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THE USE OF SONIC GEAR TO CHART LOCATIONS OF NATURAL OYSTER BARS IN LOWER CHESAPEAKE BAY[1,2]

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ABSTRACT

An underwater microphone has been developed to detect shell material on the bottom. The system is simple to use and easily constructed. It consists of a microphone encased in a PVC tube and suspended from an A-frame which is towed over the bottom. It is being used along with other methods to chart oyster bottoms in Virginia.

INTRODUCTION

A comprehensive survey of the location and extent of Virginia's natural oyster bars in Lower Chesapeake Bay was started in 1976 by the Virginia Institute of Marine Science. Its objective was to delineate on charts the location of naturally or potentially productive areas within the bounds of Virginia's 243,000 acres of designated public bottom (Baylor, 1894). The 1894 Baylor Survey set aside large areas for public use in the estuaries and included much of the State's naturally productive bottoms. In addition, however, it contained extensive areas which were unsatisfactory for oyster culture (Moore, 1910; Haven, Hargis and Kendall, 1978). In view of this situation, it is essential for management purposes to chart the productive and unproductive areas within the survey area. The sonic gear described in this paper was designed to aid in charting the productive and unproductive areas.

The characteristics of productive oyster bottoms have been described by earlier investigators (DuMont, 1950; Galtsoff, 1964; Chestnut, 1974). Based on these attributes, the following classification was used in our study. In Lower Chesapeake Bay productive or potentially productive areas are defined as those presently having significant quantities of exposed or buried shell or living oysters. Areas lacking living oysters or shells in the substrate, generally sand or mud bottoms or those deeper than 9 m, are considered nonproductive or as having a low potential for oyster culture.

Previous surveys have delineated productive oyster bottoms using several techniques. Early studies in Maryland used a dredge to locate concentrations of shells and oysters (Frey, 1946). Later, Maryland researchers investigated the use of side-scan sonar (Balderson, *et al.*, 1974). The Maryland Department of Natural Resources recently began a bottom survey using patent tongs, fathometer, and a probe to determine

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oyster density. The underwater microphone described here is used as an aid in locating oyster beds (Harold Davis, personal communications). A study in South Carolina located oyster beds by dragging a chain astern of the vessel and detected shell by the vibrations in the tow rope (Keith and Cochran, 1968).

The present paper deals with the design of a unique underwater microphone which will detect oyster and shell deposits acoustically. When towed over the bottom, the device enables an operator to detect areas of exposed shell as distinct from sandy bottom or soft mud on the basis of sound characteristics. It presently is being used in conjunction with an electronic positioning gear and other methods to delineate natural oyster bottoms.

METHODS

The positioning system used to locate sampling areas is manufactured by the Teledyne Hastings-Raydist Corporation, Hampton, Virginia. It utilizes four transmitting stations and a receiver (navigator) located in the research vessel. The navigator shows the boat's position within ± 2 m as a series of numbers on a grid system which are related to latitude and longitude.

As the research vessel is steered along a grid transect with the aid of the navigator, the vessel operator listens to the sonic gear speaker and records the percentage of time he hears the microphone impacting on shells or oysters. At the same time an experienced waterman probes the bottom at intervals of about 75 m with a long aluminum pole and reports the bottom type as shell, mud and shell, sand and shell, sand, mud, buried shell, clay, etc. This information, along with the data on depth obtained with a fathometer, is coded and entered into a printer which also records the boat's position in terms of grid coordinates. A survey using a bottom grab verifies bottom type as shown by the sonic gear and the probe. Later, all information is plotted on a chart which shows transects, station locations, bottom type, percent shell, and depth.

The sonic gear towed over the bottom consists of an A-frame about 3 m high and 2 m across the base. Suspended from each leg of the frame are 2 m of heavy chain. The microphone is attached to the center of the crossbar by 15 cm of flexible stainless steel cable. The microphone is encased in 2.5 cm diameter PVC pipe 25 cm long. One end is capped; the other end has a cap drilled to take one end of a 60 m length of coaxial cable (RG-58). The pipe enclosing the microphone unit is water- proofed and surrounded by a 1 kg cylindrical zinc weight (Figure 1). The coaxial cable leading to the vessel is loosely attached at intervals to a stainless steel towing wire. For uniform performance of the microphone unit, it is suggested that the cylindrical zinc weight, the length of stainless steel cable from the crossbar to the microphone, and the length and weight of the chain not be changed during any survey.

The schematic for the amplifier and speaker located in the cabin of the vessel and their aux-

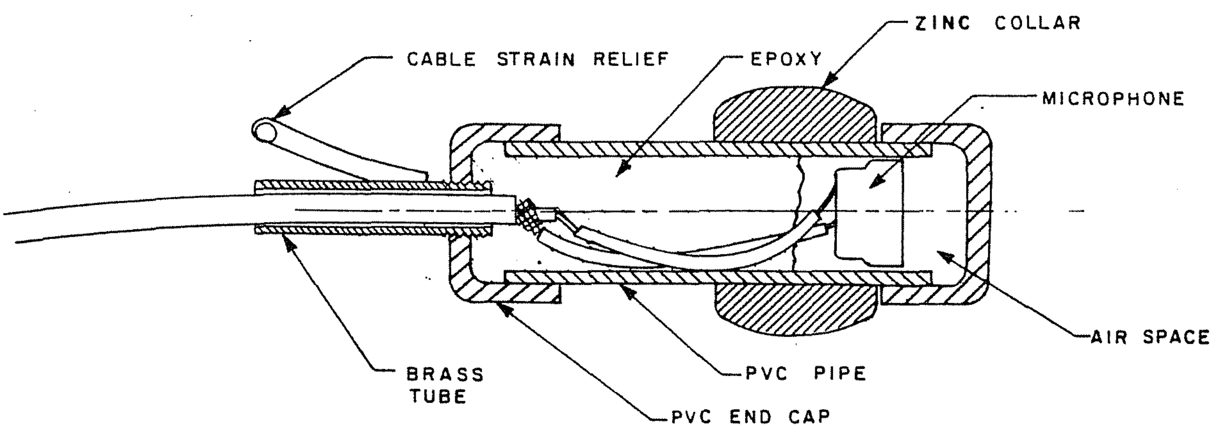
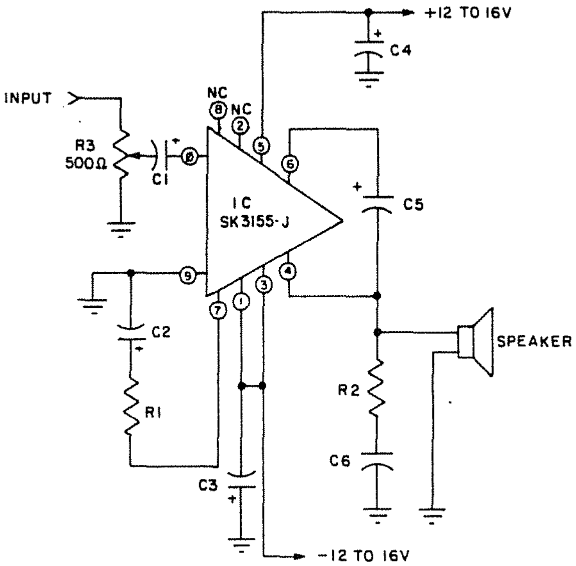


FIGURE 1. *Details of the microphone unit enclosed in PVC pipe.*



WIRING DIAGRAM

FIGURE 2. *Details of the amplifier system and speaker.*

iliary components are shown in Figure 2. The speaker unit has an output of 13 watts and 12 volts; the system is powered by two 12-volt dry batteries.

The A-frame with the attached microphone is towed at a speed of 3 knots. At this speed, the two chains are of sufficient length and weight to keep the microphone on the bottom. Dragging the sensor over the bottom causes the amplifier to emit characteristic sounds for the different types of materials it impacts.

RESULTS AND DISCUSSION

When the microphone unit is dragged over the bottom shell, oysters, or similar material, it causes an irregular series of sharp bumping sounds on the audio which range from a continuous roar for dense shell bed to an occasional click when the unit hits an isolated shell. Over a sandy bottom a hissing sound is heard. Stones or other material give a slightly different sound. No sound is heard when the bottom is soft mud. With experience, the operator becomes able to detect many subtle differences.

The superiority of the underwater microphone in detecting shell material over the conventional probe is shown in Table 1. Probing the bottom may fail to show shell where shell is widely scattered. That is, the underwater microphone shows what type of distribution exists between the probed locations.

TABLE 1 *Comparison between detection of shell by a probing aluminum pole and the underwater microphone on an oyster rock in the Rappahannock River, Virginia.*

Estimated percent of time shells heard on audio between stations	Number of stations probed	Number of times probe failed to find shell	Percent agreement
1-20	39	18	46
20-50	47	2	96
50-75	36	1	97
75-100	12	0	100

The unit described is simple to construct and easy to use; it is relatively inexpensive. Alternate methods of detecting the presence or absence of shell such as dragging a chain requires more effort. Side-scan sonar, while effective in some areas, is expensive and cannot distinguish between sand and mud bottoms. Moreover, it gives a less precise location of the beds than may be obtained with the towed sonic gear.

LITERATURE CITED

Balderson, R. H., N. H. Kenyon, A. R. Stride and A.H. Stubbs. 1972. Sonographs of the sea floor. National Institute of Oceanography. Wormley Godalming, Great Britain. The Elsevier Publishing Co.

Baylor, J. B. 1894. Method of defining and locating natural oyster beds, rocks and shoals. *In* Oyster Records (pamphlets, one for each Tidewater, Va. county, which listed precisely the boundaries of the Baylor Survey). Board of Fisheries of Virginia.

Chestnut. A. F. 1974. Oyster Reefs. In: Coastal Ecological Systems of the U.S. Ed. H.T. Odum, B. J. Copeland and E. A. McMahan. Pub. Conserv. Found., Washington, D.C. P. 171-203.

DuMont, W. D. 1950. Report on various tests on bottoms for oyster planting. Proc. Natl. Shellfish. Assoc. P. 42-48.

Frey, D. C. 1946. Oyster bars of the Potomac River. U.S. Dept. of the Interior, Special Sci. Rept. 32. 92 p.

Galtsoff, P. S. 1964. The American Oyster *Crassostrea virginica* Gmelin. U.S. Fish. Wildl. Serv. Fish. Bull. 64:1-480.

Haven, D. S., W. J. Hargis, Jr., and P. C. Kendall. 1978. The oyster industry of Virginia: Its status, problems and promise. VIMS Special Papers in Marine Science No. 4. Va. Inst. of Mar. Sci., Gloucester Point, Va. P. 1-1024.

Keith, W. J. and H. S. Cochran, Jr. 1968. Charting of subtidal oyster beds and experimental planting of seed oysters in South Carolina. Cont. Bears Bluff Lab. No. 48. P. 1-19.

Moore, H. F. 1910. Condition and extent of the oyster beds of James River. U.S. Bur. Fish. Doc. No. 729, Washington, D.C. 83 p. plus charts.