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A COMPARISON OF GRAB SAMPLERS

A variety of grab devices have been used to sample the benthic environment in southern California and elsewhere. Many are based on devices first designed and used by biologists and geologists many years ago. Each functions some-what differently and, as a result, samples a different segment of the bottom community.

In December 1974 and March 1975, at the request of the Environmental Protection Agency, we conducted a series of tests at sea to compare the performance of seven benthic sampling devices used by various California investigators. The specific objectives of this program were twofold: (1) to identify the grab device that functions with the least amount of mechanical variability and (2) to assess the biological representativeness of samples obtained with each device so that results from surveys using different devices can be compared.

MECHANICAL AND OPERATIONAL CHARACTERISTICS OF THE GRABS

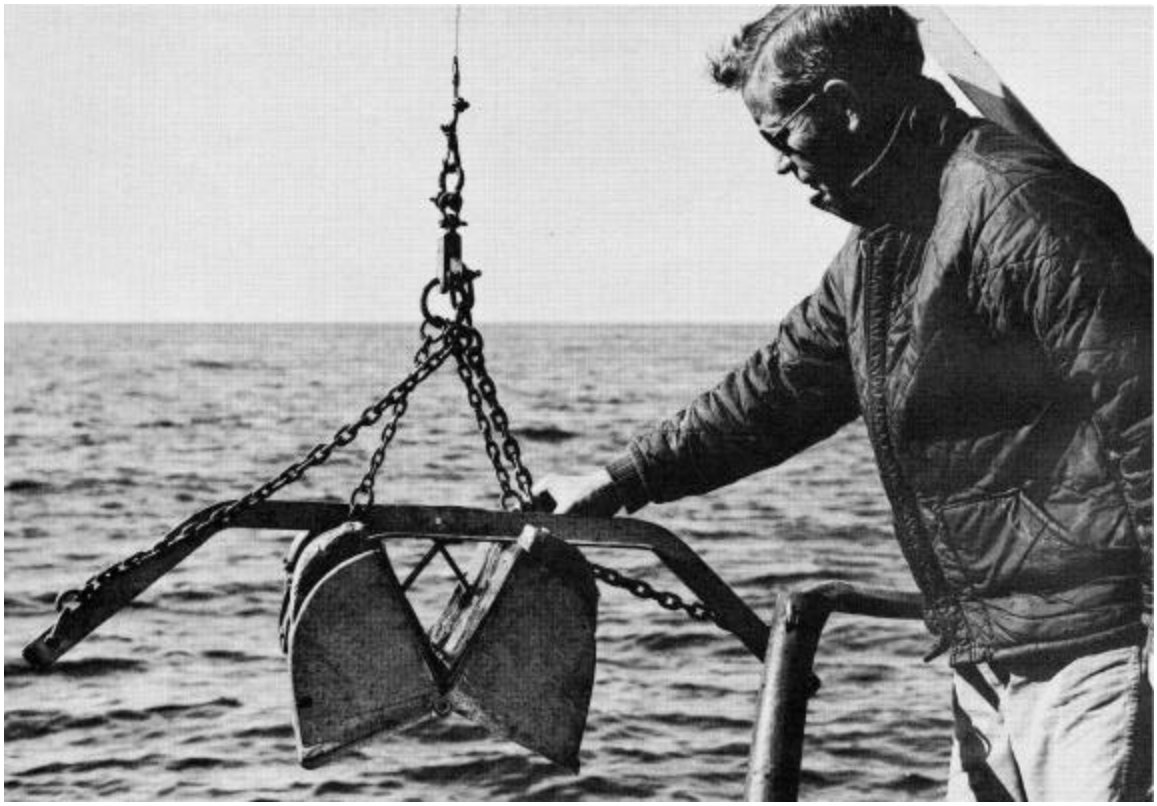
The grab devices considered in this study were USC's spade box corer, the orange-peel bucket, the Smith-McIntyre, two models of the Van Veen (No. 1 and No. 2), the Shipek, and the Ponar. Each grab was tried at four different stations ranging in sediment characteristics from coarse sand to fine clay and ocean sludge and in depth from 13 to 280 meters. Table 1 summarizes the functional capacities of these devices at two of the stations sampled.

The seven grab devices we have tested penetrate to different depths within the sediment. Video tape records of underwater television operations show that several of the grabs are preceded by a pressure wave that blows some of the uppermost soft sediment away. Some of the devices are closed by contact with the bottom, while others are not closed until after they have begun their return to the surface. Finally, all do not close equally well and therefore have different amounts of leakage. These differences in physical operation may affect the species and numbers of animals represented in a sample.

We considered five criteria in selecting the grab device mechanically most desirable: The ideal device (1) must be operable from a variety of small marine research vessels, (2) must function in shallow, sandy bottoms and deep, clay bottoms, (3) should function in rough weather without becoming a hazard, (4) should not leak or create an extreme pressure wave, and (5) should return to the vessel with a relatively intact sample of the surface sediment.

The box corer was eliminated from consideration because it is relatively large and thus cannot be operated from most of the marine research vessels used in local surveys. The Shipek was eliminated because of the tendency for a sample of sediment collected with this grab to collapse over on itself, thus disrupting the surface. The amount of surface disturbance and leakage and the number of unsuccessful attempts made to obtain a sample at the deeper stations eliminated the orange-peel bucket from consideration. The small Ponar grab worked surprisingly well at both types of stations, and its leakage ranged from none to moderate. However, it is not possible to observe the surface of the sample taken with this grab nor collect a sample without disturbing the surface.

The samples from the three remaining devices were very comparable. These devices were the Van Veen No. 1 (tripping bar), the Van Veen No. 2 (chain-rigged tripping mechanism. Figure 1), and the Smith-McIntyre. All sampled surface areas of 0.1 sq m with relatively little disturbance of surface sediment and leakage. The ability to obtain equal volumes of sample at each site slightly favored the Smith-McIntyre. The Van Veen No. 1 with the tripping bar mechanism collected larger volumes of samples than either of the other two devices. However, this grab was considered extremely dangerous to handle at the surface: The likelihood of its being activated in normal operations—not to mention when working in a rough sea—caused us to decide against using this device. Since the other two grabs were very similar in their physical sampling characteristics, we chose the simplest piece of equipment with the fewest moving parts—the chain rigged Van Veen (No. 2).



BIOLOGICAL RESULTS PRODUCED BY THE GRABS

The second problem of finding a basis of comparison for the results of biological samples taken by grab different devices is more difficult to solve. Results are necessarily biased by the type of device used. We are attempting to standardize biological analyses by assessing the "biological effectiveness" of each grab device. This interpretation is based on the premises that the different members of the benthic community occupy specific vertical layers within the sediments, and that each grab device samples these layers differently. If this is true, comparisons of the results of different surveys must consider only the organisms living in zones that are sampled equally by the different devices.

A study of the vertical distribution of southern California benthic organisms is being done by Los Angeles Harbor Project biologists of the University of Southern California's Allan Hancock Foundation, under the direction of Mr. Tom Kauwling. These data and similar data on the organisms present in the box corer and grab samples taken in our survey will be available in June. The data will then be used by Coastal Water Project biologists to determine the feasibility of comparing the results of surveys taken with these grab devices.

Table 1. Operating characteristics of seven grab sampling devices now in use in southern California benthic surveys.

Sampling Device	Maximum Surface Area (sq m)	Surface Disturbance (avg. %)	Wash-out Code Number*	Attempts Successful/ Total	Mean Penetration Depth (cm)
Silty sand, 13 m					
Dec 74					
Box Corer	0.06	<10	0-1	5/5	11+11.8
Shipek	0.04	>50	1	10/10	3.4+0.5
Ponar	0.05	100	2	10/10	**
Van Veen No. 1	0.10	>50	2	5/5	6.5+0.9
Orange-peel	0.10	100	2-3	10/13	6.3+1.5
Mar 75					
Van Veen No. 2	0.10	10 - 25	0 - 1	5/5	4.9+1.6
Smith-McIntyre	0.10	10 - 25	1	5/6	5.7+0.6
Shipek	0.04	>50	1	5/5	2.2+0.5
Clayey-silt, 280 m					
Dec 74					
Box Corer	0.06	0+	0 - 1	5/5	34.8+6.2
Shipek	0.04	50	0 - 1	10/15	11.0+1.3
Ponar	0.05	100	0	10/13	**
VanVeen No. 1	0.10	5 - 10	0 - 1	5/5	22.0+3.9
Orange-peel	0.10	25	0 - 1	10/21	15.4+1.8
Mar 75					
VanVeen No. 2	0.10	0 - 25	0	5/5	12+2.8
Smith-McIntyre	0.10	0 - 25	0	5/8	13.6+2.0
Shipek	0.04	50	1	1/5	5.0

*Leakage after sampler isout of the water (qualitative evaluation:
0 = None; 1 = Slight; 2 = Moderate; 3 = Extensive.
**Cannot be determined as the sampler cannot be opened from the top.