Rock Lobster Fisheries : Enhanced commercial yields by artificial shelters?

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Abstract

Globally, wild-stock fisheries of rock lobsters are considered to be essentially fully exploited. Fishing methods based on use of artificial shelters in juvenile nursery areas are being applied to increased catches of tropical rock lobsters, especially in Cuba and the Mexican Caribbean. Since the 1960s, annual catches in Cuba have risen from about 500 tonnes to 12 000 tonnes (value US$100 million) and this appears to be correlated with the use of increasing numbers of artificial shelters. Similarly in Quintana Roo, Mexico with increases from 25 tonnes to 350 tonnes per year.

Comparison is made between the habitat and lobster species of the Caribbean and the Torres Strait regions. The present catch of the tropical rock lobsters in Torres Strait is valued at about $5 million annually. The use of artificial shelters in Cuba and Mexico is outlined and also the increased catches apparently associated with use of shelters. The possibility and practicability for application of artificial shelters to the Torres Strait rock lobster fishery is discussed, including the potential for at least a five-fold increase in catch. However, the need for tactical research to address the mode of operation of the shelters (do they increase yield or only aggregate existing stocks?) and the extent of environmental impact of shelters on habitat is emphasised. The necessity to understand these two key elements before application of shelters to rock lobsters fisheries in Australian waters is emphasised.

Introduction

Rock (or spiny) lobster fisheries are associated with coastal and continental shelf habitats in temperate and coastal waters of most of the world's seas (Morgan 1980). Subsistence fishing of rock lobsters is common, especially in tropical and subtropical localities. Major fisheries are found in the tropics (e.g. *Panulirus argus* in the Caribbean and *P. polphagus* in South East Asia), in the subtropics (e.g. *P. cygnus* in Western Australia) and for *Jasus* spp. in temperate waters, particularly off southern Africa and off southern Australia and New Zealand.

In Australia, the rock lobster fisheries yielded 17 000 tonnes in 1987-88, worth A$240 millions (Smith 1989); about one third of the annual gross value of Australian fisheries production. This catch was predominantly from the Western Australia fishery for *P. cygnus* (60%), with 35% of the catch from *Jasus* spp. in temperate waters and some 5% of the catch from *P. ornatus* in the Torres Strait.

World market demand for rock lobsters remains high and continues to increase in volume of demand and price of product, despite a recently reduced demand in Japan for Australian product which was associated with the Emperor's demise. Globally, rock lobster fisheries are considered to be fully exploited, within the limits of usual fishing methods.

A number of options are being actively researched to try to enhance the availability of lobsters. These include evaluation and trials to develop aquaculture techniques (Phillips 1988). Various approaches have been used for intervention to increase wild-stock yields, including partial aquaculture of juveniles that can be "seeded" into nursery areas (e.g., the American lobster, *Homarus americanus*, in the north eastern United States (Van Olst et al. 1980)). However, there is no evidence to show that this approach has contributed to the catch of the commercial fishery. Of particular interest and apparent value has been the application of artificial shelters in benthic habitats, as applied to *Panulirus argus* in Caribbean waters of Mexico (Miller 1982, Lozano *et al.* 1989), Cuba (Cruz *et al.* 1987) and Bermuda (Evans 1987).

The following describes the artificial shelter fisheries in the Caribbean region and considers the high potential for increased yield in the Torres Strait fishery through use of artificial shelters. It also addresses current problems and research which is necessary before the introduction of artificial shelters, to ensure that the technique will be both applicable and ecologically sustainable.

Artificial Shelters

Over the last two decades, the introduction of artificial shelters into the Cuban and Mexican Caribbean lobster fisheries has correlated with increased catches of tropical rock lobsters (mainly *Panulirus argus*). Ten-fold improvements are characteristic of some areas. In the Caribbean, artificial shelters have been placed in large embayments which have extensive and rich seagrass beds but few reef or rock outcrops to provide shelter.

What are they?

The artificial shelters in the Caribbean region – known as *pesqueros* in Cuba and *casita cubana* in Mexico – have been used since the 1940s in Cuba and were introduced to Mexico by Cuban migrants during the 1960s. The shelters are of variable but simple and cheap construction, and are generally constructed as a flat timber or ferrocement surface (about $4m^2$) supported about 20 to 40 cm above the substratum. In Bahia de la Ascension, Quintana Roo, Mexico palm trunks are used as supports; in the Gulf of Batabano, Cuba hardwood (mangrove) logs are commonly used as supports along with other materials. The shelters are operated as permanent seabed habitats which provide shelter for rock lobsters in seagrass foraging grounds.

How do they work?

The artificial shelters apparently provide a critical refuge from predators yet allow optimum foraging in the food-rich seagrass ecosystems. The shelters may:

- reduce predation, thereby increasing the yield of lobsters;
- increase food accessibility by providing shelter in locations near food sources, leading to increased growth and survival;
- concentrate the lobsters, making them more vulnerable to capture;
- provide a combination of some or all of these factors.

Little applied research has been done to understand the detailed function of the shelters (eg. reduced predation rates, greater aggregation of existing animals at different growth stages, recruitment to shelters). Preliminary studies show that there is a relationship between the size of the shelter and the mortality of *Panulirus argus* (Eggleston *et al.* 1990). However the optimum design and placement of shelters for maximal catch (eg. form and construction of shelter, depth, position, density of shelters on the seabed) are essentially unknown. In Bahia de la Ascension, Mexico evaluations have indicated an optimum inter-casita spacing of 20 m (Miller and de la Torre 1987), but this density value is based on empirical rather than experimental evidence.

How are they used?

The artificial shelters are positioned in the shallow seagrass-dominated habitats. The shelters are regularly checked by fishermen, working from small day-trip dinghies in Mexico and from larger (18 metre) boats in Cuba where fishing trips to a large number of pesqueros last about ten days followed by a five day rest period (Anon 1989).

The shelters are lifted by divers, usually after a net has been placed around the shelter, and size animals are collected by gaff or from the nets. Up to 200 lobsters are caught per shelter, which is higher than any other gear used in the Cuban and Mexican fisheries.

In Cuba, a range of fishing gear is used for rock lobsters including various types of traps, bully nets, trap nets (jaulons, especially during the mass migration) and car tyres (Cruz *et al.* 1987). During the 1970s the Cuban fishery introduced large numbers of

artificial shelters which now comprise some 66% of the total fishing gear and produce about 50% of the catch (6000 tonnes annually, in the 1984-88 period).

What are the yields?

Since the late 1960s, the annual catch of the Cuban rock lobster fishery has risen from about 500 tonnes to 12 000 tonnes (value US$100 millions) and most of this increased yield appears to be correlated with the use of increasing numbers of pesqueros. A similar increase from about 25 tonnes to 350 tonnes (value U$7 millions) has occurred in Quintana Roo, Mexico again apparently correlated with the use of casitas.

Potential for Shelters in the Torres Strait Fishery

Application

High potential exists to significantly increase the rock lobster catch of the Torres Strait fishery through application of artificial shelters to the extensive seagrass communities of the nursery areas of the ornate rock lobster *Panulirus ornatus*. Indeed, there is evidence that this would not represent an importation of technology, but rather would be an enhancement of an original invention by the Torres Strait Islanders. Murray Islanders operate *keiar meta* (rock lobster houses); areas in which lobsters obtain shelter in holes and crevices of reef rock. In the past, additional shelter had been built in these areas by piling up coral to form shelters (Johannes and Macfarlane 1990).

The biology and fishery characteristics of *P. ornatus* in Torres Strait (Phillips and Trendall 1989) show many similarities to *P. argus* of the Caribbean (Lozano *et al.* 1989), including:

- habitats of tropical seagrass communities with apparently limited natural shelter;
- rapid growth rates (with entry to the fishery being rapid and ensuring a rapid response by the fishery to introduction of shelters);
- annual migration pattern is characteristic of both species;
- fishing operations are based on small fishing units and operate from cooperatives or village enterprises; and;
- harvesting techniques are based on a diver fishery (hence no new technology would be needed in Torres Strait to harvest the catch).

These analogous factors contribute to the potential for application of artificial shelters to enhance the Torres Strait rock lobster fishery. In addition, the collection and marketing infrastructure exists, and will be able to handle increased yields.

Economics

Catches of rock lobster in the Torres Strait are currently low, with an annual value of the order of A$5 millions. The management objective of this fishery is to preserve the stock for the indigenous people of the area, hence any increase in production would have an important impact on the economy of the area.

Calculation of a dollar value that could be achieved by introduction of the artificial shelter technique to the Torres Strait fishery is difficult, as we do not understand how the shelters operate. A very conservative estimate suggests that catches would be at least doubled, representing on current values, an additional A$5 million per year. By analogy with Cuba and Mexico experiences, it is reasonable to expect a higher return, with potential for at least a five-fold increase in catch (i.e., a value improvement up to A$25 million per year).

Dangers

In Cuba, large numbers of pesqueros have been put into the lobster grounds annually. The lack of research to understand function and operation of the artificial shelters, has resulted in too many pesqueros being put into the fishery and a dramatic drop in the catch-per-unit-effort (by about one-third per pesqueros, 1980-1988). Obviously, this is not leading to maximum economic efficiency for the rock lobster fishery in Cuba. We must ensure that this pattern does not occur when artificial shelters are introduced into Australia; the appropriate scientific knowledge must be gained before such introduction.

Problems and Need for Tactical Research

Currently there are limitations militating against the introduction of the artificial shelter technique. First, despite the use of pesqueros in Cuba since the 1940s and casitas in Caribbean Mexico since the 1960s, their function is unknown. Do they just concentrate existing stocks of rock lobsters and make them more vulnerable to fishing, or do the shelters increase production of the lobsters in the coastal ecosystems? There is common belief amongst fishermen, and some managers, that the latter applies, however, there is no scientific evidence to support this belief.

Second, we do not know the effect of artificial shelters on the stability and structure of seagrass beds, which are the common habitats for placement.

Answers to these questions are imperative before application of the artificial shelter technique in Australia, in part to ensure that from knowledge of function, appropriate management options are developed for placement and operation, and in part to ensure that the fishing technique is environmentally sustainable.

To make certain that these questions are met, we have developed an experimental field program with Cuban and Mexican scientists to scientifically evaluate the key elements, viz:

- How artificial shelters enhance rock lobster yields (in Mexico);
- Optimum density of placement of artificial shelters for maximum yields (in Mexico, by introduction to "virgin" areas; in Cuba, by experimentation in existing catch-monitored fishing areas);
- Effects of artificial shelters on the stability and structure of seagrass habitats (in Mexico and Cuba, different tropical seagrass communities);

This program builds on our earlier association with Mexico and Cuba (supported by DITAC, FAO, CSIRO), and our recent visits to each country in 1990.

The most cost-effective way to find answers to these questions is to do the scientific work in Cuba and Mexico, where the necessary catch statistics for the experimental areas are now available and data from preliminary assessments exist. We are currently seeking support from DITAC, through the Bilateral Science Agreements, and from other funding agencies to carry out the work with a view to seeking implementation of the artificial shelter technique three years from now, assuming a successful outcome from the research.

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