Construction of Shallow Water Habitat to Increase Lobster Production in Mexico

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RESUMEN

Esta presentación proveerá información detallada sobre la construcción y uso de hábitats artificiales o "Casas Cubanas" por miembros de las cooperatives en Quintana Roo, México. Se discutirá el orígen y evolución de esta técnica y se analizará la información demostrativa del aumento substancial en la producción de langostas debido a su uso. Ya que la construcción de las "casas" es relativamente sencilla y barata, el método parece ofrecer buenas perspectivas para el aumento de la producción en otras áreas. Se discutirán también las limitaciones, ventajas y problemas especiales asociados con la incorporación de esta tecnología, de suerte que los pescadores y administradores pesqueros cuenten con suficiente detalles para juzgar con propiedad la técnica en su situación particular.

INTRODUCTION

For more than a decade, many fishermen of the spiny lobster (*Panulirus argus*) in the state of Quintana Roo, Mexico have utilized artificial habitats in an effort to increase their catch. Members of fishing cooperatives in the north and central zones (Fig. 1) have constructed small shelters designed to provide refuge for lobsters. These shelters–known by a variety of names including "casitas," "casas Cubanas," and "sombras"–are assembled onshore and ferried out to areas of shallow water where they are sunk to the bottom. During the lobster season, fishermen periodically check the shelters and harvest the lobsters.

In this paper, I provide detailed information on the construction and use of habitats. In addition, I discuss the limitations, advantages and special problems associated with this technology in an effort to provide fishermen and fishery managers with enough detail to judge the appropriateness of the technique for their situations.

CONSTRUCTION

The shelters are approximately 1.5 m^2, constructed on a frame of the trunks of the thatch palm (*Thrinax Wendlandiana*) locally known as "chit". Originally, the roof or solid covering was also of chit, but newer styles incorporate a variety of roofing materials, including barrel lids, corrugated roofing material, and reinforced cement (Figs. 2–5). Chit is quite heavy, and sinks immediately. It is said to last for 6 or 8 years when kept submerged.

In making the original style of casita, known as the "entumbado," a square foundation of four poles is assembled (Fig. 2); a solid row of poles is nailed across the top of the foundation to form a roof; then, two poles are nailed

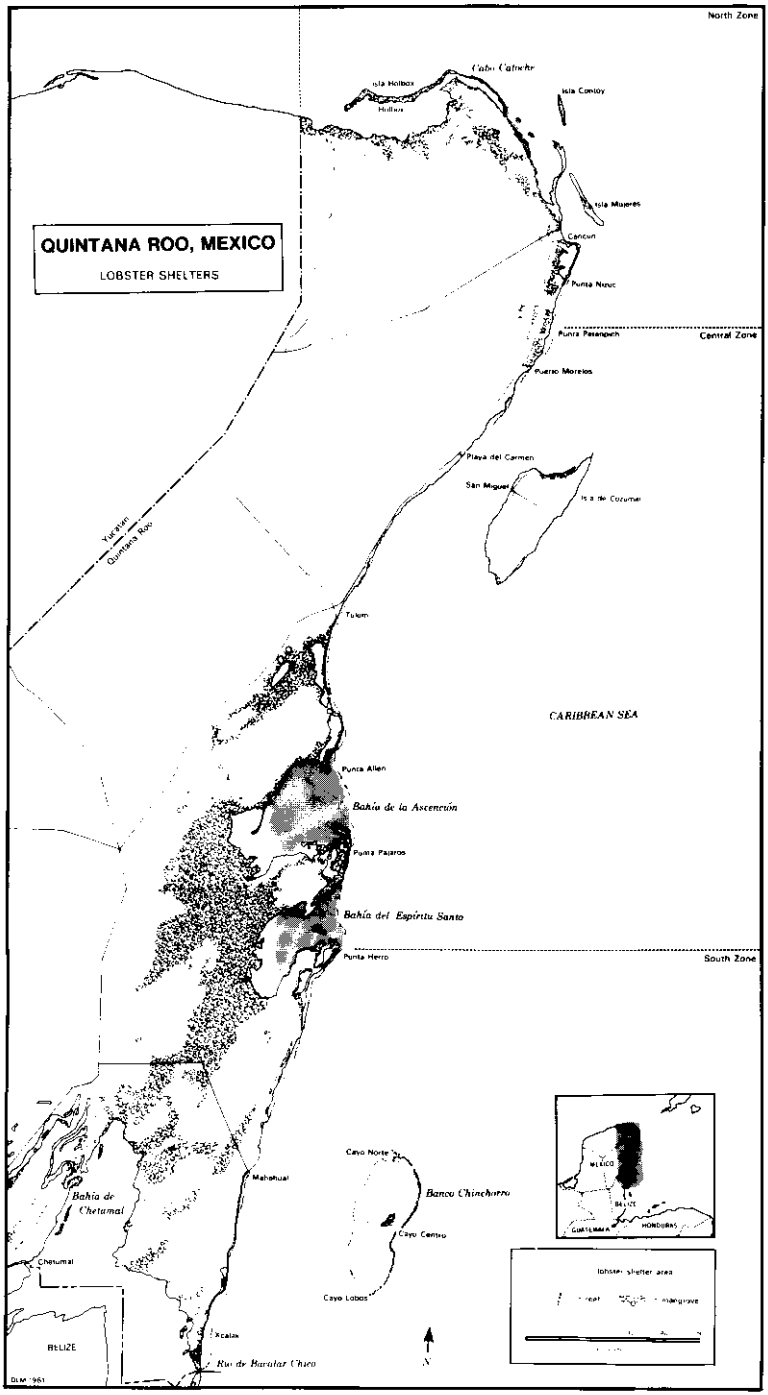

Figure 1. The coastline of Quintana Roo, showing lobster shelter areas and locations of fishing zones.

Figure 2. Completion of the shelter. The uppermost poles strengthen the structure, and serve to suspend the roof off the bottom if it is overturned.

across the roof to anchor the solid surface and to strengthen the construction. They also serve to suspend the roof off the bottom when, as happens frequently, a shelter is overturned by an apparently playful dolphin.

Construction of an entumbado style casita requires about 20 poles. With all materials at hand, three men can make 20 in a day, or two men can make 15. A detailed breakdown of materials and costs for this and other shelter styles is presented in Table 1.

Origin, Evolution and Distribution

It is common knowledge that casitas were introduced in about 1968 to Quintana Roo by Cuban fishermen. Previously, lobsters were harvested with bully nets or wood lath traps. Upon introduction of the shelters, lobsters were first removed with bully nets, but fishermen soon found it easier to dive down to the shelter and gaff their prey. Since the bully net could not be worked effectively in water over 4 m, free diving added at least another 2 m to the depth at which casitas could be deployed. This resulted in a considerable expansion of the area in which the technology was employed. At this time fishermen used outboard motors to power their skiffs or small sailboats, and were never very far from a packing plant or mother-ship carrying ice. There was no need to employ a capture technique which kept the catch alive.

In less than a decade, use of shelters was widespread, as was the technique

Table 1. Breakdown of materials and costs of the four basic shelter styles currently utilized by Quintana Roo fishermen

Style	Materials	Cost and Comments
Entumbado or Casita de Chit (Fig. 2)	Basic frame (4 chit poles) (Fig. 2) 16 poles, nails	250-300 pesos ($11.40 - 13.65 U.S.); must be re-nailed after 3 years
Casita de Tambo (Fig. 3)	Basic frame, flattened side of 55 gal barrel, 4 poles, nails	320 pesos ($14.55 U.S.); metal roof lasts one season, frames are then salvaged and re-roofed; heavy-duty oil drums last an additional season, but add 200 pesos ($9.10 U.S.) to basic costs; for every six constructed, a seventh can be assembled using barrel tops and bottoms
Casita de Asbesto (Fig. 4)	Basic frame, 1 sheet of masonite-like corrugated roofing, 2 poles, small squares of auto-tire rubber, nails	150 pesos ($6.80 U.S.); roof lasts about 8 months; rubber square serves as a washer which cushions the impact of nailing and increases the holding power of nails
Casita de Cemento (Fig. 5)	Basic frame, 1 pole, reinforcing rods, cement, small squares of auto tires, nails	About 200 pesos ($9.10 U.S.); roof is cast about 3 cm thick; holes must be molded in for nails; fishermen began constructing this style shelter in 1979 - durability remains to be established

of gaff capture. By 1977, members of the Isla Mujeres coops registered 3,000 casitas (Fig. 1). According to Fuentes (1977) the coop Patria y Progresso had 1,000 shelters, while the coop Caribe had 2,000. The Holbox coop, also in the north, had perhaps 2,000. But by far the greatest number had been set out by the two central zone cooperatives. The Cozumel Island group had between 10,000 to 20,000 in the shallow waters of Espíritu Santo Bay and the Vigía Chico coop had 7,500 to 15,000 in Ascensión Bay.

It is difficult to estimate the number of shelters currently in use, since they are distributed over such a wide area. Moreover, casitas are constructed at different times and of different materials. Each year, a certain number deteriorate and parts are salvaged for new construction. Nevertheless, I estimate that in 1981 there were between 18,000 and 26,000 casitas in use, most of them in Ascensión and Espíritu Santo Bays. These estimates are based on fieldwork completed during the summer of 1980. The breakdown by coops is

Figure 3. Construction of a "Trampa de Tambo."

as follows: Holbox, 800; Isla Mujeres (both groups), 3,000; Cozumel, 7,500 to 10,000; Vigía Chico, 7,000 to 12,000. By special agreement with the Xcalak coop (south zone), the Cozumel coop has begun to receive product from areas immediately south of Punta Herrero. Perhaps 100 shelters are involved in the activity.

Production Data

It is not currently possible to estimate the potential of the fishery since chronological data on catch and effort are not available. Although production data are reasonably complete, catch registrations do not indicate method of capture, and thus the percentage harvested from shelters can only be estimated. Nevertheless, a regional analysis of annual production (Fig. 6) provides useful information, at least for the central zone where nearly all of the recent catch has been from shelters. Here it is clear that increased production coincides with the spread of the technique.

The percentage of annual production contributed by the southern zone is very small. Few, if any, shelters were used there prior to 1978, and by July 1980, there were only about 100. These were located just south of the boundary between this and the central zone and, as a matter of convenience, most of their production was registered with the central zone.

Figure 4. A stack of five "Trampas de Asbesto" ready for transport.

In the north, the situation is more complicated, since traps and nets are also used, and divers often harvest from both shelters and natural habitat on the same trip. However, in recent years divers have accounted for about 60% of the total catch. Based on conversations with divers, I estimate that about 20% of this is taken from shelters. Thus, some 12% of recent total annual captures in the northern zone may have been taken from shelters.

By combining information from the north and south with production data from the central zone, it is possible to estimate the percentage of the total catch attributable to the use of shelters in recent years. In 1977, for example, a record harvest of 221.4 metric tons (mt) of tails were registered and 66.7 mt, or almost 30%, may have been from shelters. A year later, about 34% of the total capture (194.1 mt) came from shelters, while in 1979 shelters accounted for about 59% of a harvest of 188.7 mt.

Clearly, shelters have assumed an important role in exploitation of the lobster resource. Since all indications are that fishing effort will increase, it seems reasonable to conclude that use of casitas will become more widespread. Currently they are scattered along the bottom of some 900 km^2 of sea floor, and there remain perhaps 270 km^2 of bottom available for use, as estimated by planimeter analysis of LANDSAT imagery. However, speculation about the potential of expansion into remaining suitable areas is premature, since a variety of factors combine to determine the density at which traps may be placed.

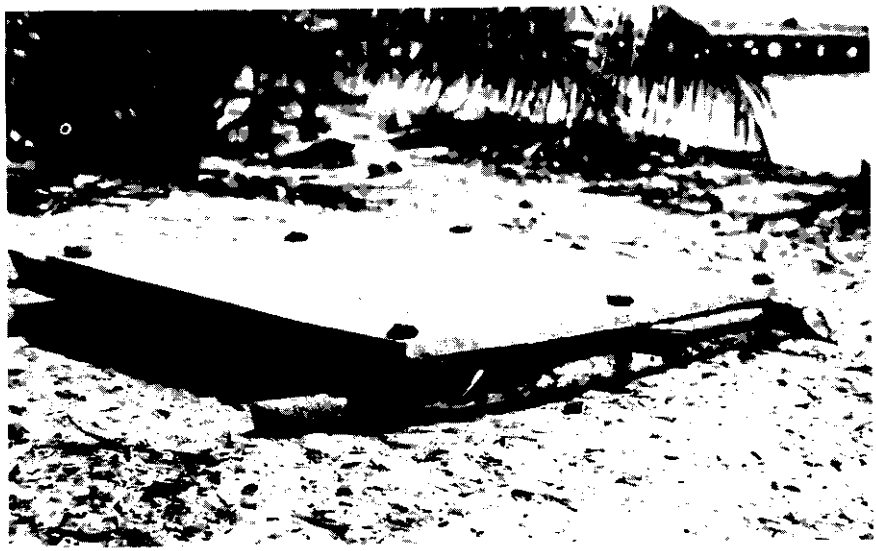

Figure 5. A completed "Trampa de Cemento." Small squares of rubber cut from discarded auto tires serve as washers for nails which are hammered thru pre-cast holes.

Placement of Shelters

Shelters must be placed on a fairly solid bottom. Fishermen in Quintana Roo place them over patches of turtle grass or on rocky bottom. Nonvegetated sandy areas ("blanquisales") are avoided because loose sand fills the crawl space under the hut. Muddy or otherwise soft bottoms are also unsuitable because the shelters sink to their roofs. Distance between shelters varies, but averages about 40 m, which seems to be the optimum, at least according to fishermen's opinions.

As a general rule, casitas are placed in the shallow waters of bays or back reef areas, but the leeward side of islands, peninsulas, and sand-spits may also be appropriate. Areas where currents run over 2 or 3 knots, or where there is excessive wave action, are unsuitable.

Water clarity is also important, since fishermen must be able to find their shelters. Where water is turbid, buoys may be used to mark individual casitas, but minimum visibility is still necessary. Of course, fishermen can wait for appropriate conditions since the shelters "work" continuously.

In Quintana Roo, shelters are used at depths of 1.5 to 6 m, limited in part by a comfortable free diving depth. Use of a "hookah" or scuba gear would increase the depth at which casitas might be placed, as well as diver efficiency. However, such modifications would increase costs and, to some degree, compromise the inherent simplicity of the capture strategy.

Further evolution of the system will no doubt occur, perhaps with the adoption of the Cuban technique of using a seine to make the harvest. According to Cruz (personal communication, 1980), Casitas are known as Pes-

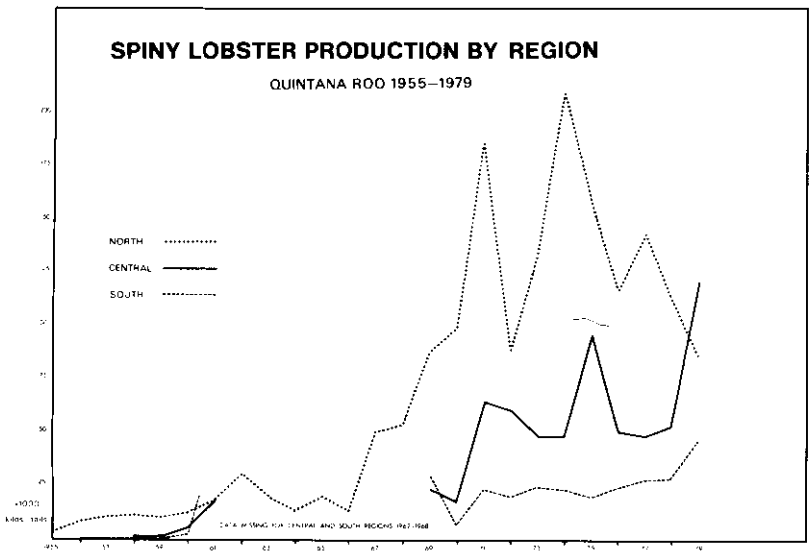

Figure 6. Annual catch, 1955 to 1979, from each zone of the spiny lobster fishery.

quero Artificiales or Jaulas in Cuba. Their construction is essentially similar to the entumbado style in use in Quintana Roo. Nearly all fishermen in Cuba are using seines to harvest lobsters from shelters, a practice which began around 1970. Prior to this time, fishermen were using bully nets to make their captures.

This system involves the use of a fine mesh seine which is lowered from a boat and positioned to encircle a shelter. A large pole with a hook on one end is the used to lift the shelter up and down, which flushes out the lobster. Lobsters are then prodded into the seine bag and the net is lifted. The harvest operation takes just several minutes and can be utilized at depths of 3 to 10 m.

Advantages of the Technology

Casitas seem an attractive option for many small scale fisheries. From an economic standpoint, the construction costs are minimal, and a variety of local materials may be suitable. Even if corrugated roofing or cement are used, cost remains low. As one fisherman who explained the system to me observed, "one catch and the casita is paid for." Most divers capture three to five lobsters per shelter, but it is not uncommon for some fishermen to remove a dozen or more from a shelter. Shelters are generally checked once a week although when lobster are particularly abundant divers may return to harvest a casita every 3 or 4 days.

The rationale for constructing shelters is grasped easily by most fishermen, because the technique involves the construction of "structure." In this sense, structure refers to the various irregularities of the sea bottom (rocks, reef, shelves) that determine the distribution of many species. Inshore fishermen readily appreciate the value of structure since one of the earliest lessons they learn is that fish and other creatures are not distributed evenly along the bottom, but according to the bottom features or structure. Thus the casita becomes an obvious addition to the structure.

Harvesting techniques include use of a gaff ("gancho"), snare ("acechanza" or "lazo"), or bully net ("chapingorro"). Gaffing results in death or serious injury to the lobster, and often requires means of preserving the catch. Snares or bully nets allow for live-capture and provide the option of maintaining the catch in live cars or corrals. Likewise, a seine allows for live capture, but since larger craft are required, most small-scale or artisanal fishermen cannot afford to fish this way. However, where larger craft are available, and other conditions are appropriate, the technique can be quickly mastered. Fishermen in many other parts of the Caribbean are proficient in the use of beach seines, and that skill may be readily transferable.

Clearly, casitas are not "high technology." Since no special skills are required for their construction and maintenance, they seem appropriate for small-scale fisheries. There are even more compelling reasons for their adoption. Most small-scale fisheries are confronted eventually with insufficient resources to increase both employment opportunities and individual catch. At some point, the effort to increase the catch results in a strained resource situation (Yap, 1980). However, Sheehy (1976) reports that construction of artificial reefs has increased American lobster (*Homarus americanus*) production in some areas where natural shelter was limited. Whether the construction of artificial habitat actually increases the carrying capacity of an area or merely concentrates stocks is uncertain. Recent work by Prince et al (1979) suggests that construction of structure can increase carrying capacity, at least for fish. Thus it would seem that the use of casitas may increase the holding capacity of an area and thus lessen the strain. Further, placement of shelters in nursery areas may be particularly appropriate if they contribute to a reduction in mortality rates. Where mortality rates and injury rates are low, juvenile lobsters grow rapidly (Waugh, 1981; Davis, 1980).

Special Problems

The successful introduction of technology is often a complex and challenging process. The decision of whether or not to introduce the casita system in a particular lobster fishery must include consideration of its problematic features and how these might be resolved within the context of biological and cultural landscapes.

With regard to the cultural context, unless there is scrupulous regard for the property of others, theft can become a problem. In response to thefts, and in order to resolve disputes over shelter ownership, fishermen in the central zone of Quintana Roo have divided most of the bay and backreef area into parcels or "campos," each controlled by an individual or family. In

some instances, as the result of mediation by state fishery officials, individuals have received documents which delineated their campo. Some campos are as large as 1 km^2. By common accord, and to everyone's benefit, the fishermen keep an eye out for anyone making an illegal harvest. While occasional disputes arise over boundaries, the system seems to be working well. In an effort to reduce friction between cooperative members who dive on the reef for lobster, the placement of shelters within 100 m of the reef is forbidden. Of course, reef divers sometimes experience difficulty determining just where the 100-m line begins. At one cooperative meeting a diver complained of this problem. Another diver, apparently more experienced, contributed his rule of thumb: "when they start shooting at you, you're in too close."

In the northern zone, there is no strategy for regulating the use of shelters. There are no campos. The coops provide material to any member who wants to build shelters, and these individuals are free to place them anywhere. Thus, for a time, only they know where the shelters are located, and gain the benefits of saving time and energy in the harvest. However, these shelters are in fact community property, and this initial advantage is often soon lost since most shelters are found by others. When a casita is discovered, it is sometimes moved to a new secret location, where it benefits only the discoverers.

The reasons for the difference in shelter management are not altogether clear. The central zone's arrangement is perhaps explained by the fact that many fishermen were previously workers on copra farms along the shore, and have remained on these farms. Once they learned of the casita system, they found it easy to place shelters just offshore, where they were accessible and easily guarded. In the north, where shelters are used in the waters between Holbox and Isla Mujeres, the coastline is almost entirely uninhabited. Since there is almost constant small boat traffic in this area, the fishermen would find it quite difficult to guard a campo.

In addition to problems associated with ownership and boundaries, the decision to adopt the shelter system should include consideration of its potential to compete with other technologies. Since lobster is such a valuable commodity, the successful introduction of casitas may eventually drain capital and labor from other sectors of the fishery. Experience in Quintana Roo suggests that shelters have the potential to compete even more directly. For example, members of the northernmost coop (Holbox) have a long-standing feud with seiners from Yucatán who frequently snag shelters in their nets, which is mutually disruptive. Also, fishermen of the central zone acknowledge the potential of their area for sustaining a shark fishery, but have no plans to pursue this because an increase in sharks, attracted by bait and chumming, would obviously be dangerous to the divers.

Clearly, the use of shelters can work to hinder diversification of a fishery. This was true in the central zone of Quintana Roo, where the two coops specialize in lobster production. The overall reason for this, of course, is the high price for the product. While specialization has proved quite profitable, it may one day prove a curse. Hurricanes frequently hit the coast, and shelters lying in shallow waters are particularly vulnerable. Moreover, changes in

water quality associated with onshore development may diminish the carrying capacity of near shore areas. If nursery areas are impacted sufficiently the lobster industry might collapse.

Additional considerations may prove problematical. With respect to the renewability of the resource, the long-term consequences of shelter use remain to be determined. Yet, given what is known about the spiny lobster's life cycle, some preliminary comments may be made. Although the use of shelters in nursery areas may be the most effective strategy to increase the catch, it may eventually have to be reduced, to insure that sufficient lobsters survive to spawn.

Use of shelters in nursery areas of Quintana Roo has resulted in the increased capture of smaller lobsters (juveniles?) and has led to a reduction of the minimum tail size from 14.5 cm to 13.5 cm. Fishermen of the central zone petitioned repeatedly for this reduction, which was eventually granted on a trial basis after a survey confirmed the predominance of smaller-sized lobsters in the area. In time, the lowered limit became the legal limit for the entire state owing to the absence of any apparent consequence and in light of practical and political considerations.

Given the remarkable fecundity of the lobster, the long-term result of such size reductions may prove inconsequential. Nevertheless, the shelter system appears to be a devilishly efficient capture strategy, particularly when employed in nursery areas. Careful monitoring of stocks seems to be in order regardless of whether recruitment of post-larvae is predominantly local or non-local. Patterns of recruitment may be altered as increased numbers of shelters are deployed, and as harvesting pressure throughout the region is intensified.

SUMMARY

The construction of artificial habitats, as by fishermen in Mexico's Caribbean, seems to offer small-scale fishermen a relatively inexpensive means of increasing their lobster catch. The ease of construction, the lack of maintenance, and the general "no-moving-parts" simplicity of the technology recommend their construction where conditions are appropriate.

With regard to introduction of the system, I recommend that careful consideration be given to the special problems associated with its use and to how it might best be incorporated into the existing cultural and biological landscapes.

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