ARTIFICIAL REEFS IN MALAYSIA : THE MALAYSIAN EXPERIENCE IN RESOURCE REHABILITATION

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■ INTRODUCTION

Since the 18th century, artificial reefs are man-made objects intentionally placed on the sea-bed to increase the abundance of fishery resources. The bulk of documented work was carried out in the late 1900 (Ino,1974). Artificial reefs are man-made hard substrates purposely or accidentally placed on sea floors so that corals, sponges, algae, and any other reef-building organisms may colonize them. Like natural coral reefs, artificial reefs provide habitat for the same diversity of fish, invertebrates, and plants that natural reefs do.

The decline in marine fisheries resources due to the use of progressive gears resulted in habitat degradation. This decline in fisheries resources was reflected in research catch data in the coastal waters off the west coast of Peninsular Malaysia. The average catch rate decreased by 55 % from 131.1 kg/ hour in December 1970 to 58.9 kg/hour in December 1980. The average catch rate of trawlers in Peninsular Malaysia for 1986 was only 18.7 kg/hour (Department of Fisheries, 1987).

Used tyres were being deployed as artificial reefs, this programme was initiated by the Fisheries Research Institute with the first tyre reef at Pulau Telur, Kedah. Two more artificial reefs were constructed at Pulau Payar, Kedah in October, 1975 and at Pulau Aman, Penang in July, 1976.

The artificial reefs project started on a modest scale and progressed gradually utilizing existing facilities and manpower at the institute. Due to encouraging ecological development around the artificial reefs and the declined in fishery resources, the project was officially recognized as a fisheries development project. During the fifth Malaysian Plan from 1986 to 1990, the project was allocated a budget of RM 8.24 million.

Apart from the artificial reef project in Malaysia (whereby the Department of Fisheries is the executing agency), the Malaysian Fisheries Board (a semi-govtment body) also under the Ministry of Agriculture conducted a FADs development programme since 1983. For the period 1983 and the year 2001, a total of 222 FAD sites were established utilizing a budget a of RM 24 million. The FADs were constructed fromvehicle tyres, konkrit kuboid and cylindrical drain pipes. The FADs were for fishing, minimizing distance to rich fishing ground thus decreasing fuel costs and aimed at increasing the household incomes of traditional fishermen. THis paper will only discussed the experience of the Department of Fisheries Malaysia in the National Artificial Reef Programme.

■ OBJECTIVES

The objectives of the artificial reef project are :

1. To rehabilitate and conserve marine habitats that were degraded by trawling.

2. To increased the biological productivity and fishery resources through enhancement of sea-beds creating habitats for nursery and breeding of fishes and other marine organisms.

3. To acts as a nucleus for the recovery of coastal fisheries resources, thereby improving catches of artisanal fishermen.

■ ARTIFICIAL REEFS SITE SELECTION

Suitable site for artificial reef deployment was based on the following criterias :-

1. Firm seabed i.e. a sandy bottom is preferable
2. Depth range between 15 m to 25m
3. Adequate water clarity if it is intended for coral growth and for easy monitoring
4. Absence of strong currents that can result in scouring effects or artificial reefs being swept away
5. Away from traditional fishing ground
6. Away from shipping lane, guaranteed navigational safety.

■ BUILDING THE ARTIFICIAL REEFS

The materials for constructing the artificial reefs should be durable, long-lasting, cheap, easily available, handled and transported lastly it should not leach out any hazardous chemicals to the seawater.

In the initial stage, used tyres were being utilized for artificial reefs construction, tyres do not degrade seawater but if not properly tied , the tyres will litter the ocean floor and become a nuisance to gill-netters. Derelict or confiscated fishing boats were also being deployed as artificial reefs in 1984. The Fisheries Research Institute started to build artificial reefs using concrete pipes and culvert in 1986. The advantage of concrete against tyres is that they can be built bigger, stronger and in various designs.

■ TYRE REEFS DESIGN AND CONSTRUCTION

Before 1985, tyre reefs were constructed using 3 to 4 tyres tied up with polyethylene ropes, the tyres were tied into a tetrahedral shape , transported and deployed in batches of 300 to 500 tyres. The modules were tied up with other adjoining modules to limit possibility of drifting. The resulting tyre reef was irregular reaching a height of 1 meter.

Under the accelerated programme since 1984, tyres were tied into 42 tyres – pyramid, with resultant height of 1.5 m to 2 m. The floor space of a single pyramid is about 3 m^2. For every launching, 10 units of tyre pyramids were linked together by a 20 mm polyethylene rope. The tyre pyramids were randomly spaced on the seabed with occasional piling of a few pyramids reaching a height of 3 metere or more. Due to this loose arrangement, an artificial reef of 50,000 tyres can cover a seabed area of 0.7 hectares.

■ BOAT REEFS CONSTRUCTION

Before being deployed, derelict or confiscated boats were cleared of all debris and loose pieces which would otherwise result in flotsam upon sinking of boats. All water tanks and fuel tanks are opened or puncture to prevent trapped air from hindering the sinking of the boats. At preselected site, boats were anchored and then sunk by allowing water into the boats by knocking out the propeller shaft or by opening sea-cocks.

■ CONCRETE REEFS CONSTRUCTION

Malaysia's first concrete reef was built at Pulau Payar, Kedah in December 1986. The two concrete reef designs were made of concrete drainage culvert and concrete pipes. Both materials were arranged into a pyramid on a wooden platform and secure by steel cables. The resulting structure is 1.2 m in length, 2.4 m in width and 2.4 m in height. Ten units of each type of concrete reef, was individually placed on the seabed with the use of a crane.

In December 1987, another 20 units of concrete pyramids were deployed at Pulau Payar to expand the existing artificial reefs there. Modifications were made, the size of these concrete pipe units was increased to 1.8 m long and 0.9 m in diameter. The thickness of the concrete pipe was increased from 3.8 cm to 5 cm and strengthened with BRC-10

specification. The concrete pipe itself had 8 holes of 20 cm diameter and the wooden platform had 4 cross- beam instead of 3 cross-beam (previous design). The diameter of the steel cables was increased from 7 mm to 10 mm and a total of 4 such steel cables were used instead of 2 cables per pyramid in the previous design. The resulting structure is 1.8 m wide, 3.65 m in length and 3.6 m in height. Twenty artificial reef units of the same design were deployed at Muka Head, Penang in December 1987. Two concrete reefs were deployed off Kuala Ibai and Kuala Setiu, Terengganu in November 1987.

■ PVC REEFS

After the five year accelerated artificial reef programme , the project proceed at a slower phase. Other materials were being tested for suitability in artificial reef construction. PVC reefs were deployed in Pulau Lembu, Kedah in 1990. This experimental scale reef was funded under the ADB loan, subsequently a large scale PVC reef was constructed at Pulau Perhentian, Terengganu. PVC is a light, flexible material that can be easily transformed into various designs. Since it is very light, no heavy machinery such as a crane was needed for deployment of PVC reef modules. The smooth surface of the PVC pipes should be sand-papered to facilitate attachment by fouling organisms.

■ RECREATIONAL FISHING REEF

A concrete recreational reef was deployed in May 1992 at Pulau Tioman (a Marine Park) in Pahang. 720 concrete cuboids are used for this reef, each cuboid is 1.2 m. X 1.2 m. As Pulau Tioman is a tourist destination, this reef enhanced the tourism activities.

■ MALAYSIAN REEF BALL ARTIFICIAL REEF

In 1998, 1500 reef balls of different sizes were deployed at Pulau Talang-talang an island in Sarawak. Another site will be at Pulau Satang in Sarawak. Unlike other material such as used tyres and derelict vehicle bodies, the reef balls constructed from fibre-glass mould, using cement with the same pH as natural seawater contain no toxins or biologically active compounds.

■ FISHERY PRODUCTION AND ECOLOGICAL DEVELOPMENT AT ARTIFICIAL REEF SITES

Qualitative surveys were occasionally conducted by divers from the Fisheries Research Institute. Preliminary observations in some reef sites showed that the artificial reefs were rapidly colonized by fishes in the first few months after deployment and then the rate of recruitment levels off after about one year. At the Pulau Payar tyre reef in Kedah, the fish population has reached a stable state (Abdul Razak, L. and R. Mohd. Kushairi, 1989) showing the fluctuations in fish population.

Encrustation on the surface of the artificial reef be it tyres , concrete or PVC had been prolific with a variety of organisms such as micro-algae, barnacles, sponges, tunicates, anemones, hard corals, soft corals and bivalves such as oysters . The rate of encrustation appeared to be faster on the concrete reefs rather than the tyre or PVC reefs.

The major species of fish identified in the artificial reef sites are snappers, groupers, fusiliers, sweetlips, parrotfishes, rabbitfishes, jacks and damselfishes. Large shoals of snappers, Lutianus spp. numbering about 10000 – 15000 and fusiliers, Caesio spp. numbering about 10000 are not uncommon at any one time at artificial reef sites.

At the concrete reef site in Pulau Payar, Kedah large shoals of carangids were usually seen swimming in the vicinity of the concrete reef. Groupers are also a resident species, census at some reef sites indicate a population level of 1 grouper per 10 m2. The grouper population differ between artificial reef sites, certain small artificial reef may harbour as many as 30 to 40 groupers.

Many studies were carried out world-wide, Bohnsack and Sutherland (1985) reviewed artificial reef literature and found numerous, well documented observations of rapid colonization rate, high fish densities and high catch rate of artificial reef sites. High priority should be given to quantitively test predictive models and determine causes of phenomenon associated with artificial reef (Bohnsack, et. al. 1985)

■ STATUS OF THE ARTIFICIAL REEF PROGRAMME IN MALAYSIA

Until the end of 1991, utilizing the funds allocated (RM 8.24 million for the period from 1986 to 1990), fifty-two tyre reefs were established around Peninsular Malaysia, seven tyre reefs in Sabah and 6 tyre reefs in Sarawak waters. A total of 1.029 million tyres were utilized to build these reefs. In addition to the tyre reefs, there are also 9 boat reefs (7 in Peninsular Malaysia and 2 more in Sarawak) plus 4 concrete reefs in Peninsular (2 in the west coast and 2 sites in east coast). All the artificial reefs are located within the coastal inshore waters and the majority are near islands with distances ranging 200 – 500 meters from the shoreline.

■ PROBLEMS AND CONSTRAINTS AND RECOMMENDATIONS FOR FUTURE ARTIFICIAL REEF PROGRAMME

Under the accelerated programme of artificial reef development, more than 1 million tyres were collected and emplaced at all the artificial reef sites by 1990. This posed severe logistical problems in obtaining supply, storage, transportation and preparation of tyres. Accordingly the Department of Fisheries embarked into experimenting with materials other than tyres for the construction of artificial reef.

Efforts should now be directed to monitoring the reefs now considered 'matured', to quantify the benefits of the artificial reefs in terms of fisheries resource enhancement, conservation and rehabilitation of coastal ecosystems. The socio-economic impact to artisanal fisherfolks should be studied. The fisheries resources and other marine life in the immediate vicinity of the artificial reef must be protected and conserved in order to fully realize its potential in habitat rehabilitation and resource enhancement of coastal waters in Malaysia and around the world. Artificial reefs that act primarily by attraction may promote overfishing under heavy fishing pressure by increasing fish catchability.

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