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Artificial Reefs- Strategy for Habitat Improvement

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Abstract: Artificial reefs are benthic structures that are deliberately positioned with the goal of preserving, enhancing, or restoring features in marine ecosystems. They are employed as a potential tool for managing fisheries in order to maximize resource augmentation, resource conservation, habitat rehabilitation, and mitigation, as well as one of the ways to address the issue of declining fish resources in coastal waters. The establishment of artificial reefs or other underwater man-made structures is a common strategy for habitat improvement in aquatic areas. The design is the most crucial step in the planning process for purpose-built artificial reefs, and it entails choosing the right materials and creating a precise structure depending on the intended use of the reef as well as the local oceanographic circumstances.

Keywords: Arificial Reefs, Marine Habitat, Fisheries Conservation.

1. INTRODUCTION

Threats to coastal reef environments include overfishing, habitat destruction, pollution, and climate change, among many others. On coral reefs, for instance, there has been considerable habitat loss and degradation observed. Foundational species connected to stony reefs, including kelp, have also decreased. Because of the importance of the ecosystem services that reefs offer, managers frequently decide to improve the current reefs even when they are not actively being degraded. Adding artificial structures to the ocean floor is a popular strategy for improving reef habitat. Decommissioned energy platforms are demolished and transformed into artificial reefs, as are human-made artificial structures, including as metal boats and concrete modules that are regularly deployed as artificial reefs on the seafloor to produce reef habitats. These structures are classified into two groups, artificial reefs (ARs) and Fish Aggregating Devices (FAD), depending on the functional area and animal group they are intended to serve. ARs are designed for demersal fishes, while FADs are intended for column and pelagic species. They provide ecological niches and support ecological

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succession. It serves as a habitat for feeding grounds, a place to hide from predators, a nursery for larvae and juvenile fish, and it also plays a crucial function in protecting fish stocks from overfishing. Artificial reefs are benthic structures that are deliberately positioned with the goal of preserving, enhancing, or restoring features in marine ecosystems. They are employed as a potential tool for managing fisheries in order to maximize resource augmentation, resource conservation, habitat rehabilitation, and mitigation, as well as one of the ways to address the issue of declining fish resources in coastal waters. The establishment of artificial reefs or other underwater man-made structures is a common strategy for habitat improvement in aquatic areas. Traditions dating back hundreds of years to improve subsistence and artisanal fishing have expanded to include improving commercial and recreational fisheries efficiency, producing new biomass in fisheries and aquaculture, enhancing recreational and ecotourism opportunities, preserving and restoring coastal habitats and biodiversity, and advancing research. All inhabited continents' maritime habitats use artificial reefs to differing degrees, with varying results. While early scientific studies of reef ecology focused largely on colonization and succession, more recent research has characterized hydrodynamics, bioenergetics, and food webs, as well as the function of reefs in the recruitment of new species. A rising number of reefs are being rigorously tested for function and are designed to meet the life history needs of the species, assemblages, and systems that are of concern in the ocean environment.

Design and Construction

The design is the most crucial step in the planning process for purpose-built artificial reefs, and it entails choosing the right materials and creating a precise structure depending on the intended use of the reef as well as the local oceanographic circumstances. Around the Philippines and Malaysia in the southwest Pacific, artificial reefs made of tires are particularly common. More than 50 reefs have been built in Malaysia using 1.5 million tires. Since 1975, artificial reefs have been constructed in Malaysian fisheries waters using a variety of materials, including used tires, derelict and confiscated fishing vessels, reinforced concrete, polyvinyl chloride, fiberglass, ceramic, and combinations of several materials (reef balls).

Feasibility: The design of the proposed reef should be based on components that are simple to obtain or produce, and the handling, transport, and deployment of the modules and other components should be both safe and affordable. Designs need to be simple in order to satisfy this requirement.

Functionality: The reef must be able to accomplish the goals for which it is being built.

Durability and Stability: Materials should be strong and stable enough, combined with the design, to keep the reef's shape and functionality even through the worst weather conditions that are anticipated to occur at that location. The geology of the seabed where the reef will be built is another factor that must be considered. A shifted reef may experience extra detrimental effects.

Environmental Compatibility: Artificial reefs should only be built if they can be proven to have a net environmental benefit in connection to the stated goals after taking into account all socioeconomic and environmental costs. It is best to stay away from materials with known

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environmental concerns, and reefs shouldn't significantly interfere with other productive uses in the surrounding area.

Monitoring Initiatives: Prior to the installation of an artificial reef, baseline studies should be conducted to collect benchmark data for the later monitoring of the reef's effects on the marine ecosystem. There should be short-, medium-, and long-term monitoring programs after the reef is deployed to ensure that the management goals are met (compliance monitoring) and that the anticipated benefits are realized. The monitoring program should also be designed to determine and evaluate the artificial reefs environmental effects and/or any problems with other legal uses of the maritime region or portions thereof.

The following characteristics of the reef site are taken into account when designing artificial reef modules.

- The water column's depth.
- The kind of seabed (various types of modules are needed for muddy and sandy bottoms).
- The resource being aimed at

There is a strong connection among reef height and water column depth. The rule of thumb is that the height of the reef should be at least one tenth that of the water column, therefore if the water column is 15 meters deep, the height of the reef should be at least 1.5 meters. Less than this results in a reduction in the reef's effectiveness. During the monsoon season, muddy bottoms encounter mud drifting, and eventually, modules are likely to sink in the mud. To keep the reef functioning under such conditions, reef modules must be deposited on a regular basis. In contrast, modules with sandy bottoms are more stable and maintain their effectiveness over time. Areas with strong water currents during the monsoon season are found to be more suitable for 1.5Mx1.5Mx1.5M triangular modules with a 0.60x0.60m window on all sides. Regardless of how they get there, triangular modules stay in place in the ocean floor. Although more expensive, cubical modules also serve the same purpose. Used tires, well rings, and concrete pipes are all relatively affordable building materials for coral reefs.

- Triangular modules
- Rectangular box type modules
- Circular modules
- Tetra pods
- Concrete rings
- Old tyres fixed on a concrete bed
- Triangular or rectangular modules with PVC or stoneware pipes fitted inside.
- HDPE pipe structures

For example, while building a lobster reef module, stoneware or PVC pipes are utilized in the module to offer the animal with a place to hide. This is done to satisfy the behavioral requirements of the targeted species. In cracks with a convenient escape aperture, lobsters typically live. Therefore, the pipe is left open at both ends so that it can escape if a predator attacks it. The juvenile lobsters can settle, mature, and populate the entire reef in the new habitats provided by the lobster reef. Due to the abundance of food available in fish reefs,

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initially gathered fish will stay put and eventually breed and fill the reef, creating a fishery resource in the nearby fishing grounds.

Fabrication of Reef Modules

In order to reduce transportation costs, reef modules are made on land not far from the reef site. The weight of the modules should be as low as possible because they will be carried by fisherman from the shore to the transportation platform. Modules are constructed using either ferrocement or reinforced concrete. For reinforcement in concrete and ferro cement, respectively, 4 mm weld mesh and chicken mesh are both employed. The concrete contains 0.5" of granite jelly to lower the module thickness to 4-5CM. After the concrete has finished curing, the individual slabs of the module are assembled. Typically, curing takes place for 12 days. A 0.60Mx0.60M window is included in the middle of each 1.5Mx1.5M slab. Dried slabs are combined to create rectangular or triangular modules, depending on the situation. To ensure better strength, it is possible to keep the ratio of cement, sand, and jelly at 1:2:4. For strong corners when connecting the slabs, 2 mm tying wire is utilized. Due to the abundance of food organisms in the newly constructed habitat, artificial reefs are artificial ecosystems where large-scale fish aggregation occurs. However, as time goes on, the size of the population grows and the food availability declines. The reef's production declines as a result of this. The ideal solution to this issue is to enhance the reef by scattering plant materials like fresh-cut tree branches, coconut leaves, coconut stumps, palm leaves, and more modules around the region. When plant material decomposes, particularly coconut or palm leaves, a characteristic odor is released that draws fish and other species that serve as fish food to the reef region. The larvae and fingerlings of numerous creatures have enough food thanks to the reef's sudden abundance of food. This has been used for fish aggregation in both freshwater and marine habitats for as long as there have been fishermen. Additionally, this is a common method used by fishermen on the northern Malabar coasts to catch cuttlefish and squid.

Socio Economic Aspects

Artificial reefs improve fish availability in coastal waterways, which expands artisanal fishermen's employment opportunities. ARs also contribute more to resource preservation by stopping automated vessels from fishing inshore seas and robbing small and marginal fishermen of their means of subsistence. In locations where traditional fishermen confront resource decline from overfishing or automated fishing, ARs are increasingly significant. Reefs offer extra places for fish to attach and grow, as well as the organisms that make up fish food. Having more food always draws smaller fish to the reef, which eventually draws larger fish. By employing hooks, lines, and other simple equipment, these fish multiply and replenish the reef, providing a fishery resource to traditional fishermen. Artificial reefs are thus necessary for the traditional fishermen's livelihood as well as for the management and maintenance of our precious coastal fisheries resources.

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2. CONCLUSION

ARs used for conservation must have SMART (specific, measureable, achievable, realistic, and time-bound) objectives in order to be a successful management tool. To prevent unclear judgments about success, structural design, site selection, and monitoring should be adjusted for specific conservation aims.

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