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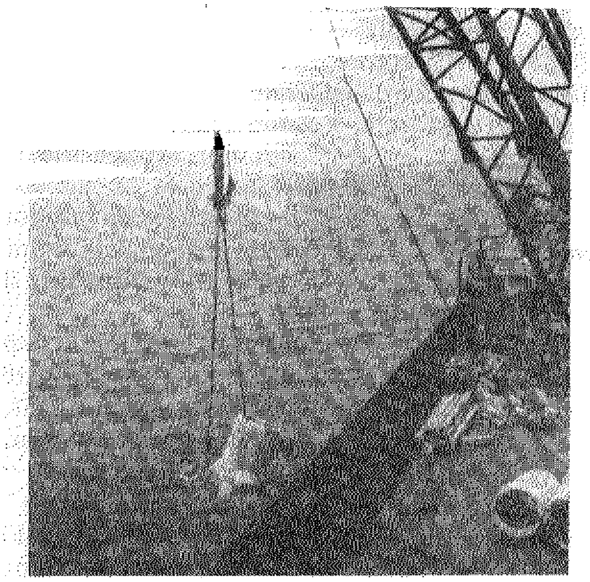
ARTIFICIAL REEF SITE SELECTION AND EVALUATION

INTRODUCTION

One of the most exciting marine fishery management tools in the last few decades is the artificial reef. When properly built in optimum locations, these reefs can create an oasis of fish on what was formerly a biological desert.

In recent years coastal communities around the country have started artificial reef building projects. Unfortunately, some of these projects were failures or did not realize their full fish habitat potential due to improper site selection at the beginning of the project. With proper site selection an artificial reef can last indefinitely. Improperly sited it may last less than six months.



PHYSICAL LOCATION

One of the main reasons for building an artificial reef is to attract food and game fish to a location easily accessible to fishermen and sport divers. With this in mind, planners should find a site that is easily located, with a minimum of travel time and fuel consumption.

Wherever possible, a reef should be located directly offshore from the channel or inlet where most fishermen will be departing. Many anglers utilizing an artificial reef will have small inexpensive compasses, seldom corrected or even checked. For this type of angler, a compass course such as 147° or 219° will decrease the likelihood of his finding the reef if it is more than a few miles offshore. A reef that is due south, east, or west from a sea buoy is usually best. However, a bearing like southwest or other major compass point is still much easier for small boaters than some odd number.

In locating an artificial reef directly offshore from the channel or inlet, care must be taken to avoid interference with navigation. If the area is frequented by large ocean-going vessels, there is the hazard of small boat anglers being run down by a large ship during fog or on a dark night. Such a location requires a lighted buoy greatly increasing the original cost and maintenance. Once the reef is constructed it probably will have many small boats anchored over it both day and night.

Another important consideration is the commercial fishing activity in the area. It is best to avoid an area used for purse seining, drift netting, or trawling to avoid conflict with commercial fishing interests and possible net damage. In most areas the local commercial fishing interests will cooperate and point out which areas they do not fish. Many areas will already have some existing obstructions that prevent net use anyway, and such obstruction areas make ideal reef locations (assuming the substrate is firm).

A final consideration is to avoid areas with strong tidal currents. A tidal current will cause erosion along alternate sides of the reef. This can cause reef materials to slowly work down into the substrate. A constant current from the same direction is usually not a serious problem. Since many of the benthic invertebrates on an artificial reef are filter feeders, a reef with its long axis running at right angles to the prevailing current would be more productive.

DEPTH VS DISTANCE OFFSHORE

A very important consideration in reef site selection is water depth. In coastal areas water depth is normally a function of the distance offshore. Therefore, water depth and distance offshore must be considered together.

As a general rule, a shallow water reef in depths of 10 to 15 meters* will not attract the large benthic species common to reefs in 20 to 40 meter depths. Shallow reefs will often support a larger total fish biomass, but most anglers are more interested in catching a single ten pound fish than ten one pounders.

An ideal site is one with 30 to 40 meter depths only a few miles offshore from the inlet or harbor. However, in areas with a wide continental shelf, 30 to 40 meters of depth is seldom found less than 75 to 100 miles offshore. For that reason, some type of compromise between depth and distance offshore is required. This is best solved by building several reefs to accommodate different user groups. Deeper reefs farther offshore provide larger individual fish for larger boats. Shallower reefs closer to shore attract smaller fish for smaller boats. Wherever possible the small boat reef should be in sight of land.

The depth of the reef site is also important in the choice of reef building materials. In this respect, however, the average wave energy as a function of water depth is of primary importance.

In the open ocean a wave travels free of the bottom when the depth of the water is greater than one half the wave length. Once a wave enters water less than ½ the wave length it begins to interact with the bottom and any structure on the bottom. For example, a wave with a 20 meter length will begin to "drag" the bottom at a depth of approximately ten meters. This not only stirs up the bottom sediment around the reef but can actually shift low density reef materials about and even move them off the reef site entirely. Several artificial reefs have been built, only to discover a year later that the entire reef was scattered out of the original drop site and, in one case part of the reef ended up on a public beach. This type of failure could seriously hamper future reef building projects in a given area and elsewhere.

Early in the project, planners should determine the average wave length for a range of storm waves, and some estimate should be made of what length waves probably would occur during a ten year storm cycle. This information can be obtained from the National Oceanic and Atmospheric Administration (NOAA) hydrographic offices. If the average wave length in such a storm is 50 meters, high density reef materials such as concrete and steel hulls should be used since the reef would be only 25 meters deep or less.

With high density reef materials, the wave energy problem is not as serious, and in most coastal areas, depths as shallow as ten meters are safe. An exception might be some exposed Pacific coastal areas like in California or Hawaii.

Auto bodies would normally be considered low density reef materials because the major portion of the car body is very thin metal. The auto frame itself is high density, but tends to separate from the body sections after a few years in sea water. P.V.C. tubing used in structures such as the "Prentiss" reef is also considered low density material as well as automobile tires and wooden hulls. One way to utilize a variety of reef materials is to build several reefs at varying depths simultaneously. On the deeper water reef (30-40 meters) use low density materials like auto tires, and on shallower reefs use high density materials like culvert and concrete rubble.

SUBSTRATE

Once the above factors have been considered the next step is to go out to the selected area and make an underwater survey of the bottom. A diver/biologist can make a general biological assessment of the benthic communities present, but if a biologist is not available, then an experienced diver would be the next best choice.

The types of substrate to avoid are mainly soft sediments (clay or silt size particles) and bottoms that are already biologically productive.

*1 meter = 39.37 inches or 3.208 feet

To determine the bearing capacity of the bottom a diver should probe the substrate either by hand or with a metal rod. As a general rule, a suitable bottom is one where the hand will not push down into the bottom past the wrist in a single push. If the hand penetrates beyond the wrist (with fingers extended) the bottom is probably too soft and will result in much of your reef effectiveness being lost soon after construction. In one case off the Florida east coast, a group built a reef in such a soft substrate that one year later no trace of the materials remained about the bottom. In most areas the bottom will be fairly firm for long distances with only an occasional soft spot. In other locations one may spend several days locating a suitably firm bottom.

The idea of selecting a site without existing productive benthic communities may seem strange. It would seem logical to try to improve on a productive area. However, while an artificial reef can provide more niches and habitat than a natural reef, the improvement will not be that significant in most locations. If a bottom area is already productive, **then leave it alone,** and select a barren sand or shell bottom where the improvement and additional habitat will add to the existing situation. A grass bed or rock outcrop already provides habitat, while a barren sand bottom has almost none at all. So the total habitat and, therefore, the total fish biomass of a given bottom area can be improved best by adding habitat where it does not exist or is scarce, rather that slightly improving an already productive location.

In many areas there may be rock or hardpan strata that will intersect the bottom surface at given points offshore. Where this occurs, a good practice is to move up slope from such an outcrop and locate a site with 10 to 30 centimeters of sand or shell over a rock foundation. This will assure that reef materials can sink no more than a short distance into the bottom, and often the current action around the reef materials will expose the rock itself, making additional habitat.

In one case of poor site selection in the Florida Keys, a tire reef was dropped on a grass bed adjacent to a coral reef. The unsecured tires not only damaged the grass beds, but some shifted and began to batter down the coral heads.

Firm sand or sand/shell combinations are the most suitable substrates for high and low density reef materials. Low density materials like car tires often only become relatively stable on the bottom when they become imbedded in the sand.

EXACT LOCATION

Once a suitable reef site has been selected it is vital that the spot be precisely fixed. All the careful steps in site selection can be totally negated by being a few hundred yards off when actual construction begins. In most states the necessary construction permits must show the exact location, as do permits from the U. S. Army Corps of Engineers and Coast Guard.

Time and distance runs from a known location are never accurate enough for reef site selection, nor are Loran A coordinates. If the reef site is within site of land with prominent landmarks, then horizontal sextant angles will give enough accuracy for site location. If the site is farther offshore, then Loran C is the only alternative. The same Loran C set should be used for the original site selection dives and the actual buoy placement prior to the first drop.

REEF PERMITTING

Permission must be received from both the U.S. Army Corps of Engineers and the appropriate state permitting agency to construct a marine reef. Regulations of each agency are available upon request.

INITIAL BIOLOGICAL REPORTS

Most permitting agencies will expect a biological report on the reef site as a part of the original permit application. This report also provides a good record of productivity of the site prior to reef construction for later comparison.

The initial survey should include a list of both invertebrates and fish species and some measure of abundance. If the above suggestions are followed, the initial biological report should be simple because the ideal reef site will have only a minimal plant and animal population prior to construction.

Once the reef is built, a series of fish counts should be conducted to evaluate the reef's effectiveness, and if personnel and funds are available, primary production and invertebrate populations should also be measured. If the reef is sited and built properly, the "before" and "after" comparisons should be so impressive as to warrant additional reef building projects.

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