Artificial Fish Habitat

An Artificial Fish Habitat (AFH) is a man-made, underwater structure, typically built for the purpose of promoting marine life in areas of generally featureless bottom. AFH may also serve to improve hydrodynamics for surfing or to control beach erosion. An AFH is one or more objects of natural or human origin deposited purposefully onto the seafloor to influence physical, biological or socio-economic processes related to living marine resources.

It is a submerged structure deliberately constructed or placed on the seabed to emulate some functions of a natural reef such as protecting, regenerating, concentrating, and/or enhancing populations of living marine resources and their habitats which includes the promotion of research, recreational opportunities, and educational use of the area. However, submerged structures deliberately placed to perform functions not related to those of a natural reef such as breakwaters, mooring, cables, pipelines, marine research devices or platforms are not considered as AFH even if they incidentally imitate some functions of a natural reef.

The term 'AFH' has been used to encompass a wide range of structures including any objects placed in the ocean either intentionally or accidentally (e.g. shipwrecks). Types of AFH range from man-made reefs intended to mimic natural reefs, through other forms of artificial habitats that increase benthic complexity, to fish aggregating devices (FADs). AFH can increase production in many ways such as increasing habitat, shelter, and creating substrate.

AFH can be built in a number of different methods. Many reefs are built by deploying existing materials in order to create a reef. This can be done by sinking oil rigs (through the Rigs-to-Reefs program), scuttling ships, or by deploying rubble, tires, or construction debris. Other AFH are purpose built (e.g. the reef balls) from PVC and/or concrete. Historic or modern shipwrecks become unintended AR when preserved on the sea floor. A wide range of materials have been used to construct AFH, including transplanted corals and other natural substrate, tyres, concrete, rocks, ship hulls, vehicles, oil rigs, other waste materials and purpose designed, fabricated modules such as 'Reef Balls'.

The primary purpose of AFH structures is to attract fish by providing them with more favourable habitats than are present in the original environment. The background knowledge on temporal and spatial changes in distribution of fishes is required to analyse the effects of deployment of artificial structures. For the appraisal of changes in distribution patterns, seasonal variations in hydrodynamics and environmental variables affecting the organisms have to be understood. The AFH presented a useful opportunity to study the influence of environmental parameters on the fish assemblage. The fishes occur commonly in shallow near shore waters, inhabiting muddy or sandy bottoms and searching for river mouths during spawning.

- Artificial Reef (AR) is a kind of artificial fish habitat which provides living, hiding and breeding places for aquatic organisms, thereby augmenting the biodiversity and abundance of fishery resources.

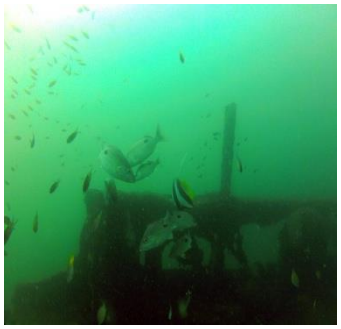
- The installation of ARs along coastal regions could bring down the fishing pressure from mechanised sectors and thus support the traditional subsistence inshore fisheries

Fig.1 Construction and deployment of rectangular type AFHs

Low cost rectangular AFHs for coastal waters of Goa

Three kinds of rectangular AFHs (see table) with circular holes (diameter of 10 cm) were designed and constructed with RCC. With the participation of fishermen community, a total of six AFHs with marker floats (B and C- three numbers each) were deployed at two locations (rocky grounds) in Zuari estuary. To rejuvenate and replenish the fish stocks in Zuari, site specific nine rectangular Artificial Fish Habitats (AFHs) were constructed and deployed with the participation of fishermen community. The ecological evaluation of these AFHs is in progress. Evaluations of existing AFHs (shipwrecks in Grande Island) are also in progress. Diving surveys counted total of 21 species on the AFHs and the maximum abundance of *Heniochus acuminatus*, *Halichoeres nigrescens, Lutjanus russelli, Lutjanus fulvus, Pomadasys furcatus, Acanthurus blochii, Chaetodon collare, Chromis chromis, Lutjanus lutjanus* were observed at the AFHs.

Design	Length (m)	Breadth (m)	Height (m)	Number of holes	Number of AFH
A	1	1	1	24	4
B	1	1	0.5	20	4
C	1	0.5	0.5	18	4

The concept of AFH is pretty new in the State and the development will be gradual. Initial surveys using fish experiments were difficult. The experiments started only after making a rapport with the fishermen. The surveys would be more efficient if we would have provided with underwater camera, diving and snorkelling equipments. However, through awareness and building a rapport with the fishermen group, the deployment of the AFHs was successful. A collaborative underwater visual census programme with diving and underwater visual census apparatus was organised to visualise the development of ecological assemblages on the AFHs.

Shipwrecks as an artificial fish habitats in Goa

Sunken vessels are also reported to function as artificial reefs and they help to enrich the local fish biodiversity and fish conservation. The deployment of artificial reef structures in coastal and marine environment was also intended to accommodate the mounting pressure on the exploited fisheries resources in recreational fisheries. The different sectors like recreational and commercial fisheries, tourism industry and diving industry were endorsed with the fish assemblages in the sunken ships and the fishermen and divers preferred sunken ships as efficient artificial fish habitats over other structures. The higher densities of fish assemblages in these habitats attract the recreational fishers and divers. Due to the high number of ships abandoned and sunken on the seabed of the world oceans, it is important to strengthen our knowledge about the role played by these artificial structures in marine ecosystems. Therefore, more scientific studies and illustrations are required to ascertain the functioning of sunken ships for fisheries and ecological enhancement.

The SS Rita, built in U.K. in the 1930's, is a 130 meter metal cargo ship and reportedly arrived carrying a cargo of railroad tracks. The ship sank near Grande Island around 1950's in a storm with loss of only one life and now it is popular as Suzy's Wreck. Much of the wreck has been salvaged leaving a superstructure covered with molluscs and small soft and hard corals. The wreck is now in pretty broken up condition. A total of 85 fish species from 26 families was recorded from the shipwreck. The most abundant species on the shipwreck were *Pempheris multiradiata, Ostorhichus compressus, Lutjanus indicus, Heniochus acuminatus, L. fulvus, Epinephelus coioides, Pomadasys guoraca, Pomadasys furcatus, Odonus niger, E. erythrurus* and *Monodactylus argenteus.* Species like *Caesio cuning, C. caerulaurea, C. striata, Chaetodon collare, Caesio xanthonota, Acanthurus dussumieri, Arothron hispidus,* and *Apolemichthys xanthurus*. These fishes are basically from fish groups like snappers, butterfly fishes. Grunts, Groupers and damselfishes. Fishes from all trophic levels (herbivores, planktivores, carnivores, omnivores were observed on the shipwreck. This indicated that the

shipwrecks can act as artificial fish habitat, attracting assemblages of fish species and leading to enrichment and a greater diversification of the local fish assemblages. Moreover, the high diversity and abundance of the species of fisheries importance on the wreck site compared to natural reefs indicated that it support the local fisheries. There were 32 ecologically less resilient fish species and 23 vulnerable fish species observed on the wreck. This underlines that the wreck act as a refuge for the vulnerable fish species.



New dimensions in research

The performance of rectangular AFHs was commendable on the basis of ecological succession and fish community aggregations. However, there is only one limitation that the structures are heavy and it is difficult to transfer and deploy in offshore ecosystems. Hence, research trials can be initiated to reduce the weight and size of the structure to facilitate easy transportation.