Farming the Reef: A State-of-the-Art Review of Aquaculture of Coral Reef Organisms in Nearshore Environments

The objectives/justification of the project

The goal of the project is to provide information and policy recommendations for the application of aquaculture for live r developing country tropical near shore waters as a priority solution for reducing the pressures on coral reefs arising fror destructive fishing associated with the trade in wild-caught live reef organisms, and as an important livelihood option fo alternatives for exit from destructive capture fishing.

The project will lead to technological and knowledge base improvements in the state of the science, increase public and policy awareness, and concrete actions for reducing the incidence of over- and destructive fishing on coral reefs.

The specific objectives of the project include:

1) To provide an overview and analysis of the global trade in aquacultured live reef organisms;

2) To review the biology and technology for aquaculture of important reef species for the live reef organism trade;

3) To analyze the bioeconomics and markets for these reef species;

4) To evaluate the potential of aquaculture to reduce the incidence of over□ and destructive fishing for wild caught reef

5) To present policy recommendations for the development of frameworks and incentives for the appropriate, feasible a driven application of aquaculture technologies in coral reef environments and recommendations for further research.

In many cases, the sources of stress and impacts on reefs are known, but for many areas the linkages between human coral reef condition are not well established. Conditions contributing to environmental degradation (e.g. over-harvesting land), and the decline of reefs worldwide will be difficult to control under scenarios of growing demand for reef products loss. These conditions are fueled by increasing population growth, coastal development, and rapid expansion of tourism associated impacts. Solutions to these conservation and management problems will need to incorporate timely and accu information, the effective use of science and economic analysis, and sound laws and policies.

The coral reef colonies of Southeast Asia and the adjacent island states of the Western Pacific and the Indian Oceans (t – constituting some 45 percent of the global total of coral reefs □ are the global epicenter of marine biodiversity. Millio fishing communities derive their livelihood and virtually all their animal protein from the rich fisheries that these reefs s Unfortunately, these rich biological resources are under unprecedented assault. A recent WRI assessment of global thre discovered that 80 percent of Southeast Asia's reefs are seriously at risk of degradation, and 56 percent of them are at et al. 1998). In the Western Pacific and the Indian Ocean, the situation is somewhat better but the risks of degradation

Like other reefs around the world, those in the Indo□Pacific are subject to pressures from coastal development, onshor erosion, over fishing, and the use of destructive fishing practices such as cyanide, explosives, and other poisons. Cumu pressures have had two results: 1) the degradation and/or net loss of reef habitat to sustain reef organisms, and 2) the through the removal of organisms. More specifically, the overfishing of valuable reef organisms has led to the fact that there are now too few adults to replenish stocks.

Two particularly destructive target reef fisheries are the live food fish trade and nonfood reef products for the curios an (Barber and Pratt 1997). A recent global assessment of some 200 fisheries around the world concluded that the live ree Southeast Asia and the Western Pacific represent some of the most threatened fisheries on the planet, due in large part and lucrative live reef fish and aquarium fish trades and their association with the use of cyanide to capture these fish (Related to the live reef fish trade is the unsustainable and often illegal trade in reef products, including a variety of cora mollusks, and sponges, as well as sea turtles and dugongs. This has led to the endangerment of several species throug and biological extinction of local populations.

Aquaculture is being increasingly cited as a priority solution for reducing the pressures on coral reefs arising from over□ fishing associated with the trade in wild□caught live reef organisms. For example, the argument has been raised that i aquarium fish could be cultured, it would decrease the demand for species captured in the wild. Aquaculture involves ei juvenile fish and invertebrates in hatcheries, or collecting juveniles from the wild and nursing them through to a larger also involves the propagation of marine invertebrates such as edible algae.

The typology of aquaculture practice is generally recognized as comprising three categories (Bell 1999):

1) Cultured juveniles can be released into the wild to restore stocks to levels where they provide substantial, sustainabl process is known as *restocking*.

2) Cultured juveniles can be released into the wild to increase stocks compared to historical, unexploited levels. This pr as *stock enhancement* and is designed to overcome the common phenomenon of recruitment limitation.

3) Cultured juvenile fish and invertebrates, or propagules of algae, can be grown in captivity to increase productivity in from the management of wild fisheries. This process is usually referred to as *farming*. Farming methods vary by type ar including cage and pen for finfish, raft for mollusks, bottom string for seaweed, and bottom culture of mollusks such as conch and crustaceans such as lobster.

The argument for the application of aquaculture in developing country tropical nearshore waters is premised on four ass

1) Availability: Technologies exist to culture major species in trade from egg to adult, a "closed cycle", rather than just juveniles in the wild and growing them out in captivity. The former is really just a variant on a wild capture fishery and aquaculture which reduces demand on the wild stock of fish.

2) Feasibility: These technologies are economically feasible in the sense that sufficient quantities can be produced to ha impact on demand, and at a cost that is competitive with prices received for the same species that are captured in the are socially and culturally appropriate within a developing country context and can be used as a management tool to re resident reefs.

3) Incentive Driven: The firms and fishers who capture and sell live reef fish and aquarium fish from the wild would hav incentive to enter the aquaculture business and trade and therefore reduce their reliance on the capture of wild-caught the firms and fishers who now engage in the capture fishery be the ones who will enter and operate the aquaculture op other

entrants with access to capital and technology move into the business. If the later is the case, what will the firms and fi involved in the capture fishery do with themselves? Will they shift to another fishery or will they continue to fish the fish destructive and/or nondestructive fishing methods?

4) Low Impact: The aquaculture technology employed in tropical nearshore waters of developing countries will have mi on the coral reef environment.

While strong arguments exist in support of aquaculture, the successful operational reality may be very different. To dat aquaculture in coral reef environments in the tropical Indo□Pacific is currently confined to the cultivation of only a few seaweed (*Eucheuma* and *Gracilaria*), microalgae (*Spirulina),* giant clams (*Tridacnidae*), milkfish (*Chanos chanos*) and p There have been numerous attempts at developing various forms of fish and invertebrate culture in coral reef systems few have come to fruition. Most past efforts have been based on the introductions of familiar species, such as oysters a none have been a commercial success, although remnants of introduced stocks survive in many areas (Munro 1994). P 1990) has pointed out that many fishers would resist shifting from capture fishing to aquaculture because of social and difficulties. Some threats to the coral reef environment appear to be posed by the prospects of cage and pen cultivation species (Munro 1994).

Aquaculture is being increasingly cited as a priority solution for reducing the pressures on coral reefs arising from over- fishing in the trade in wild-caught live reef organisms. It also can be an important livelihood and income generation opp sector that is plagued with over-capacity in wild capture. As such, there is a need to first comprehensively and objective biology, technology, economics and socio-cultural aspects of aquaculture. This involves looking at the demand for live r and aquariums and selected invertebrates in coral reef environments prior to the broad scale prescription of this interv of-the-art" review would provide critical and timely information for developing policy frameworks and incentives for aqu reef environments in order to guide the development of this industry for both public decision-makers and the private se

For further details on the project please contact:

Porject Overseer
Stetson Tinkman
Senior Fisheries Officer
Office of Marine Conservation, U.S. Department of State
2201 C Street, NW

Washington, DC 20520
USA
Tel: 1-202-647-3941
Fax: 1-202-736-7350
E-mail: tinkhamsx@state.gov