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A simple and efficient device for sorting large marine benthic samples

Maria Fernanda L. dos SANTOS; Ana Maria S. PIRES-VANIN & Pablo MUNIZ

Instituto Oceanográfico da Universidade de São Paulo
(Caixa Postal 66149, 05315-970, São Paulo, SP, Brazil)

Introduction

Sorting benthic macrofauna is the slowest and boring stage of all benthic study. So, trying to save time, many kind of apparatus have been developed (Lauff *et al.*, 1961; Powers & Robertson, 1965; Worswick & Barbour, 1974; Robinson & Chandler, 1993). However, many of these devices are complex and difficult to construct (Magdych, 1981).

Most of the described designs employs the elutriation technique. It consists in removing the animals from the bottom by passing a continuous flux of water through the sediment, which puts all but the heaviest materials in suspension in the water column. The suspended material is then retained by a collection device.

As usual in benthic marine sampling, the sediments are preliminary sieved in the field to reduce their volume. The elutriator is employed prior to sorting under stereomicroscope, cleaning the sample and saving time.

Usually the described devices for elutriation are designed for small samples, or samples from rivers and places with muddy sediments (Lauff *et al.*, 1961; Worswick & Barbour, 1974; Magdych, 1981). However, when working with large samples in the continental shelf, sorting is a lengthy process, which delays very much the analysis of the data. Besides time, sorting is also related with the type of sediment. On surveys performed in coastal areas, frequently all kind of bottoms are found: from coarse and sandy to fine and muddy, with mixed types included. So, an apparatus that saves time and is effective in all substrates collected, will be extremely useful to benthic researchers.

The device described below has proven to be very effective in separating the benthic macrofauna from a variety of marine coastal sediments, including common coarse bottoms.

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Material and methods

The elutriator efficency was tested through a series of 22 samples of gravel, coarse, medium and fine sand, obtained in the São Sebastião Channel, in the northern coast of São Paulo State, Brazil. Each sample was submitted to elutriation for a period varying from 15 minutes for fine sands to 30 minutes for gravel. After that, the elutriated material and all the residue were sorted separately under stereomicroscope, identified and counted.

Sampling employed a 0.1 m^2 vanVeen grab and a rectangular dredge of 0.6 mm mesh size collecting in water depths ranging from 8 to 40 m. Granulometry was very variable in the area. Whereas sand mixed with gravel and coarser grains dominated at shallower places, sediment increased in finer particles with depth.

The efficiency of the elutriator in sorting macrofauna was investigated by adding the animals obtained by elutriation to the washed residue, which was then sorted by hand-picking technique. After this conventional sorting, the residue was elutriated a second time, and the recovered organisms were counted. Time required to separate macrofauna employing each technique was measured and compared.

Muddy bottoms samples could not be elutriated because the animals were completely sorted on the sediment washing made in the field previously.

Design and procedure

A diagram of the elutriator is presented in Figure 1. Samples are put into the larger plastic cylinder whose bottom is connected to the cock through a main tube. When entering the cylinder water passes through a 270 μ sieve glued in the mouth of the tube to avoid clogging. The ascending water flux passing through the sediment re-suspends it, removing the lighter animals, which go to the water column. After that they are conducted by the PVC tube to the conic sieve attached to the smaller cylinder.

A small rubber tube placed on the lower part of this cylinder drains water away.

To improve the elutriation in all type of sediments, gentle agitation of the substrate during the washing process was made manually, facilitating the separation of the animals (Fig. 2).

Results

The macrobenthic groups presented in each type of the twenty-two bottom samples analysed are: Crustacea (Tanaidacea, Amphipoda, Isopoda, Ostracoda, Copepoda Harpacticoida, Brachyura and Anomura), Mollusca (Bivalvia, Gastropoda and Scaphopoda), Polychaeta, Nematoda and Echinodermata (Asteroidea and Ophiuroidea).

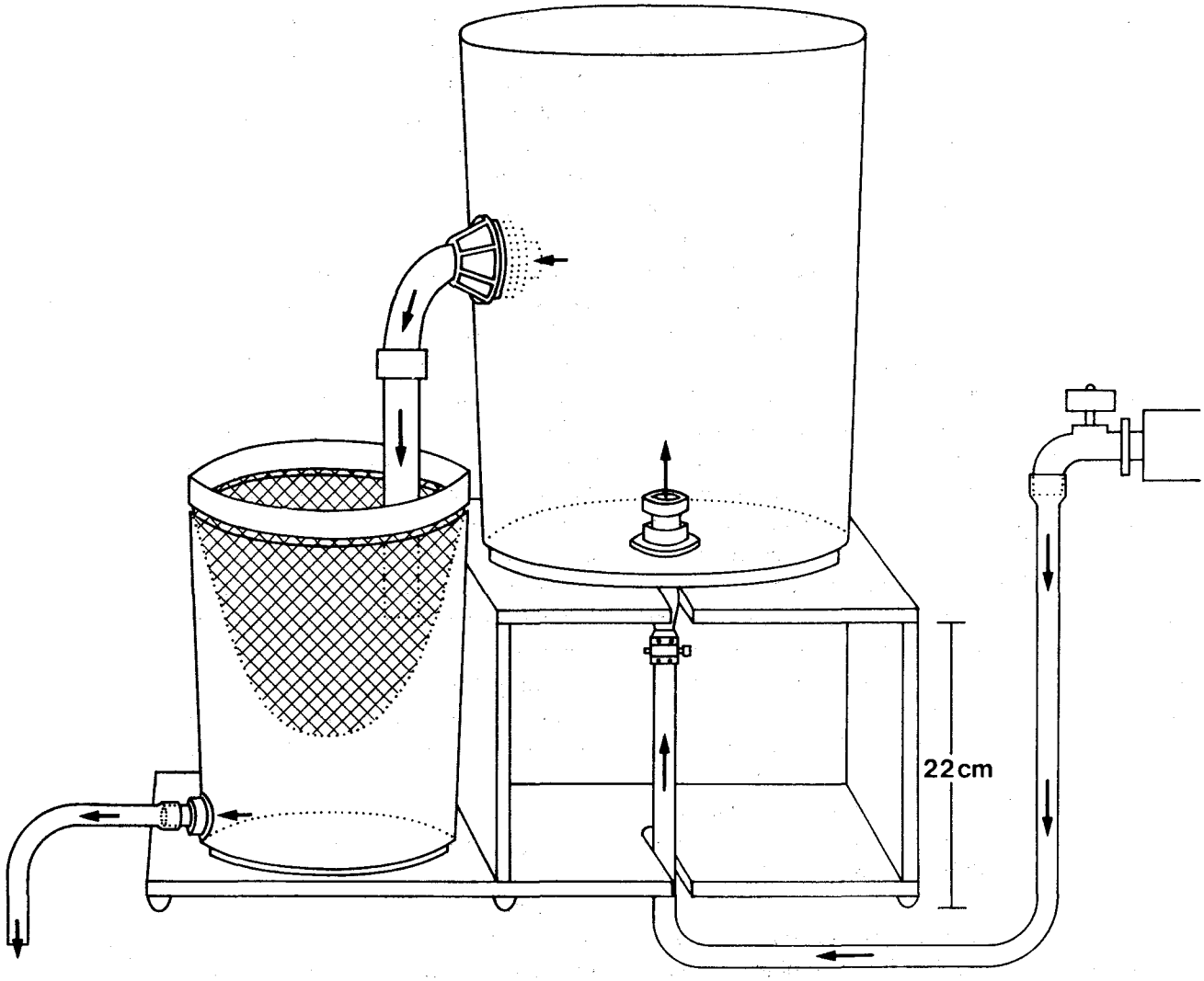

Fig. 1. Diagram of the elutriator. Larger cylinder with 37 x 29 cm. Smaller cylinder with 11 x 19 cm, conic sieve of 270 μ nylon screen.

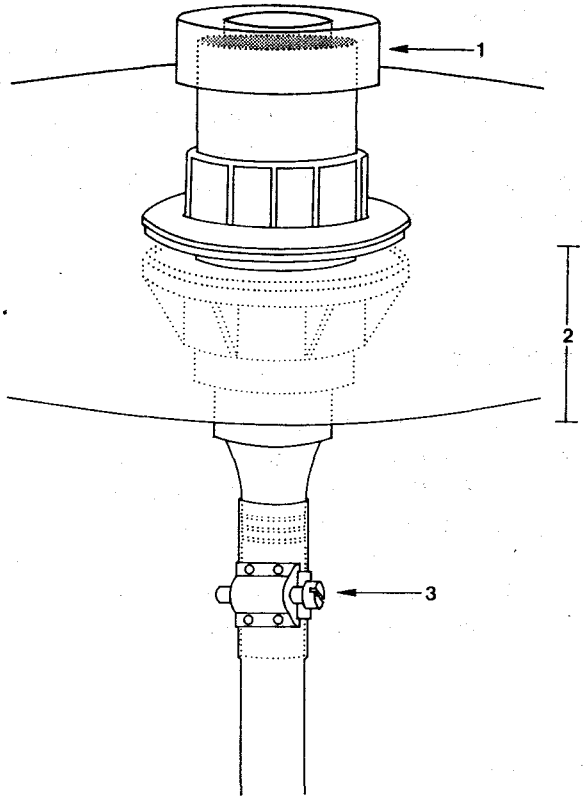

Fig. 2. Detail of the terminal part of the tube which transport the incoming water to wash the sediment. 1: a 270 μ sieve with 3.5 cm in diameter at the end of the PVC tube; 2: a system of PVC nuts to enlarge tube diameter ; 3. steel clamp.

A first examination of Table 1 shows that efficiency of elutriation in sorting animals is directly related to type of washed sediment. There is a sensible increase of the number of floating animals from gravel to finer sand (63,5 to 98%). Lighter animals, as crustaceans and polychaets, were well sorted with the elutriator even in gravel bottoms (86 and 76%, respectively). The best performance is attained with polychaets in all types of sand. However, heavier animals, like molluscs and echinoderms tend to stay in the sediment in higher numbers than the other groups. After elutriation 75% of the molluscs remain in the gravel samples, but this value decreases to 57 - 40% in sandy bottoms. Retention of echinoderms is higher in coarse sand (83%), but they are completely sorted by the elutriator in medium and fine sands.

To sorting 1.5 *l* of a fine sand residue elutriated from the 0.1mm sieve, time required was of 4 hours, less than half the time spent sorting the same sample with hand-picking technique (8:30 h).

A comparison between the two techniques indicates that 148 individuals (100%) were obtained with the elutriator, and only 125 organisms (84.6%) were sorted by conventional method (Table 2). Even though hand-picking was carefully done, 23 individuals (nearly 15%) were recovered after elutriation of the sediment previously sorted by hand. Table 2 indicates that all groups were better sorted with the elutriator, molluscs and echinoderms excepted .

Table 1. Number and percentage of floating animals and of animals retained in the sediment after elutriaton
N = number of samples of each type of sediment

SEDIMENT TYPE		MOLLUSCA	POLYCHAETA	CRUSTACEA	ECHINODERMATA	NEMATODA	TOTAL
GRAVEL (N=6)	N° IND. FLOATING	30	226	78	27	0	361
	N° IND. BOTTOM	90	72	13	32	0	207
	% IND. FLOATING	25	76	86	46	0	63.5
	% IND. BOTTOM	75	24	14	54	0	36.5
COARSE SAND (N=6)	N° IND. FLOATING	5	156	15	4	0	180
	N° IND. BOTTOM	4	4	0	20	0	28
	% IND. FLOATING	56	98	100	17	0	86.5
	% IND. BOTTOM	44	2	0	83	0	13.5
MEDIUM SAND (N=5)	N° IND. FLOATING	6	336	31	13	0	388
	N° IND. BOTTOM	8	0	5	0	0	13
	% IND. FLOATING	43	100	86	100	0	97
	% IND. BOTTOM	57	0	14	0	0	3
FINE SAND (N=5)	N° IND. FLOATING	6	294	0	0	75	375
	N° IND. BOTTOM	4	4	0	0	0	8
	% IND. FLOATING	60	99	0	0	100	98
	% IND. BOTTOM	40	1	0	0	0	2

Table 2. Number (N) and percentual (%) of individuals found in each macrobenthic group obtained by elutriation and by hand-picking techniques applyed to sandy bottom samples

GROUPS	ELUTRIATION		HAND-PICKING		SECOND WASHING	
	N	%	N	%	N	%
MOLLUSCA	5	3.4	5	3.4	0	0
POLYCHAETA	105	71	89	60	16	11
CRUSTACEA	26	17.5	21	14.2	5	3.4
ECHINODERMATA	1	0.7	1	0.7	0	0
NEMATODA	11	7.4	9	6	2	1.3
TOTAL	148	100	125	84.6	23	15.4
TIME (h)	4:00		8:30			

Discussion

A separation with the elutriator of 98% of the total individuals present in medium and fine sands, is an extremely good result, in particular if it is considered the time saved. These bottoms contained mainly crustaceans, polychaets and nematods, organisms easily removed from the sediment by the incoming water flux.

The elutriator worked less satisfactorily with gravel samples, even though nearly 60% of the animals in the sediment was collected in the sieve. Molluscs constitute the major part of the non removed individuals, since the water flux employed (1.5 m/s) is not able to dislodge these heavy animals. Washing the samples with a higher water speed probably could separated a larger number of molluscs, but the smaller and delicate exemplars would certainly be damaged.

The time required for sorting a sample using the elutriator in a medium sand substrate, was reduced by more than half. An average value for the 22 samples sorted was about 2 hours and 15 minutes for each one. This reduction occurred because samples become easier to be sorted under stereomicroscope since they were clean of sediments. This decrease of more than four hours at least for sorting a sandy bottom is a substantial time saving, specially if the researcher has an expressive number of samples to sort (frequently a hundred or more) on each expedition.

The recover of nearly 15% of the macrofauna with an elutriation after a conventional hand-picking also indicates that the latter was a less efficient technique even if it is carefully done.

Due the good performance of the elutriator in sandy bottoms, it can be supposed that it also performs quite well in removing the remanent residues from muddy sediments, facilitating the sorting process.

If sieving was carefully done in the field, we verified that the animals were more preserved after sorting by the elutriation technique than by hand-picking. This was specially true for polychaets and crustaceans, which did not lose their appendages or body parts, many times of crucial taxonomic importance.

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