MARINE INSHORE ECOLOGICAL METHODS

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Abstract. The utilization of diver observations to assist in subtidal ecological studies by the California Department of Fish and Game is reviewed. Current methodology and techniques are discussed. The validity of some current survey techniques is questioned and some alternatives are suggested. Additionally, the application of modern statistical techniques to this field is discussed.

INTRODUCTION

The earliest recorded use of diver observations to assist in a biological investigation performed by the California Department of Fish and Game occurred in 1939. During investigations into the status of the abalone and its fishery, Paul Bonnot attempted to use commercial hard hat divers to assist in his work. This attempt was a failure, due primarily to the inability of the divers to make accurate biological observations. Bonnot then trained himself in the use of hard hat gear, and in October 1939 made his first dive (Bonnot, 1940). This use of diver observations continued on an intermittent basis until the introduction of Self Contained Underwater Breathing Apparatus (SCUBA) in the early 1950's. At this time the Department, with the assistance of the United States Navy and Conrad Limbaugh of Scripps Institute of Oceanography, initiated its program of training biologists as divers. The first project to utilize this tool was the southern California sportfish investigation, followed by the then new abalone project, headquartered in central California.

The use of this tool has continued to expand until the present time, when we employ approximately 20 biologists who dive as a regular part of their duties. The Department conducts advanced training for its personnel, and maintains a certification program which includes depth restrictions for personnel, based on experience and performance. In addition, regular refresher courses are held to assure that proficiency is maintained.

DISCUSSION

The basic methods used by the Department in its subtidal ecological investigations have been obtained by modifying conventional principles of terrestrial quadrat-transect

sampling for use underwater (Turner, Ebert, and Given, 1965, 1966). With the basic assumption that the most important criteria affecting the distribution of benthic organisms are substrate type and depth, transects were established, beginning at the intertidal zone, and continuing seaward to a depth of 100 ft. The intertidal zone was treated as one station, and the subtidal stations were established at each selected depth increment along the transect, utilizing the boat's fathometer to locate the station.

The actual subtidal study area was then defined by attaching a measured line to the station marker, and inscribing a circle with this line as the radius. Quantitative observations were made within this perimeter, while extralimitally only the major features were noted. Within each arc, a quadrat was used to define the area from which a complete sample was removed for further identification in the laboratory. The size of the arc and of the quadrat have been arbitrarily set for each of two general substrate types. In rocky areas, an arc encompassing 15 m^2 has been used, with a quadrat measuring 0.25 m on a side. Sandy areas, due to their sparser biota, have been surveyed with an arc encompassing 30 m^2, and a quadrat measuring 0.50 m on a side.

The parameters measured at each station can be separated into two major categories. The physical description of each station includes vertical temperature and visibility profiles taken at 10-ft. intervals. The presence of suspended material in the water column and the color of the water are also noted. The description of the station proper includes substrate type and relief; the presence or absence of ripple marks and their period and direction; and the presence of debris, with its location. A diver-held plastic coring tube is used to obtain a vertical profile of the sediments, and the cores are measured and checked for evidence of putrefaction below the sediment surface (evidenced by the presence of a hydrogen sulfide odor).

The biological description of each station includes the number and variety of plants and animals, along with their location in relation to major topographic features of the station. Quadrat samples are collected, and photographs are taken where water conditions permit. All observations are recorded on plastic slates to lessen the possibility of omissions. Finally, benthic grab samples are taken from the surface to record the presence of benthic organisms not apparent to the diver.

The basic sampling plan described above is in the process of review. One modification under consideration involves our need to reproduce the survey after the effects of a change have stabilized. Two methods are currently under consideration. The first involves selecting stations in representative habitats and marking that location in some permanent fashion, so the biologist can return to that point at some later date. This method may see its greatest use as a monitoring tool, where the effects of a given parameter on the environment must be established. The second method involves the use of a stratified random sampling plan to locate the stations. In this method, the area to be surveyed is stratified by depth, substrate type, and other parameters considered to be of importance. Stations are then selected from each stratum and sampled. This method assumes that a random station selection plan will describe the area at some confidence level. It is hoped that one or both of these methods will allow a more meaningful analysis of our data.

Other problems encountered have included the need to shift from arc surveys to transects of equal area where heavy silt accumulations have been encountered. In this manner, a diver can move along the transect, swimming upcurrent, without obscuring his visibility. Another problem was that of the loss of material during quadrat collections. This problem has been solved by the construction of an airlift suction device which collects the material as the diver scrapes it from the substrate.

The need to isolate the diver from water possibly contaminated by outfalls led to the use of surface air supply equipment, and the full facemask. An unexpected boon from this new equipment was an increase in the efficiency with which data could be collected. The full facemask allows the use of communication equipment, thus relieving the diver of the note-taking task. Many other problems remain, but their solution will undoubtedly come, as the methods mature.

RESULTS

The Department's biologist-divers have conducted many surveys, including impact studies on dredging operations, power plants, and sewage outfalls; site selection for new installations and projects; and the monitoring of some areas of the coastline to obtain basic biological data on population cycles in benthic communities.

LITERATURE CITED

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