer designed for quantitative work on soft mud bottoms have been described. One of the most practicable of light corers is that described by Kajak (1963). Elmgren (1973) tested three types of meiofauna corer for soft mud bottoms and compared them with grab-type box samplers. The efficiency of the Kajak type, as modified by Hakala (1971), has been tested by Holopainen & Sarvala (1975) using samples taken by a SCUBA diver as a quantitative standard. Ankar & Elmgren (1976) have investigated the suitability of their own 'Askö gravity corer' for soft mud bottoms in the Baltic Sea. As far as is known, no meiofauna corers operating on relatively hard, rough bottoms have been described earlier.

The heavy "Perämeri corer" was planned especially for rough sand and moraine bottoms in the Bothnian Bay. It was mainly constructed on the basis of the Kajak corer (Hakala 1971) and the light corer described by Ankar & Elmgren (1976). The heavy "Perämeri corer" differs from the above mainly in its weight, in the size of the tube and in the lower valve system (Fig. 1). The purpose of this paper is to describe the structure and functioning of the "Perämeri corer" and to compare its efficiency with samples taken by a SCUBA diver using the same corers.

2. Methods

2.1. Structure and operation

The main parts of the corer are the collecting tube and the heavy metal weight around its upper end. A strong winch is needed, as the total weight of the corer is 42 kg. Valves are constructed to close at both the upper and lower ends as the sample is taken. A hoop helps both to settle the equipment into the bottom and to release the valves (Figs. 1, 2.). The lower hoop, (5 C, Fig. 1) of the release mechanism is adjusted to a suitable height according to the hardness of the sediment using the nuts on the supporting rods (5 B) of the release mechanism. The steel tube (14) is placed into its socket (6) and fastened with a wing-nut (15).

The corer is set while in a hanging position: the tongue (9 A) of the setting system (9) of the lower valve is lifted into the holder (8) on the upper hoop (5 A) of the release mechanism (5), upon which the lower valve (11) is held open by the corer tube. The upper valve (2) is opened and supported by the holder (13, Fig. 1).

On impact with the bottom, the momentum of the corer drives the tube into the sediment to the set depth, releasing and closing the upper valve. The lower valve release mechanism is pushed down the outside of the tube by the lower weight (6) and as the corer is lifted from the sediment (Fig. 2) the lower valve is closed by the rubber hands (12).

When the corer has been lifted up, the sample is allowed to flow into a bucket or plastic bag, and the lower valve and the lower inside end of the tube are washed out with filtered water into the sample.

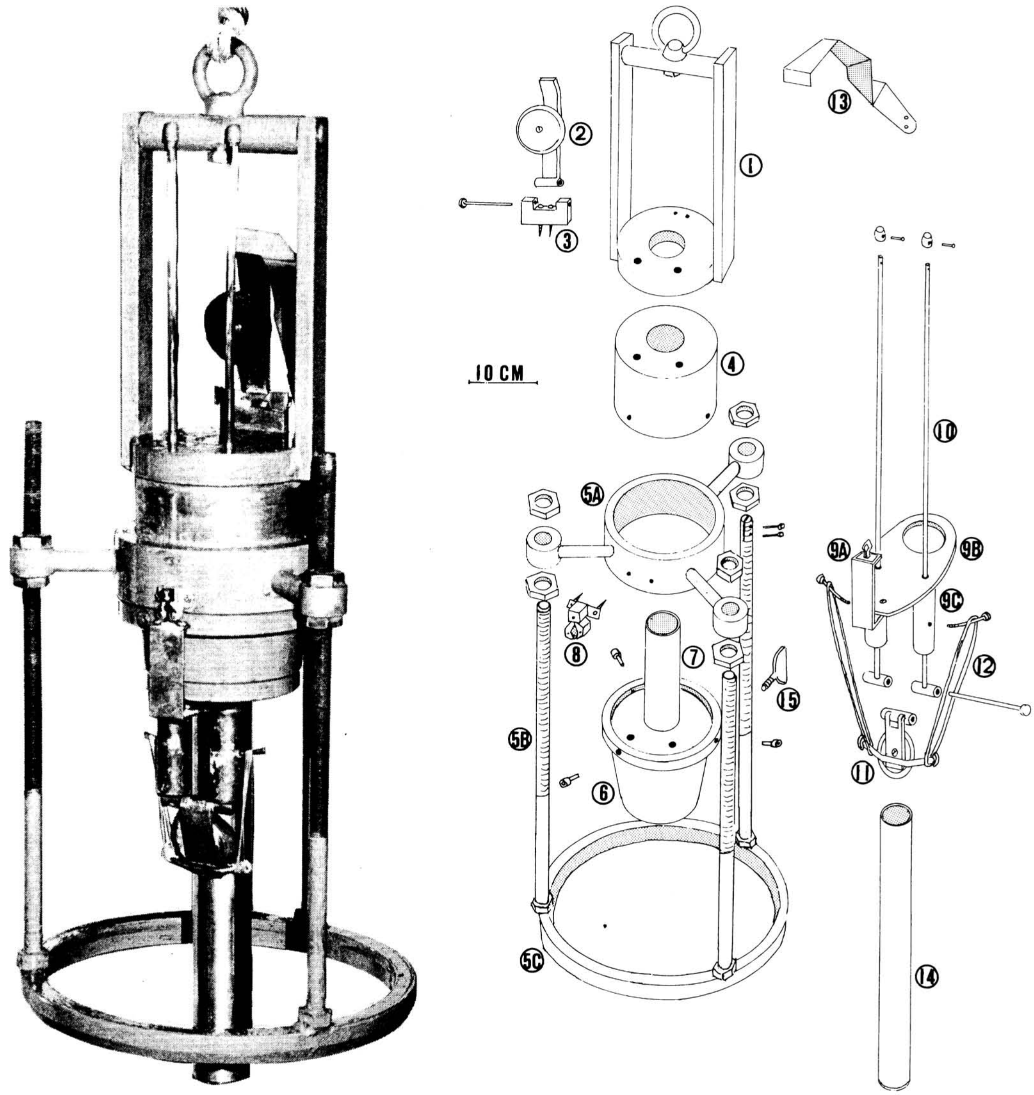

Fig. 1. The Perämeri corer.

1. Upper supporting frame (steel)
2. Upper valve (brass) with neophrene washer
3. Upper valve stage (brass)
4. Guide support for the release mechanism (brass)
5. Release mechanism A) upper hoop (steel)
   B) supporting rods (steel)
   C) lower hoop (steel)
6. Lower weight — tube socket (steel)
7. Support for the lower weight (steel, welded to the upper frame)
8. Holder for maintaining lower valve in open position (steel)
9. Setting system for the lower valve
   A) tongue (steel)
   B) guide support (brass)
   C) weight (brass)
10. Guide rods for lower valve setting system (brass)
11. Lower valve (brass) with neophrene washes
12. Rubber bands
13. Holder for maintaining upper valve in open position (brass)
14. Tube (stainless steel)
15. Wing-nut (brass)

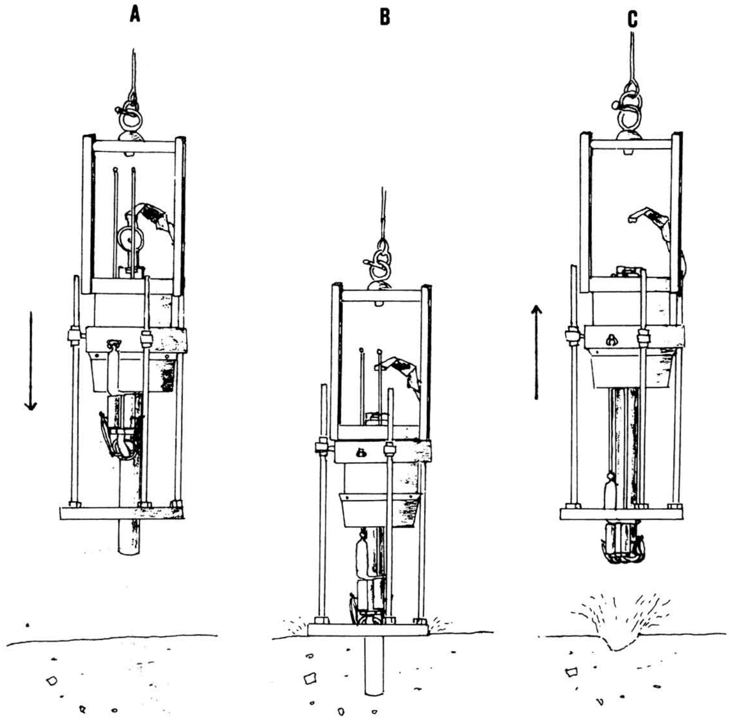

Fig. 2. In A the corer is seen in the set position above the sediment; in B having penetrated into the sediment with the upper valve closed; and in C on being lifted out of the sediment, upon which the lower valve has closed.

2.2. Test arrangements

The efficiency of the corer was investigated near the island of Hailuoto at two sites where the bottom is composed of fine sand (Table 1).

The samples were taken from the stern of the boat, which was moved 1—2 m between sample units using the foreward anchor so as not to disturb the bottom with the propellers. The SCUBA diver took his sample units from the same line as the corer, using the same tubes. Eleven sample units each from station I and ten each from station II were taken using the corer and by the diver. The penetration depth of the corer was regulated to a maximum of 60—70 mm. Four per cent formaldehyde neutralized with hexamin was added to the samples which were decanted 6—7 times using sieves of mesh size 1.0, 0.5, 0.2, 0.1 and 0.04 mm. Each fraction was preserved in 4 % formaldehyde and stained with Rose Bengal. The animals were counted using 12—25 × magnification.

Since the ratio of variance to mean ($s^2 > \bar{x}$) showed a contagious distribution, the original abundance figures were transformed for the analysis of variance and for the test using $\lg(\bar{x} + 1)$ (c.f. Elliot 1971).

3. Results

Although the total numbers of individuals obtained by the SCUBA diver and with the corer (Table 2) do not differ statistically (analysis of variance), this is not the case with the proportions of the different groups of animals when compared using the chi-square heterogeneity test: there were differences between some groups of animals. When the absolute numbers of the different groups of animals were compared using the *t* test, the number of copepod nauplii taken with the corer at Station I proved to be statistically slightly greater ($P < 0.05$) than that found in the sample taken by the SCUBA diver. At Station II the situation was reversed, and the statistical difference is greater ($P < 0.01$). At Station I the number of individuals of the planctid Calanoida copepods was greater ($P < 0.01$) in the samples taken with the corer than in those taken by the SCUBA divers. No statistical differences were noted between the other groups of animals.

Table 1. Position and depth (m) of the stations, sampling dates and the grain size (mm) of the sand at the stations.

Station	Position	Depth	Grain size	Date
I	65°06′N 24°34′E	3	0.120	28.VI.1979
II	65°02′N 24°33′E	5	1.125	31.VII.1979

Table 2. Mean numbers of individuals (x $10^3/m^2$) and standard errors in samples taken with the corer and by the diver from two stations. *N* = number of samples.

	Station I				Station II			
	Corer		Diver		Corer		Diver	
Turbellaria	40.0	± 2.9	32.8	± 5.9	243.5	±18.3	275.0	±16.2
Nematoda	222.7	±11.6	208.9	±13.0	288.7	±28.3	271.1	±16.3
Oligochaeta	45.8	± 6.1	44.9	± 7.3	150.6	±15.8	136.4	±13.6
Cladocera	0.2	± 0.1	0.2	± 0.2	10.8	± 1.6	7.9	± 2.4
Copep. nauplii	25.4	± 2.7	17.1	± 1.9	55.1	± 6.8	82.6	± 5.2
Calanoida	7.0	± 0.8	3.3	± 0.4	2.1	± 0.3	2.7	± 0.6
Cyclopoida	0.1	± 0.1	0.2	± 0.1	0.6	± 0.2	0.3	± 0.1
Harpacticoida	12.7	± 1.2	16.1	± 2.5	175.1	±16.9	169.0	±13.8
Ostracoda	—	—	—	—	0.6	± 0.2	0.3	± 0.1
Halacaridae	0.1	± 0.1	—	—	0.4	± 0.1	0.2	± 0.1
Chironomidae, juv.	—	—	—	—	2.1	± 0.5	2.6	± 0.5
Total	354.0	±16.5	323.5	±22.5	929.5	±56.1	948.0	±41.9
Efficiency (%)	109.4				98.0			
N	11		11		10		10	

4. Discussion

There are no previous reports of meiofauna investigations carried out on rough sand bottoms (mainly free of organic material) on the eastern side of the Bothnian Bay. The total numbers of individuals recovered by SCUBA diving in this study agree relatively well with the results obtained by Wulff et al. (1977) using the same method in the area off Luleå on the western side of the Bothnian Bay, although the numbers of Turbellaria found at Station II are much higher than those found in that investigation. This is possibly due to the presence of a recently hatched generation, because nearly all the individuals were found in the 0.04 mm sieve fractions.

Nematodes very often account for about 90 % of the total number of meiofauna individuals, especially in detritus bottoms (c.f. Ankar & Elmgren 1976, Wulff et al. 1977, Keynäs & Keynäs 1978). The abundance of nematodes found here, in coarse bottom areas, is clearly lower than in the papers mentioned above. Wulff et al. (1977) report that the harpacticoids and oligochaetes stand out better in relation to other meiofauna animals on sand than on detritus bottoms. In the present study the harpacticoids were nearly all interstitial species, such as *Parastenocaris* spp. and *Paraleptastacus* spp. living within the sand. In addition, Elmgren et al. (1981) found that the proportion of nematodes was lower in the Bothnian Bay than in the southern part of the Gulf of Bothnia.

The inner diameter of the tubes used in the corer and by the SCUBA diver was 47 mm (cross-sectional area 1730 mm^2). Holopainen & Sarvala (1975) found that a 44 mm tube on soft bottoms was less effective than the larger tube used as a standard and the efficiency of the 'Askö gravity corer' tested by the Ankar & Elmgren (1976), with a cross-sectional area of 394 mm^2, averaged 50—70 % of the efficiency of the tube used by the SCUBA diver (2460 mm^2). The "shock wave", which partly originates from the pressure of the lower edge of the tube and partly from friction as the water flows through the tube, is greater in relation to the sample area in narrower tubes than it is in wider ones, so that part of the uppermost loose layer of soft mud in the bottom material will not be collected in the sample.

Stánczykowska (1966), however, found no difference in efficiency between tubes of 1000 mm^2 and 4300 mm^2, and proposed that it is most practicable to use a tube of the smallest possible area. According to Holopainen & Sarvala (1975) the effect of the shock wave is mainly dependent on the nature of the sediment. In the present study the sediment was composed of fine sand, and the Harpacticoida fauna, for example, consisted almost entirely of interstitial species which live within the sand.

The disturbing effect of the shock wave upon the sample is probably small in the case of such bottom types. No attempt was made to analyse the shock wave produced by the SCUBA diver.

Wind velocity was only 0—1 m/s when both samples were taken. High wind velocity (over 10 m/s) limits the use of the corer, which begins to oscillate and can disturb the sample if it does so near the bottom.

On the basis of the total numbers of individuals, the efficiency of the heavy "Perämeri corer" can be considered to be equal to that of a similar tube used by a SCUBA diver. The proportions of the various groups of animals were also in good agreement. The only differences were found in the numbers of individuals of copepod nauplii, chiefly Harpacticoid nauplii, and of calanoids of planktid origin. It is possible that differences in the abundance of nauplii originate from the ability of the corer to penetrate the sediment and from the depth below the surface of the sediment at which this group of animals is found. The depth of the corer was regulated to maximum 60—70 mm, but the depth of penetration of the tube used by the SCUBA diver was principally dependent on the nature of the sediment. Since the grain size was greater at Station II, it was possible for the SCUBA diver to push the tube deeper. The nauplii may also occur deeper there than in finer sand, and so number of nauplii taken by the SCUBA diver was higher than that obtained by the corer.

As far as is known, no investigations have been carried out on the vertical distribution of nauplii in sand bottoms, although Harris (1972) noted, for example, that there were differences between the sexes and between copepodites in the vertical distribution of an interstitial harpacticoid population.

The difference between the numbers of calanoids or copepod nauplii recovered from the corer and by the SCUBA diver may be due to such factors as the heterogeneity of the bottom or the contagious distribution of the animals on the bottom.

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