"Feasibility Study of Marine Artificial Reefs for Rehabilitation of Demersal Fishes in the Persian Gulf, Iran"

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1. Introduction

1.1. Background of study

Nowadays destruction of marine environments caused by human and natural reasons such as overfishing and pollution etc. have been made fishing activities to be unsuccessful. The main reason for this is that the stocks have decreased sharply, and catch trend is declining fast. Many countries have started establishment of such artificial reefs. Scientists believe that, artificial reefs have positive effects on stocks and sea production.

Persian Gulf is not an exception to this global problem. The most recent information shows that catch quantity has decreased and stocks has damaged. There are different ways to reduce pressure on stock i.e. limitation of catch, modifying fishing gears, artificial propagation and releasing aquatics such as fishes, shrimps etc. One of methods for solving this problem is creation of artificial reefs.

Now, the fisheries cooperatives, associations, fishers, who are interested in artificial reefs have become more active in producing such structures.

Establishment of artificial reefs increases productivity throughout the sea PGI (Persian Gulf-Iran).

1.2. Statement of proposal

This project aims to address the problem of fisheries recourse reduction through creation of artificial reefs, study the biological and ecological aspects of restocked aquatics and investigate the effects of artificial reefs on the natural environment. The artificial reefs increase productivity and possibility of the development of aquatic population throughout the sea PGI (Persian Gulf-Iran).

The artificial reefs will be constructed from:

(a)   The designed materials such as reef balls and fish havens in different sizes and holes on them, which they are arithmetically designed in terms of hydrographical aspects, to have less resistance against sea currents and waves. Usually they are made of concrete (Fig. 1-2)

(b)   Out used materials, e.g. broken concrete, columns, bridges, big pipes, big pieces of metals, old ships, old airplanes, and old machines. To take the environmental and pollution problems into consideration, their weights should be between 0.5 kg –10 tons.

  Each of stations include 50 reefballs, 5o fish haven a hundred out use material. The table number 2 shows the kid, weight, size and number of artificial reefs.

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After establishing artificial reefs in the sea, aquatic animals will start to live around and inside them. These include different fishes especially demersal species such as Grouper, Snapper, as well as mollusks, eel, algae, crustaceans, echinoderms, corals, sponges, and other aquatics.

After a period, they will look like a part of natural reefs and will support production in the sea. In addition, the artificial reefs can be used for restocking and a site for sport diving as well. They also can be used as sites for training of students of marine biology and consider as an attractive place for the people interested in sea life.

1.3. Significance of the study

Decreased catching in the sea has resulted in decreasing of fishing income and unemployment for anglers and fishermen. On the other hand value of aquatic proteins and day to day increasing demand for them, are the major reasons indicating the significance and importance of creating artificial reefs and attracts attention for using these structures for rehabilitation.

The results of this project can help enhance marine stocks, which in turn help in increasing occupation and income of fishermen. On the other hand it can increase recourses of some species which have been reduced significantly.

1.4. Objective

The main objectives of this projects are:

1.4.1. Feasibility study on establishment of artificial reefs in the Persian Gulf.

1.4.2. Investigation of production increases caused by established artificial reefs in the Persian Gulf.

1.4.3. Evaluation of efficiency of established artificial reefs in terms of occupation and income in fisheries sectors in the Persian Gulf.

1.4.4. Protection of critically decreased populations of aquatic animals.

1.4.5. Resource enhancement of commercially important marine species.

2. Literature review

Human has built artificial reefs in sea using construction materials, trunks, stones, big potteries, centuries before and they have caught more fishes. Since 1950's some countries such as Japan , Malaysia, China, America, England and many costal countries have started research projects on artificial reefs. Now it is believed that these reefs can increase resources and production. Coastal countries in the Persian Gulf such as Kuwait, Saudi Arabia, U A E, Oman and Qatar have also started creation of artificial reefs and they have developed artificial reefs in vast areas.

In Iran, from centuries ago fishermen specially Bushehr's people were carrying out such activities such as placing and throwing stones, trunks and the big potteries in costal waters resulting in increased catch. They believed that these reefs are useful for restocking fishes. Pearl oyster fishers in Bandar-e-Lengeh create

artificial reefs using tree branches to collect oyster spats. After a few weeks they shake the branches for releasing the larva and placing them on seafloor.

Rostamian (1995) has undertaken a study on the possibility of artificial reef establishment in the Iranian waters of the Persian Gulf indicating positive increment in fish stocks. Although in this study, lack of facilities and using standard structures as well as lack of baseline information on pre and post deployment of artificial reefs have not provided a reasonable view in this respect.

In Asia, America and Europe many coastal countries such as Japan, China, Malaysia, Australia, India, Italy, France, Britain, Spain, Portugal, Norway, Canada, Brazil, Peru, USA many research projects have been undertaken to investigate:

(1) The effect of artificial reefs in primary and secondary production.

(2) Using old and out used tiers for creating artificial reefs in marine environment.

(3) Effects of marine currents and waves on artificial reefs and evaluate the effects of (hydrograph logy) hydrology on them.

(4) Biology of aquatic systems living on artificial reefs.

(5) Possibility of coral settlement on artificial reefs.

(6) Using oil industrial items such as platforms in creating the artificial reefs.

(7) Using unpolluted materials and constructions as marine artificial reefs.

(8) Comparison of the different structures for using in the artificial reefs.

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3- Methodology

For the reason that there is a need to study and investigate the effects of artificial reefs in large scale and obtain best results, 9 stations (3 treatments) will be selected at three depths (10±3, 20±3, 30±3 m) in costal waters of Hormozgan Province in northern waters of the Persian Gulf, Iran. Fig. 5. These stations are located in Bandar-e-Lengeh region. Each depth consists of 3 stations, (2 replicates and one reference site). Therefore in total 9 stations will be studied. (Table 1)

Different depth stations

Replicates stations	Stations	Depth 10 m	Depth 20 m	depth 30 m
	1st	A1	B1	C1
	2nd	A2	B2	C2
	3rd Reference site	A3	B3	C3

Table 1. – 3 depths (treatments) each one consist 3 stations or replicates

(2 reef stations &1reference station or site)

In this project we will provide:

(a) Two kinds of designed and constructed reefs e.g. Reef ball and Fish haven with an average weight of 1.5 tons (fig. 1-2).

(b) Out used materials, e.g. concrete, column, metals, old vehicles, beg and old pipes with the average weight 2 tons, total numbers 600 pieces according to attached table (table No. 2).

This study include the following steps:

(3-1) Preliminary study before establishing of artificial reefs.

(3-2) Design, build and preparing the structures for artificial reefs.

(3-3) Transporting and deployment the structures in the sea.

(3-4) Sampling and study after creating the artificial reefs.

3-1- Preliminary study before establishing of artificial reefs

(a) Determine suitable sites for construction the structures

The best place to establish an artificial reef site should have hard and strong sediment, in order to prevent sinking of artificial structures in ooze or soil. The situation of the substrate and the aquatic population in the sites will be assessed by direct observation through SCUBA diving and sampling by trap and check in laboratory for identification of aquatics to the genus and species level.

(b) Determination of the compound and relative frequency of marine life in stations.

The fishes around the reefs will be caught by three fishing gears such as gillnet, trap and trawl in each stations twice a month to address the compound and relative frequency as well as CPUE (Catch Per Unit Efforts) on the basis of one of the following three methods:

(1) Catch per unit effort in spreading or surface.

(2) CPUE per day.

(3) CPUE in trap.

This data help in selection of target species and to make comparison the catch before and after establishment artificial reefs.

(c) The investigation of the possibilities for transporting the structures from coast to stations in the sea. These are included: ports, roads, vehicles and tools for building the structures.

(d) Recording primary physical and chemical data of water in stations.

(e) Determining the aim or purpose for choosing the species in search.

(f) Underwater videography and photography in order to document the development and rehabilitation of aquatics around and on artificial reefs.

3-2-Desigen and building the artificial reefs

The artificial reefs will be constructed with the following :

(a) Reef ball and fish haven Fig. 1 - 2.

(b) Out used materials such as concrete, broken bridges, old ve hicles big and old pipes, and metals.

3-3-Transportaion and deployment of structures

A qualified diver team is necessary for deployment of structures in accordance with the attached plan. Figure 3-4. After deployment of artificial reefs some physicochemical properties of water including pH, salinity, temperature and dissolved oxygen as well as biological data on biodiversity of aggregated fish around the artificial reef and data on planktons and benthos will be collected.

Preparing the plan to construct the reefs: This project needs to have a temporal and spatial plan for deployment of reefs. Fig.3- 4.

Preparing the big buoyant vehicles such as barge, tow boat, boats, for using during the construct the reefs.

To deploy the structures in the selected stations: The diver team will position the stations according to the determined plans.

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Underwater videography and photography: This will be carried out during all practices including pre- and post-deployment.

Inspection of quality or circumstance (manner) to take in to consideration all of the actions from coast to under water.

3-4 Underwater study of artificial reef.

One of the very important parts of this project is to study the structures after deployment in the sea over a 24 months period to check out the following issues:

(a) Measurement of physico-chemical properties:

These factors include: Temperature, Salinity, pH, Dissolved Oxygen, Nitrite, Phosphate, Chlorophyll *a*, Turbidity, Grain size, Benthic or substrate (benthos) and TOM (total organic matter).

Temperature (both air and water)   will be measured in three points around each station in each month.

Salinity   will be measured in three points around each station in each month.

pH   each month from surface an d bottom.

Dissolved Oxygen will be measured **each month from surface and bottom by Oxygen meter.**

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Nitrite and Phosphate: These factors are two main parameters indicating the nutrients situation in the sea. These are based on the food chain for producing in the sea.

Turbidity will be measured with spectrophotometer and Secchi Disc.

(b) Identification and biometry.

Once the reefs are deployed, many aquatic organisms will start to settle on these structures as a base and habitat. These organisms will be collected in order to study their biodiversity to the genus and species level and to determine their relative frequency. These are mainly demersal fishes, mollusk (bivalves, planktons, Cephalopods…), echinoderm (cucumber, sea stars…), crustacean (shrimps, barnacles, craps …), sea worms (polychaetes …),marine algae or sea weeds,

ichthyoplankton and other macro and micro benthos and benthic.

Sampling of fishes: Sampling from fish will be undertaken using three gillnets and 9 traps in each station in a seasonal interval for the duration of two years.

Macro-organisms settled on the structures such as some bivalves, barnacles, algae, corals, sponges, and etc. will be detached from reef surface and be

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transferred to laboratory for identification and to determine their relative frequency.

Sampling from benthos will be carried out using the grab at 3 points in each station in each season for the identification purposes. In addition, the total organic matter of substrate (TOM) will be determined according to grain size.

Sampling of planktons: phyto and zooplanktons will be colleted using a plankton net with 55 microns mesh from surface and bottom in each month.

Sampling of ichthyoplanktons: will be colleted using net(300-500 micron mesh) from the surface to the bottom.

References Cited:

B erger T.,J. McGurrin,and R.Stone. 1994. An assessment of coastal artificial reef development in the United States. Bulletin of marine science 55(2-3): 1328.

Bohnsack,J.A., D.L. Johnson and R.A. Ambrose. 1991.Ecology of artificial reef habitats and fishes. Pages 61-107.In: W. Seaman, Jr. and L.M.Spargus, eds. Artificial Habited For Marine and Freshwater Fisheries. Academic Press, San Diego.

Fabi, G and L. Fiorentini. 1994. Comparison between an artificial reef and a control site in the Adriatic Sea: analysis of four years monitoring . Bulletin of Marine Scince 55(2-3):538-558

Hagion, S. i991 Fishing effectiveness of the artificial reef in Japan. Page 119-126. In: M Nakamora, R. S. Grove, and C.J.Sonu, eds. Recont Advances in Aquatic Habitate Technology Proceedings, Japan-U.S Symposium on Artificial Habits For Fisheries. Southern California Edison Co., Environmental Research Report Series 91-RD-19, Rosemead, CA.

Omar, R. M. N. R., C.E. Kean, S. Wagiman , A.M.M. Hassan, M. Hussein, B.R. Hassan,and C.O.M.Hussiu. 1994. Design and construction of artificial reef in Malaysia. Bulletin of Marine Science 55(2-3): 1050-1061.

Ozasa, H., K. Nakase, A. Watanuki, and H. Yamamoto. 1995. Structures accommodating to marine organisms. Page 406-411. In: H. Sako, ed. Proceeding, International Conference O Ecology System Enhancement Technology For Aquatic Environments. Japan International Marine Science and Technology Federation Tokyo.

Rostamian, H. 1995 Study on establishment of artificial reefs in the costal waters of Bushehr, Iran . Final report. Fisheries Research Organization Press. 85 pp.

Seaman, W. 2000. Artificial reef evaluation with application to natural marine habitats. CRC press. Washington DC. 246 pp.

Wilding, T. A. and Sayer, M.D.j. 2002. Evaluating artificial reef performance: approaches to per and post - deployment research. ICES Jurnal of marine scince , 59: S 222-s 230.

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Table 2. technical charactristic of marine artificial reefs in the Persian Gulf of Iran

No.	name	weight t.	size m.	quantity no.	kind
1	reef ball	l-1.5	1.5*1.5*1.2	50	concrete
2	fish haven	l-1.5	1.5*1.5*1.2	50	concrete
3	out used material	different weight	different size	100	broken and old concrete, metals, column, meshes, ships and pipes

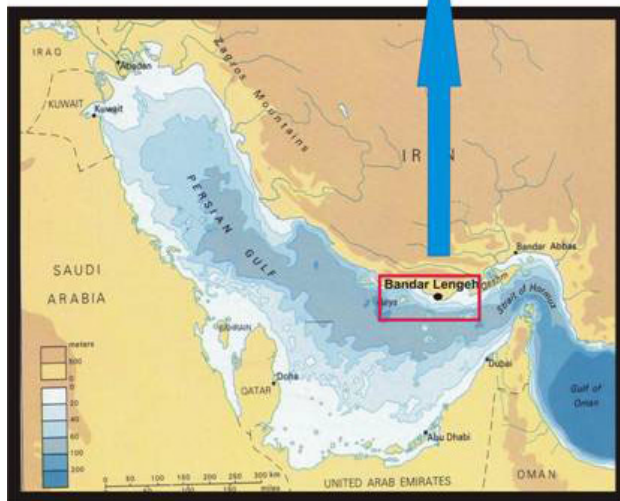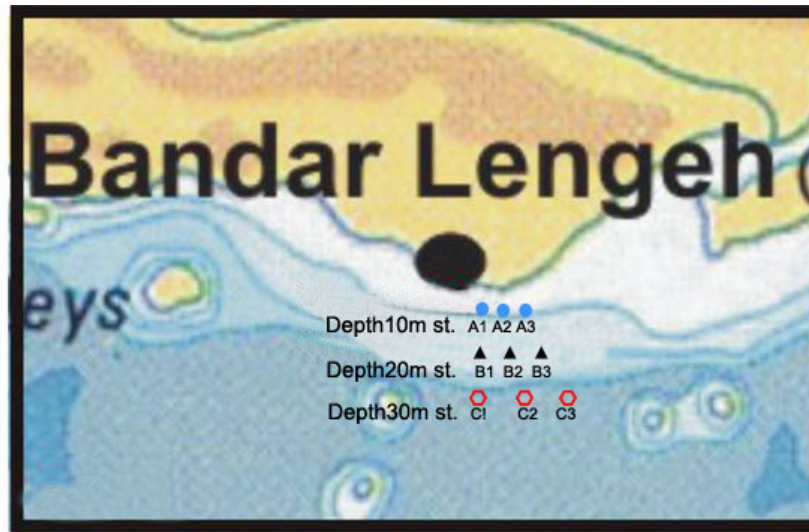Depth10m st. A1 A2 A3
Depth20m st. B1 B2 B3
Depth30m st. C1 C2 C3

Figure 3. Map of the region(Bandar Lenggeh -Iran) located stations.

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