Artificial reefs

Challenge: Sea level rise **Adaptation response:** Green infrastructure for shoreline protection

Description

An artificial reef is a submerged (or partly exposed to tides) structure deliberately placed on the seabed to mimic some functions of a natural reef, such as protecting, regenerating, concentrating and/or enhancing populations of living marine resources. This includes the protection and regeneration of habitats. It will serve as habitat that functions as part of the natural ecosystem while doing 'no harm' (FAO, 2015).

The term excludes artificial islands, cables, pipelines, platforms, mooring, and structures for coastal defence (e.g. breakwaters, dikes, etc.) which are primarily constructed for other purposes, as well as the fish aggregation devices (FADs) employed to merely attract fish in certain fishing areas.

Many reefs are built using objects that were built for other purposes, for example by sinking oilrigs (through the Rigs-to-Reefs program), scuttling ships, or by deploying rubble or construction debris. Other artificial reefs are purpose built from PVC or concrete. Shipwrecks may become artificial reefs when preserved on the sea floor. Regardless of construction method, artificial reefs generally provide hard surfaces where algae and invertebrates such as barnacles, corals, and oysters attach; the accumulation of attached marine life in turn provides intricate structure and food for assemblages of fish (NOAA, 2014).

Implementation

Artificial reefs should only be established if, after due consideration of all socio-economic and environmental costs (e.g. undesirable impacts or alteration), a net benefit can be demonstrated, in relation to the defined objectives.

An analysis focusing on conditions that support attachment and growth of marine life must be done for site selection. Proper siting is vital to the success of an artificial reef. The initial focus should be to enhance or create habitat and a diversity of fishery resources, while not impeding or interfering with navigation.

The goals of the artificial reef project, social and economic considerations, and environmental and biological concerns should be identified early in the planning stages. Potential pollutants such as tires should be avoided when selecting the site. If choosing a shipwreck, ensure that oil and other toxic substances are cleaned up. The reef can be established by anchoring reef structures (pillars, rocks) or sinking wrecks and planting of propagated nursery corals. Reef development needs to be monitored before, during and after construction to determine whether reefs meet permit terms and conditions and are functioning as anticipated. Maintenance work may be required, for example re-shifting reef construction or removing invasive/unwanted species.

Environmental Benefits

- Creates high value biodiversity hotspots.
- Decreases the force and velocity of waves, protecting coastlines from the effects of storms and

flooding.
- Reduces wave impacts, mitigating shore erosion and land retreat.

Socioeconomic Benefits
- Protection from erosion and flooding by reducing energy from waves.
- Fish aggregating devices increasing fish catches (care must be taken to sustainably manage fisheries and avoiding harvesting more from the reef environment than is produced).

Opportunities and Barriers

Opportunities:

- If well-managed and stress is kept to minimum, reef self-resilience improves and little restoration is required
- Provides climate change adaptation benefits along with a host of other ecosystem services important for human and environmental well-being.

Barriers:

- Not all artificial reefs establishment is successful
- Management and local community involvement are crucial to curb illegal activities threatening reefs.

Implementation considerations*

Technological maturity:	3-4
Initial investment:	3-5
Operational costs:	1-3
Implementation timeframe:	2-4

* This adaptation technology brief includes a general assessment of four dimensions relating to implementation of the technology. It represents an indicative assessment scale of 1-5 as follows:
Technological maturity: 1 - in early stages of research and development, to 5 – fully mature and widely used
Initial investment: 1 – very low cost, to 5 – very high cost investment needed to implement technology
Operational costs: 1 – very low/no cost, to 5 – very high costs of operation and maintenance
Implementation timeframe: 1 – very quick to implement and reach desired capacity, to 5 – significant time investments needed to establish and/or reach full capacity
This assessment is to be used as an indication only and is to be seen as relative to the other technologies included in this guide. More specific costs and timelines are to be identified as relevant for the specific technology and geography.

Sources and further information

FAO. 2015. Practical guidelines for the use of artificial reefs in the Mediterranean and the Black Sea, by Gianna Fabi, Giuseppe Scarcella, Alessandra Spagnolo, Stephen A. Bortone, Eric Charbonnel, Juan J. Goutayer, Naoufel Haddad, Altan Lök, and Michel Trommelen. Studies and Reviews. General Fisheries Commission for the Mediterranean. No. 96. Rome, Italy.

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