

Artificial Reefs - The Underwater Treasures

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SUMMARY

Artificial reefs are man-made structures placed on sea for protecting habitats, reducing soil erosion, boosting recreational fishing and increasing biotic diversity. There are different types of artificial reefs made of cubes, pipes, tires, concrete structures, sunk old ships etc. these provide good mediums for fish perching, foraging, breeding and to defence them from their predators. Thus, for construction of a artificial reef investment cost is higher. Hence, people preferred to use the waste materials like bottles, PVC pipes, rubber tires, stones etc... However, these reduced the investment cost but resulted in marine pollution by leaching out chemicals and toxins upon soaked in water for several months. These toxins are harmful to the marine ecosystem. The use of sustainable materials in the field of construction is nowadays considered a compulsory requirement in the case of artificial reefs. Hence, the present paper has been aimed to provide an insight on the use of sustainable construction materials, benefits, and drawbacks of setting an artificial reef.

INTRODUCTION

An artificial reef is a submerged structure that are placed on the seabed to mimic like a natural reef, for protecting, regenerating, concentrating or enhancing the biodiversity of living marine resources. It serves as a habitat that acts as part of the natural ecosystem and no harm is caused by these artificial reefs. They provide hard surfaces which allows the algae and small marine organisms like barnacles, corals, and oysters grow on it. This accumulation of marine organisms acts as a food for fish groups which helps in the productivity of the food chain in aquatic ecosystem. (NOAA, 2014). Thus, this paper has a detailed view about the artificial reefs, their uses and methods of construction and also its drawbacks

Characteristics of an Ideal Artificial Reef

An ideal artificial reef should be a) Stable and non-destructable by storms or winds b) Made from long-lasting, solid, non-toxic materials c) Designed properly to have good texture for the growth of corals, sponges, and other organisms d) Designed to provide a high amount of structural complexity to provide shelter for fish fry and other animals e) Designed in a way to either blend in with the natural reef. f) Considerations such as depth, placement, boat navigation, etc. must be considered.

Factors to be considered while setting an artificial reef

Some of the factors has to be considered while constructing an artificial reef is listed and should be carefully followed. (i) Proper siting is mandatory (ii) Pollutants such as tires should be avoided (iii) Pre-analysis should be done (iv) The main focus is to create a marine habitat and diversity (v) It shouldn't interfere with navigation of ships (vi) Consider all the socio-economic and environmental costs (vii) Avoid using chemicals (viii) Consider factors like depth, seabed contour etc. (ix) Materials used must be bio-degradable. (x) Maintenance work has to be done periodically. There are different types of construction materials for artificial reefs they are briefed below.

Construction materials for artificial reefs

(i) Wrecks and other large steel structures

Metal ship wrecks or sunk ships are the oldest and well-developed artificial reefs. In these steel structures, there are some minerals present that enhance the growth of algae and also beneficial bacteria. Decommissioned oil platforms also act as artificial reefs provided with proper environmental preparations and acts as a amazing 'islands of biodiversity'. The major disadvantage caused by using these ship wrecks include electrolytic degradation of steel boats and these structures break apart in a few months.

(ii) Concrete structures

The majority of reef managers choose to utilise concrete for a variety of reasons. Concrete is extremely similar in composition to natural coral limestone and is strong, heavy, inexpensive, and widely available worldwide. Concrete's primary disadvantage is that constructions made of it can easily become heavy.

(iii) Modular units made of Steel rebar, Cement, or glass

In this method, some smaller structures are constructed first and then they are easily deployed (carried to a boat) and then assembled into larger structures underwater. An example of this type of artificial reef is our Bottle Units. It consists of a concrete base, into which glass bottles are placed and become the securement point for corals. The units are sunk into the sands to prevent them from moving around. By these structures the corals have enough place to attach themselves and waves doesn't disturb them since they are sunk into sands even if the bottles collapse they form a substrate allowing the corals to grow.

(iv) Mineral Accretion devices

The new type of artificial reefs involves the use of mineral accretion devices, or electrified artificial reefs. In these structures low voltage electricity is passed through the structure in the water. This results in cathodic reaction providing protection to the structures from corrosion, bleaching etc. Thus this devices were beneficial for the growth of corals and reef-associated organisms. The major disadvantage is these units are very costly and huge amount is needed for its maintainence.

(v) Use of 3D printers

The 3D printing can play a key role in the manufacture of artificial reefs, as it allows the creation of specifically designed models, giving the possibility to optimise their shapes and textures to attract as much marine life as possible. These act to simulate natural environments to attract the fishes.



Fig 1.1. Ship wreck reefs



Fig 1.2. Concrete structure reef



Fig 1.3. Bottle reef units

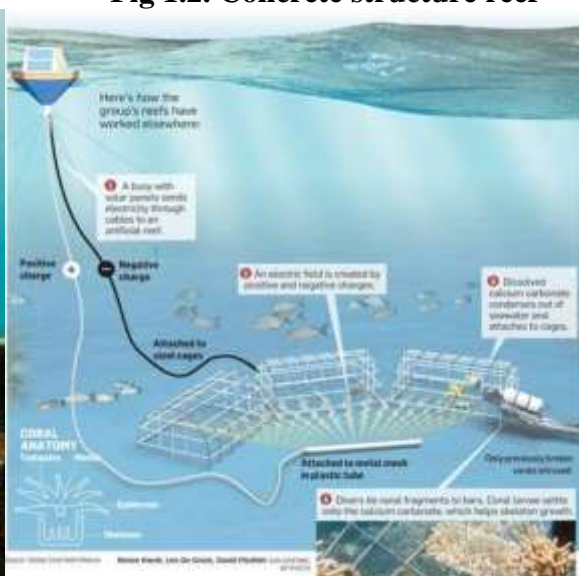


Fig 1.4. Mineral Accretion devices operated reefs

Limitations of artificial reef

However, these artificial reefs provide shelter and support to various micro-organisms and small fishes. There are also drawbacks which affects the aquatic environment due to use of harmful construction materials which upon several months release toxins resulting in marine pollution and also mortality of sea-creatures through ingestion of those toxins.

Waste material-a potentially toxic material

Waste materials are rarely good construction materials since they are cheaper and easy to construct. Mostly rubber tires and plastic pipes have been used for these purposes. these are small structures which leach upon toxins day by day and these toxins is carried from one place to another by means of storms. The most famous example of this is the Osborn reef built in Florida in 1970.

PVC as artificial reef

Using PVC pipes artificial reefs are built. These are not stable and move/collapse even in light storms. These PVC pipes doesn't support the growth of corals due to its smooth structures to which corals cannot be attached. Thus, use of these waste materials for constructing artificial reefs has more drawbacks than its advantages. Marine pollution is a major drawback in using these waste materials. Hence, it is better to avoid using toxins leaching waste materials as construction materials for artificial reefs.



Fig 1.5
Rubber tyres as artificial reefs



Fig 1.6
PVC pipes as reefs

Benefits of artificial reefs

- They develop and act as a high value biodiversity hotspots.
- The reefs decrease the force and velocity of waves, protecting coastlines from the effects of storms and flooding.
- Mitigate shore erosion land retreat and reduces wave impacts.
- Can be used as Fish aggregating devices for increasing fish catches.
- Reduce the pressure from coral reefs.

CONCLUSION

The recovery of degraded marine coasts and the improvement of natural habitats are current issues of vital importance for the development of life, both marine and terrestrial. Thus artificial reefs have become a tremendously popular habitat enhancement technique even though relatively little experimental research has been done on artificial reef biology. Over the last few years, more and more interesting or novel methods like 3-D printers are being used to design artificial reefs. Thus, there are many techniques that can be used while setting an artificial reef which results beneficiary for the fishermen and also enhance the productivity of the marine ecosystem. Hence, Research is still needed to emphasize and create awareness on the importance of on artificial reef operation and management and to further optimize reef design, size, and location.

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