Coral relocation in Chabahar Bay, the North-east of Oman Sea

Ajdari D. [1]*, Motallebi A. A.[2], Sharifrohani M.[2]; Sanjani S.[1], Ajdari Z.[1], Hajirezaee S. [1], Zaiton Ibrahim Z.[3]

Received: April 2012 Accepted: November 2012

1- Offshore Fisheries Research Center, Chabahar, Iran.
2- Iranian Fisheries Research Organization, Tehran, Iran.
3- Faculty of Environmental Studies, Universiti Putra Malaysia, 43400 UPM Serdang
*Corresponding author's email:danielajdari@yahoo.com

Keywords: Coral relocation**,** Coral carrier, Chabahar Bay, Oman Sea

Corals are marine benthic animals typically living in compact colonies of many identical individual polyps (Barnes, 1987; Gateno et al., 1996; Sumich, 1996). Coral reefs are important for many reasons including: a) Most importantly, they provide protection and shelter for many different species of fish. b) They turn surplus carbon dioxide in the water into a limestone shell. Without coral, the amount of carbon dioxide in the water would increase dramatically and that would affect all living things on Earth. c) Similar to a barrier, the coral reefs protect coasts from strong currents and waves by slowing down the water before it gets to the shore. d) Coral reef ecosystems support a variety of human needs such as fisheries and tourism (James and Spurgeon, 1992; Moberg and Folke, 1999; Cesar, 2000). Therefore, the conservation of coral colonies is very vital for marine organisms and human. In Chabahar Bay, the coral reefs are in danger of destruction due to the development program of Shahid Beheshti Port. Since the corals are very sensitive to turbidity and suspended sediments from land reclamation and dredging projects, therefore appropriate measures should be conducted for conservation and recovery of them. At present, the coral relocation is suggested as a good method for recovery of coral reefs after a disturbance in condition of their native habitats . In our project, over 28,000 hard corals were transported to coast of Hotel Lipar (Fig. 1), an area at a distance of 3.5 km far from Shahid Beheshti Port. Also, the new techniques were used for coral reattachment and transportation.

[DOR: 20.1001.1.15622916.2013.12.1.20.3]

Figure 1:Location of Shahid Beheshti dock (Donor site) and Hotel Lipar (receive site) in relocation area of coral colonies.

Substrate preparation in reattachment area

The concrete rectangular blocks with two holes were arranged side by side for preparation of 37 substrates or receive sites (each site: 5m × 10 m) (Fig. 2).

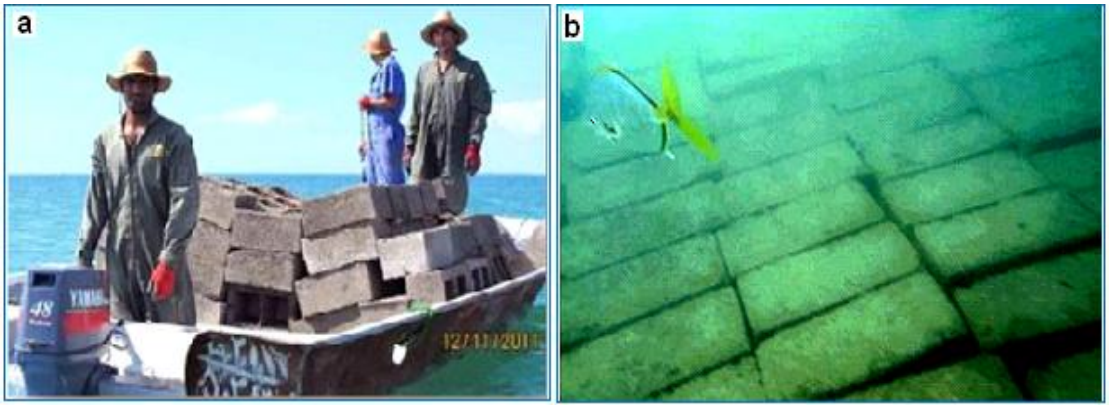

Figure 2:Designed concrete block (a), the arrangement of concrete blocks (b) for substrate preparation.

Coral detachment

Three coral sizes classes including small size (10-20 cm in diameter), medium size (20-100 cm in diameter) and large size (more than 1 m in diameter) were chosen for detachment. Off course,only 10 large colonies were transported daily. Selected colonies were separated by shearing the coral/substrate attachment point using a hammer and chisel (Fig. 3a) and lifting the colony off in one piece, to the extent possible.

[DOR: 20.1001.1.15622916.2013.12.1.20.3]

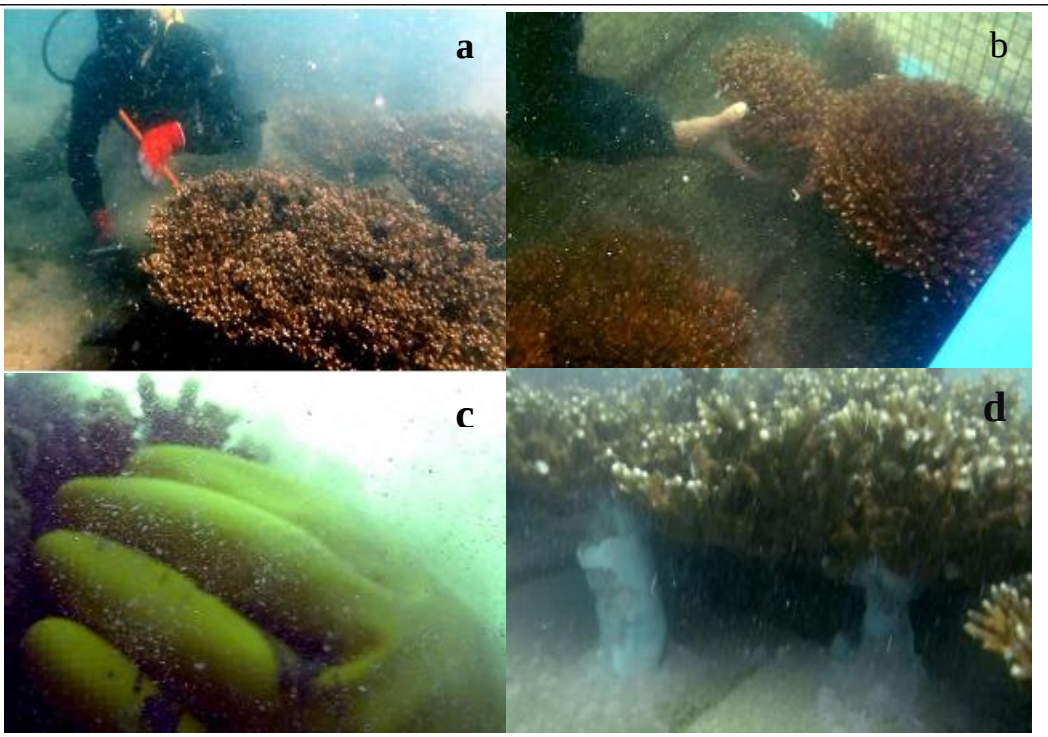

Figure 3. Detachment (a), loading (b) and reattachment (c&d) of coral colonies.

Coral transportation

After detachment of coral colonies, they were transported by a special coral carrier (Fig. 4) to receive site (Hotel Lipar). This carrier is composed of a main bascket (or main board) for loading of corals (Fig. 3 b) and 4 balance tanks for air storage and providing of buoyancy. The inferior surface of each balance tank is open (without plate) while its upper surface is closed and has a faucet for water and air exchange. The entrance of air to tank is conducted by a hose joined to an air compressor on boat. After loading of coral colonies on bottom, the faucet is joined to air compressor by hose and air is entered to tanks for providing of buoyancy. After reach to suitable buoyancy, the faucet is closed. Previously there was a coral basket that raid two side of boat (Fig 4 a). This innovated coral carrier solves the previous coral basket problems by five individual characteristics(Fig 4 b) as a) saving the time, because of diver do not need to go under water and back for many times. b) The corals will not break. c) Can carry many corals in one time transporting because of large size of new coral carrier. d) It is not necessary bring coral to surface. e) Makes composure, relaxing and decrease the stress for corals. These advantages of new coral carrier make increase healthy and decrease the mortality of corals during relocation compare to pervious coral basket.

[DOR: 20.1001.1.15622916.2013.12.1.20.3]

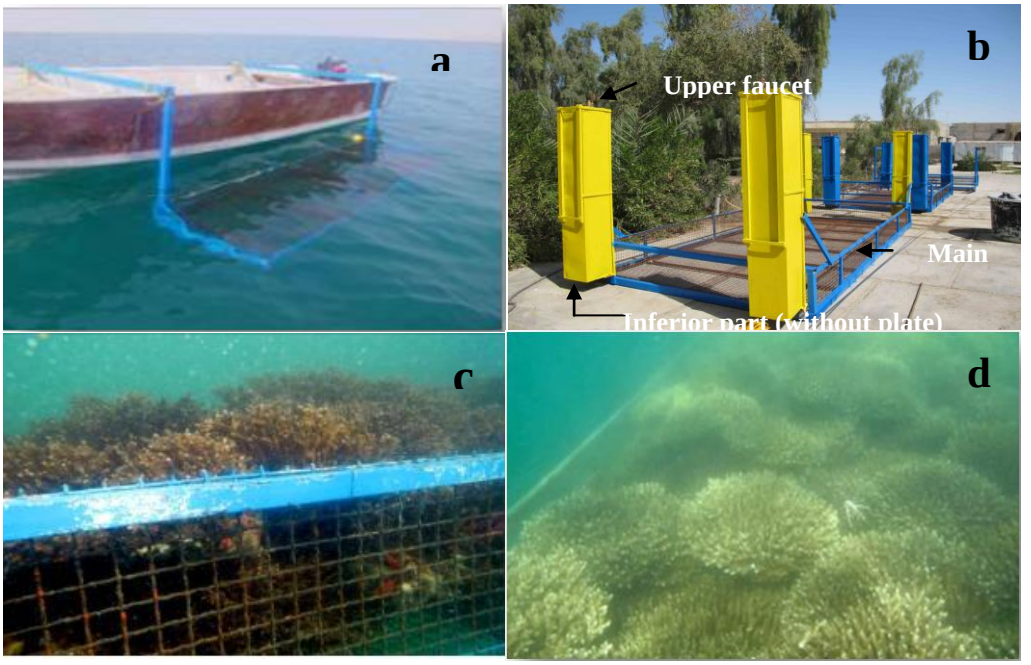

Figure 4: The images of coral carrier, previous coral basket (a), innovated new coral carrier (b), mass transporting of new coral carrier (c & d).

Coral reattachment

In reattachment area, the plastic bag containing hydrohic cement is used for reattachment of coral colonies on flat surface of blocks (Fig. 3c,d). Each plastic bucket containing concrete glume is opend at the time of reattachment inside water.

Coral health monitoring

The relocated corals were checked periodically during operation and for a period of 6-8 months after relocation to investigate the health status of corals. The health condition were investigated by Coral Watch method (Hill and Wilkinson, 2004; Maghsoudlou, 2011, Tehranifard et al., 2011). In this regard, 3 receive sites were selected randomly and then the numbers of bleaching, broken and damaged corals were calculated. The coral bleaching was measured by Coral Health Chart (Hill and Wilkinson, 2004; Tehranifard et al., 2011). The Coral Health Chart is basically a series of sample colours, with variation in brightness representing different stages of bleaching. In the field, we compared colours of corals with colours on the chart and recorded matching codes.

In this project, totally, 28,000 corals were relocated successfuly to a appropriate area. Based on field observations, all relocated coral colonies had healthy situation according to Coral Watch method and some aquatics such as cuttlefishes, scarids, chaetodontids , snappers and sea urchins were observed largely inside and outside of these colonies (Fig. 5).

[DOR: 20.1001.1.15622916.2013.12.1.20.3]

Fig 5. Residing fishes and other sea organisms on relocated coral colonies

To prepare the substrates, the side by side arrangment of concrete blocks can efficiently support coral reattachment substrates against strong waves and sea currents. Also, the holes of blocks provides habitat for fish and sea urchins which both are useful for survival of these corals (Bak, 1994).

To best of our knowledge, there are no special carrier for safe carring of corals during relocation programes. Of course, the coral baskets placed on two sides of boat are used usually, but this method is very time consuming and stressful for corals (Jokiel et al., 2005). The stresses including: possible exposure of them to direct sunlight, moving of coral baskets to up and down by sea waves and sea currents, coral breakage and etc.

In this project, we invented (for the first time) an efficient carrier for safe relocation of corals with minimum of adverse impacts on corals.

Our carrier has several benefits as follow: a) this coral carrier was equipped with balance tanks which they regulate the buoyancy of carrier in any desirable depth of the sea water. In fact, the corals could be transported as submerged without any direct contact with sunlight and other environmental factors in the water surface. b) The regulateable buoyancy of carrier in

[DOR: 20.1001.1.15622916.2013.12.1.20.3]

any desirable depth and submerged transportation of corals cause that the relocation operation could be conducted with more speed, less diving effort and in a shorter periods. Because, it was not necessary to carry the detached corals from depth to surface. c) Using this carrier, the detached corals could be loaded altogether with more numbers in main board while in commonplace method (i.e. usage of baskets), more time and diving effort are allocated for transportation of each coral from sea bed to surface. Therefore, the costs of relocation operation were decreased significantly. d) Decrease in quantity of broken and damaged corals since with this carrier the coral colonies are loaded from native source of corals without need to their continuous deliver to surface water. But in basket method, the corals may break due to their continuous deliver from bottom to water surface and moving of boat to up and down by sea waves and sea currents during transportation.

In conclusion, the results of this project indicate that hard coral relocation is a viable means of off-site mitigation for unavoidable impacts to sensitive coral habitats.

Acknowledgement

The authors express their sincere appreciation to the people who gave their time, advice and support to this project especially Port and Maritime Organization for financial support of project and diving team for field operarions. Also, we are grateful to Dr. Michael Risk for his useful consulting during project.

References

Bak, R. P. M., 1994. Sea urchin bioerosion on coral reefs: place in the carbonate budget and relevant variables. *Coral Reefs*, 13:99-103.

Barnes, R. D. K., 1987. Invertebrate Zoology (5th ed.). Orlando, FL, USA: Harcourt Brace Jovanovich, Inc. pp. 149–163.

Cesar, H. S. J., 2000. Coral Reefs: Their Functions, Threats and Economic Value. In: H.S.J. Cesar (ed). Collected Essays on the Economics of Coral Reefs. CORDIO, Kalmar University, Sweden. pp. 14-39.

Gateno, D., Israel, A., Barki Y. and Rinkevich, B., 1998. "Gastrovascular Circulation in an Octocoral: Evidence of Significant Transport of Coral and Symbiont Cells". *The Biological Bulletin (Marine Biological Laboratory)*, 194 (2): 178–186.

Hill, J. and Wilkinson, C., 2004. Methods for ecological monitoring of coral reefs. Australian Institute of Marine Science, Townsville, Australia. pp. 46-47.

James, P. and Spurgeon, G., 1992. The economic valuation of coral reefs. *Marine Pollution Bulletin*. 24: 529-536.

[DOR: 20.1001.1.15622916.2013.12.1.20.3]

Jokiel, P., Ku'ulei, L., Rodgers, S. and Farrell, F., 2005. Coral Reef Assessment and Monitoring Program (CRAMP), Coral Relocation Project in Kaneohe Bay, Oahu, Hawaii Report on Phase I, University of Hawaii, Hawaii Institute of Marine Biology, pp. 4.

Maghsoudlou, M., 2011. Hardal corals of the Iranian coastal waters of the Persian Gulf. Iranian National Institute for Oceanography, Tehran, Iran, pp.46-47.

Moberg, F. and Folke, C., 1999. Ecological goods and services of coral reef ecosystems. *Ecological Economics*, 29: 215-233.

Risk, M.J., 1972. Artificial reefs in Discovery Bay, Jamaica, Atoll Res. Bull. No, 255: 91-100.

Sumich, J. L., 1996. An Introduction to the Biology of Marine Life (6th ed.). Dubuque, IA, USA: Wm. C. Brown. pp. 255–269.

Tehranifard, A., Farhadi, M. and Aminirad, T., 2011. Survey the Health of Coral Reefs Communities among the Chabahar Bay, Iran. 3rd International Conference on Chemical, Biological and Environmental Engineering IPCBEE, IACSIT Press, Singapore, 20: 1-7.

[DOR: 20.1001.1.15622916.2013.12.1.20.3]