AN EVALUATION OF ARTIFICIAL SHELTERS IN THE ARTISANAL SPINY LOBSTER FISHERY IN GAZI BAY, KENYA

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Two designs of artificial shelters were evaluated for use in the artisanal spiny-lobster fishery in Gazi Bay, Kenya. Both types of shelter were effective in aggregating the spiny lobster Panulirus ornatus in nearshore seagrass beds. Lobsters aggregated at the shelters were caught by fishermen, free diving, using spearguns and hand nets. Mean lobster catches taken from the shelters ranged from 0.38 to 0.83 kg·trip⁻¹, around 50% of those taken farther offshore in natural reefs. No significant difference was found in the size or sex composition between shelter and reef-caught lobsters.

Spiny-lobster harvest methods along the Kenyan coast have changed little since 1954 (Mutagyera 1978, Okechi and Polovina 1994). Landings are from artisanal fishermen who, operating from small, non-mechanical craft, dive to depths of about 10 m to capture lobsters. Fishing is mainly during the north-east monsoon (November - mid February) and inter-monsoon (mid February - April) periods, when weather conditions are favourable. Spearguns and hand nets are used to catch spiny lobsters, and although trammel nets have been used successfully in Kenyan waters (F.A.O. 1971), they are not used routinely because of economic constraints. Also, lobster traps have been proved to be ineffective in local waters (Department of Fisheries, Kenya, 1967).

In many areas along the Kenyan coast, the nearshore habitat consists of seagrass or mangrove beds, and fishermen have to travel several kilometres or more from shore to reach the coral reef or rocky substrata to catch the lobsters. Because of this limitation, exploitation of the lobster population is relatively low (Okechi and Polovina 1994). Catches of lobsters could be increased by aggregating them closer to shore, as has been demonstrated in the Gulf of Mexico. There, artificial shelters have been used successfully to concentrate spiny lobsters on seagrass beds (Miller 1982, Cruz and Phillips 1994, Briones et al. 1994).

Shelters were first used in 1968 in the Gulf of Mexico by Cuban fishermen, and they are now widely used in the fishery for Mexican lobster Panulirus argus. Shelters are appropriate for...
small-scale fisheries because they are easily constructed and maintained (Miller 1982). Also, they may have a biological impact, research on P. argus in the Gulf of Mexico suggesting that shelters provide protection from predation, increasing juvenile survival (Eggleston et al. 1990).

This paper presents results of applying artificial shelters to catch Panulirus ornatus at Gazi Bay, Kenya (Fig. 1), the first application to an artisanal spiny-lobster fishery in East African waters.

Gazi Bay adopts its name from the nearby village of Gazi. The economy of its 750 inhabitants depends largely on fishing and harvesting of mangrove poles. Gazi Bay covers an area of 15 km², and it is protected by the Chale Peninsula to the east and a coastal fringing coral reef to the south (Fig. 1). The creek bottom in some areas has a dense cover of seagrass beds and seaweeds, but in other areas the bottom is bare and sandy. Spiny lobsters are occasionally captured inshore on seagrass beds, but the majority are caught on the fringing reef 3 km from Gazi Beach (see Fig. 1).

Two types of shelters were constructed, both with a square base (180 x 180 cm) made from four mangrove poles approximately 4 cm wide. The roof of the shelter consisted of either a row of thin mangrove poles nailed or tied across the top of the foundation, termed a "mkoko" (Fig. 2a), or of metal roofing material and termed a "mabati" (Fig. 2b).

One pair of mkoko and mabati shelters was deployed in August 1992 and another in October 1992. All four shelters were placed on seagrass beds in water about 5 m deep approximately half way between the beach and the fringing reef (Fig. 1). Weather permitting, the shelters were harvested approximately once per week by snorkel divers using seine nets. Catch data from the first and second pairs of shelters were collected from 15 September and 4 November 1992 respectively to 2 February 1993. The number, mass (kg), sex and carapace length (cm) of each species of lobster were recorded from the shelters as well as from farther offshore, in the fringing reef region. Catch rates and catch proportions were compared using the Student’s t-test, and a $\chi^2$ test was used to examine the differences between length frequency distributions.

Interviews with fishermen indicate that three species of spiny lobster (Panulirus ornatus, P. versicolor and P. longipes longipes) are caught in Gazi Bay, of which P. ornatus is by far the most abundant in the fishery catches. The shelters appeared to be used almost exclusively by P. ornatus, which accounted for 94% of the catch. Catches of P. ornatus were proportionately lower (72%, $p < 0.01$) from the reef region. There was no significant difference ($p > 0.05$) in the proportion of female lobsters caught at the shelters (47%) and those taken from the reef (55%). Also, there was no significant difference ($p > 0.05$) between the length frequency distributions of P. ornatus caught at the shelters and those taken from the reef during the same time-period (Fig. 3). There was no significant difference ($p > 0.05$) between the mean catches of lobsters taken from the shelters during the two harvesting
periods; values ranged from 0.38 to 0.83 kg·trip⁻¹ (p > 0.05, Table I). The mean catch of lobsters taken from the reef was higher (at 1.30 kg·trip⁻¹), than was caught from the shelters (0.78 kg·trip⁻¹; statistically significantly lower (p < 0.05).

Although catch rates of lobsters appear to be lower from the shelters than from the reef farther offshore, because of ease of accessibility, the Kenyan artisanal lobster fisheries would benefit from their usage in nearshore seagrass beds. It is speculated that lobsters forage at night on seagrass beds and return to the reef for refuge during the day. Artificial shelters on the seagrass beds may therefore retain foraging lobsters.

The present results suggest that the use of shelters would not alter the size or sex composition of the catches but that they could increase the level of exploitation of P. ornatus. Given an average value of U.S.$6.20 per kg of lobster and a mean catch rate of 0.7 kg per week for each fisherman, a shelter, which costs U.S.$15.00, would pay for itself in about a month. In the Gulf of Mexico, the concrete roof design is now widely used because it requires fewer mangrove poles than the mangrove roof design and it lasts longer than the metal roof design. Such a design may have merit for East African artisanal lobster fisheries. However, before widespread use of artificial shelters in Kenyan waters, approaches to control fishing effort and the resolution of issues of shelter placement and ownership should be addressed.

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LITERATURE CITED


FAO 1971 - Report to the government of Kenya on the evaluation of prawn (Penaeidae) and spiny lobster (Palinuridae) marine resources. FAO/UNDP/TH., 3006: 40 pp.


FIGURE LEGENDS

Fig. 1: Gazi Bay, showing the shelter deployment sites and locations of mangroves, seagrass beds and fringing reefs

Fig. 2: Designs of (a) mkoko and (b) mabati shelters

Fig. 3: Length frequency distributions of P. ornatus caught from the shelters (47 lobsters) and from the reefs (29 lobsters) in Gazi Bay, Kenya

RUNNING HEADINGS (Odd Pages)

Okechi & Polovina: Artificial Shelters in the Kenyan Spiny Lobster Fishery
Table I: Catch statistics of lobsters taken from the vicinity of the mangrove roof shelter (Mkoko), the metal roof shelter (Mabati) and the offshore reefs (standard error in parenthesis)

<table>
<thead>
<tr>
<th>Harvest period</th>
<th>Shelters</th>
<th>Reefs</th>
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<tbody>
<tr>
<td></td>
<td>Mkoko</td>
<td>Mabati</td>
</tr>
<tr>
<td></td>
<td>Number of trips</td>
<td>Number of lobsters caught</td>
</tr>
<tr>
<td></td>
<td>Mean lobster catch (kg·trip⁻¹)</td>
<td>Mean lobster catch (kg·trip⁻¹)</td>
</tr>
<tr>
<td>9.8.92 - 2.2.93</td>
<td>16</td>
<td>23</td>
</tr>
<tr>
<td>11.4.92 - 2.2.93</td>
<td>9</td>
<td>24</td>
</tr>
</tbody>
</table>
With shelter
Without shelter

CARAPACE LENGTH (cm)

FREQUENCY (%)