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A SIMPLE, DIVER-OPERATED SUCTION SAMPLER FOR QUANTITATIVE SAMPLING IN SHALLOW, SANDY BOTTOMS

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ABSTRACT

The sampler consists of a PVC tube; one quarter of its length is perforated with holes, and this part is enveloped by a second tube into which pressurized air is conveyed from the surface. A PVC-armoured hose (50 mm in diameter) is connected between the sampler and a sieve system at the surface. The small expanding air bubbles rushing through this sampling hose create an effective suction force which drags water and substrate material up the tube to the sieve.

A brass bar, attachable to the sampler, makes it possible to sample the substrate in successive sections.

INTRODUCTION

The species composition and distributional patterns of the macrofauna of level-bottom environments have been described from a great many areas, especially within sublittoral soft bottoms. Quantitative studies of the benthic macrofauna in shallow sandy areas are scarce, probably because of technical sampling problems. The substrate of these areas is too hard to be penetrated by grabs, box samplers etc.

A number of samplers employ suction to draw the sediment into a collector (see e.g. Brett 1964, Barnett & Hardy 1967, Christie & Allen 1972). However, another efficient and simple suction sampler for taking many large and deep samples in a short time was constructed in connection with a survey on population dynamics of the deep burrowing bivalve *Dosinia exoleta* (L.) (Tunberg 1979, 1983), and the community structure of the macrofauna (Tunberg 1981, 1982) in a shallow, sandy bottom in Raunefjorden, western Norway. After modification, this sampler has been used successfully in a study of the community structure of the macrofauna, and the population dynamics of *Upogebia deltaura* (Leach) (Crustacea, Callianassidae), in a sandy bottom outside Gullmarsfjorden on the Swedish west coast. The burrows of *U. deltaura* reach a substrate depth of 50-70 cm in this area.

The sampler is constructed so that separate samples can be taken from different sediment depths; this is necessary for studies on the vertical distribution of macrofauna.

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CONSTRUCTION

The sampler consists of a PVC tube (3 mm wall thickness), perforated over part of its length, enveloped by a second tube with an air inlet (Fig. 1).

The 800 mm long (inner) tube has a diameter of 40 mm, and the 200 mm long (enveloping) tube of 55 mm. The length of the lower part of the inner tube is adapted to the intended sampling depth. The part of the inner tube surrounded by the outer one is perforated with 2-3 mm holes, spaced 10 mm apart. These holes permit air bubbles to enter the inner tube, where they rise upwards, sweeping water and bottom material with them. The air inlet is placed 50 mm from the lower margin of the outer tube. The tube is glued (PVC-glue: Tangit) to the inner one with PVC rings at each end, so as to form an airtight seal. A low pressure air-valve is connected to the air inlet (Fig. 1B). The air is supplied from air-pressure tanks, equipped with a reduction valve, at the surface. A low pressure air-hose is connected between this valve and the valve at the sampler. The best hose for this purpose is the type used for SCUBA diving. This hose is intended to withstand a pressure of about 5 MPa (50 bar). It is necessary to use a reduction valve that can take a heavy air-flow without freezing. A good SCUBA-valve can be used for this purpose, but a better one is the type used for 'hookah' diving, which makes it possible to check, on separate gauges, both tank (primary) pressure and hose (secondary) pressure, and the secondary pressure is also easily changed on this type of valve.

A PVC-armoured hose, with a diameter of 50 mm, is connected between the upper end of the inner PVC tube and a sieve at the surface. This sieve is equipped with a hinged lid and a screw connection to the sampling hose. The sieve is preferably made of plates of perforated stainless steel or aluminium. The size of the sieve is adapted to the intended sample sizes. The volume of the sieves used in this survey was 40 l.

The sampler needs a secondary pressure of about 0.7 MPa (7 bar) + 0.1 MPa (1 bar) for each 10 m water depth.

When sampling, the operator forces a metal cylinder of (in this survey) 0.1 m^2 in cross section into the substrate to whatever depth is desired for the study. The lower end of the sampling tube is then pushed into the cylinder and extracts the substrate enclosed by it. This can be done in successive layers by means of a transverse bar which is attached to the sampling tube and prevents its further

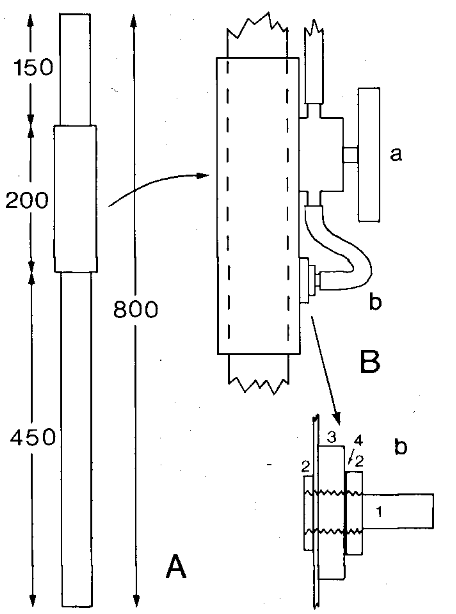

FIG. 1. The sampler. A: PVC tubes. B: Air valve (a), and air inlet (b); threaded brass pipe (1), screw nuts (2), PVC piece, glued to the tube (3), gasket (4). Measurements in mm.

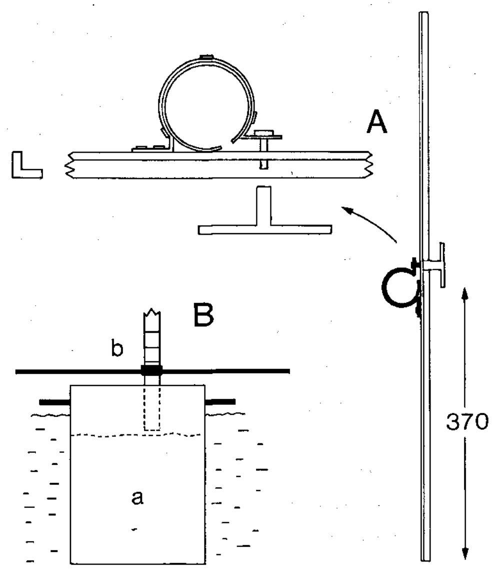

FIG. 2. Section sampling bar. A: brass bar (see the text). B: The sampling cylinder (a) pressed into the substrate, and the bar attached to the sampler for section sampling (b). Measurements in mm.

descent into the cylinder. This bar (Fig. 2) is made of a metal strip (L-shaped profile) with a length greater than twice the diameter of the sampling cylinder. A PVC ring, with a slit and an inner diameter of 40 mm, 50 mm long, is connected to the center section of the bar with a brass band, as shown in Fig. 2A. The bolt and the PVC ring can be tightened by hand with a screw nut (see Fig. 2A). By attaching this bar to the lower part of the sampling tube (Fig. 2B) it is possible to collect separate sections of substrate.

The sampling cylinder is made of a 2 mm steel plate, with two handles 50 mm from the upper margin. It is important not to make the sampling cylinder of thick material, or it will be difficult to work it down into the substrate.

DISCUSSION

The efficiency of the sampler is high from ca. 3 m water depth downwards. With reduced efficiency it is, however, possible to use it from about 2 m depth. If a small boat is used, it is necessary to construct a holder for the sieve outside the railing. Sometimes a few fragile animals are damaged in the sieve. This damage may be avoided by keeping the sieve submerged when the samples are collected. Some long and slender polychaetes may be torn apart before passing into the sampler, but in general very few animals are damaged.

When the samples are collected in sections, a mark on the sampling cylinder indicates how deep it should be pressed down. Ring markings on the tube indicate where to fix the horizontal bar (see Fig. 2B). However, because of the strong water flow at the sampler opening, all substrate up to about 1 cm from the opening are likely to be sampled.

It is advantageous to have both sieves and air supply at the surface. The diver regulates the air flow (for the best efficiency) with the valve at the sampler, and with a simple signal system the sieves are changed, or emptied, rapidly at the surface, and many samples can be taken in a short time.

When the sampler is turned on with the valve at the air inlet, and before it starts to work properly (ca. 5-10 sec.), the sampling hose is filled with air only. It is then sometimes hard for the diver to hold the sampler, but the problem can be ameliorated by attaching 3-4 kg of weights to the upper part of the sampling tube.

The air consumption of the sampler is dependent on depth and on substrate structure. At 12 m depth in a shell-sand bottom outside Gullmarsfjorden on the Swedish west coast about 10 l of free air for each litre of substrate had to be used.

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