The Artisanal Inshore Shrimp Fishery off the Cross River Estuary, Nigeria

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Introduction

The coastal waters adjoining the Cross River estuary, Nigeria, support a large stock of shrimps that sustains a huge artisanal fishery for shrimps and small fishes. The fishery is one of the major sources of "crayfish" (smoke-dried shrimp) available in Nigerian markets. Moses (1980) estimated the yield of the artisanal shrimp fishery in Akwa Ibom and Cross River States (the two states bordering the Cross River estuary) to be 20,000 metric tons (wet weight) in 1977. Between 1980 and 1984, the crayfish yields of 165,000 tons in the two states amounted to 11% of the national marine fish landings, and to 26% of the marine fish landings of the two states. The greatest yields of crayfish come from the Cross River estuary, and the active shrimp fishermen in that area number more than 10,000 (Nsentip 1985).

Due to the importance of this fishery, both in terms of providing a source of animal protein to Nigerians and as a major rural industry, an investigation was carried out to assess the current status of the fishery with respect to catch rates and species composition.

Materials and Methods

The site of this investigation was Inua Abasi beach, one of the major landing stations of the shrimp fishery in the outer Cross River estuary, Nigeria (4°34'N and 8°18'E, Fig. 1). The beach was

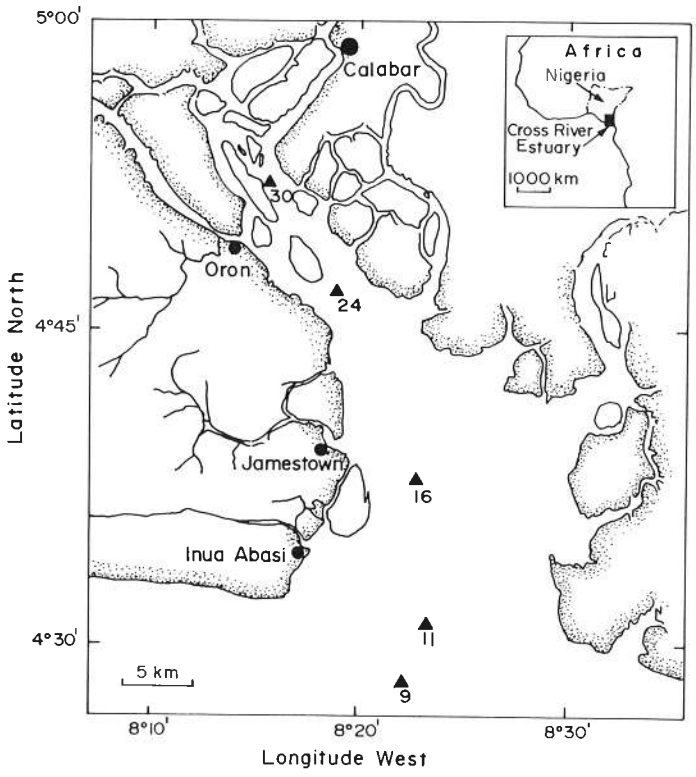

Fig. 1. Map of the Cross River estuary, Nigeria, showing sampling stations (beach near Inua Abasi) and several navigational buoys (Δ), including buoy 11 at the mouth.

visited mornings, usually once a week for a period of over two years from November 1986 to December 1988.

The fishermen were interviewed to obtain information on the type and dimensions of gear used and the fishing location. The catches of a number of fishermen were weighed and their values noted, as was the number of nets used. Samples were obtained from well-mixed catches and preserved in 9% formalin. Fifty of such samples were taken in 23 months. The weight of the pooled monthly samples varied between 542 and 3488 g (average: 1936 g).

In the laboratory, the samples were sorted into different species and the individuals of each species were counted and weighed. The total length of individual fish was measured, and only those less than 10 cm were included in the analysis. Larger fishes were assumed to occur in catches by accident because they have the capacity to escape the stationary gears used by the fishermen.

Questionnaires were distributed to ten fishermen to find out how many days per month they spent on actively fishing. Some trips were undertaken, together with fishermen, to witness the process of fishing and to map the fishing grounds. Rainfall data were obtained from the Department of Geography, University of Calabar, Nigeria.

Results

Fishery characteristics

The only gear used in the fishery is an anchored net that resembles the stake net described by Garcia and Le Reste (1981), except that it is not staked but anchored. The opening is 2.5 m wide and 2 m in height. The length of net from mouth to tip of cod-end is about 7 m. Stretched mesh size varies from 2.8 cm around the mouth to about 0.9 cm at the cod-end. The crafts used are dug-out canoes. Those powered by outboard engines average about 10 m in length, while the non-motorized ones average about 8 m. Four fishermen on the average operate in one boat. The number of nets per boat varied between 25 and 40 (mean = 32). The owner of the boat has between 15 and 25 nets, while the men working with him have 5 nets each. These men are not paid, but own the catches of their nets.

Fishing takes place in the daytime, during either floodtide or ebbtide. No night fishing is carried out, and mostly one tide is exploited per day by a given fisherman. Fishing takes place about 23 days a month, and year-round. Out of the 80 visits to Inua Abasi between November 1986 and December 1988, fishermen were not fishing on only 4 days. Reasons given for stopping fishing included roughness of the sea (2 cases), poor catches in the previous days (1 case), surplus catches in the previous days (1 case). In the latter case, fishing was stopped to allow shrimp traders to sell off the surplus catches bought in the previous days. Three of the off-fishing days were in the rainy season (April-October) and one in the dry season (November-March).

The fishery is based largely on the coastal waters outside of the estuary. Of the 80 sampling days, fishing took place in five cases within the estuary (i.e., landward of Buoy 11 in Fig. 1). In 4 of these 5 days, fishermen exploited the ebbtide and 4 of the days occurred during the rainy season. The fishermen explained that during heavy rains, the speed of ebbtide currents becomes extremely high, leading to displacement and loss of nets, or mixing up of nets of different fishermen. Hence, after heavy rains, the fishermen do not go far outside of the estuary for ebbtide fishing. The shrimp catches are mostly smoke-dried without sorting, before being transported to the nearby urban markets.

Species Composition

As shown in Table 1, three shrimp species occurred regularly in samples. Of these, the estuarine prawn *Nematopalaemon hastatus* was the more dominant, accounting for 81.5% by weight and 91.9% by number in the samples. Small fish (< 10 cm) of several species and squids also occurred in the samples, notably croakers *(Pseudotolithus elongatus* and *P. senegalensis)* which were the more common fishes and formed 5.6% by weight and 3.5% by number in the samples. Other fishes

Table 1. Compositions of catch samples from the artisanal shrimp fishery off Cross River estuary, Nigeria, 1987-1988.

Taxa	Catch composition (%) weight	number
Shrimps:		
Hippolytidae		
Exhippolysmata hastatoides	1.8	1.1
Palaemonidae		
Nematopalaemon hastatus	81.5	91.9
Penaeidae		
Parapenaeopsis atlantica	8.2	2.1
Unidentified caridean shrimps	(some)	(some)
Fish and squid bycatch	8.5	4.7
TOTAL	100.0	99.8a

[a]Total number <100.0 due to round-off errors.

included *Ilisha africana*, threadfins (*Polydactylus quadrifilis, Pentanemus quinquarius* and *Galeoides decadactylus*), *Gobioides ansorgei, Trichiurus lepturus*, pufferfish, *Drepane africana, Batrachoides* sp., *Alestes* sp., and some members of the families Cynoglossidae, Carangidae, Scombridae and Ariidae. Squids occurred in almost all the samples.

Catch rates

As shown in Fig. 2, the estimated mean monthly catch rates (kg/net/day) of shrimps peaked between March and June, i.e., end of dry season and early rainy season. A second smaller peak was observed in October/November 1988, during the transition period from rainy to dry season. The overall mean catch rate was 2.3 kg/net/day throughout the period of sampling (2.4 in 1987 and 2.2 kg/net/day in 1988). The monthly catch rates during floodtide (annual mean = 2.6) were significantly higher (t-test, $\alpha = 0.05$) than those during ebbtide fishing (annual mean = 1.7 kg/net/day). (The very high catch rates during ebbtide in February and March 1988 (Fig. 3) appear to have been an exception).

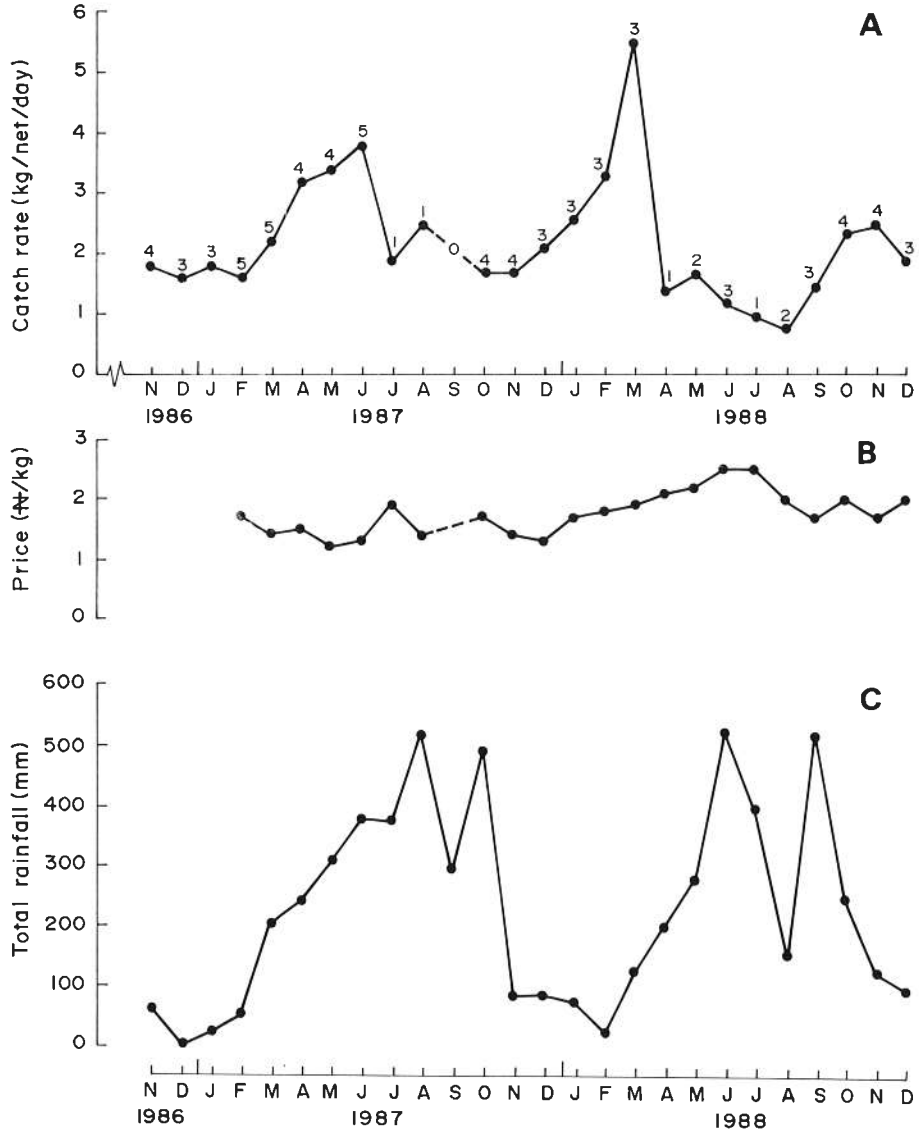

Fig. 2. Time series relevant to the artisanal fishery off the Cross River estuary, Nigeria, November 1986 to December 1988
Above: Rainfall at Calabar
Center: Price of fish shrimp, in Naira per kg.
Below: Catch per net per day (in kg); the numbers associated with each value refer to the sampling days per month (total = 80 days).

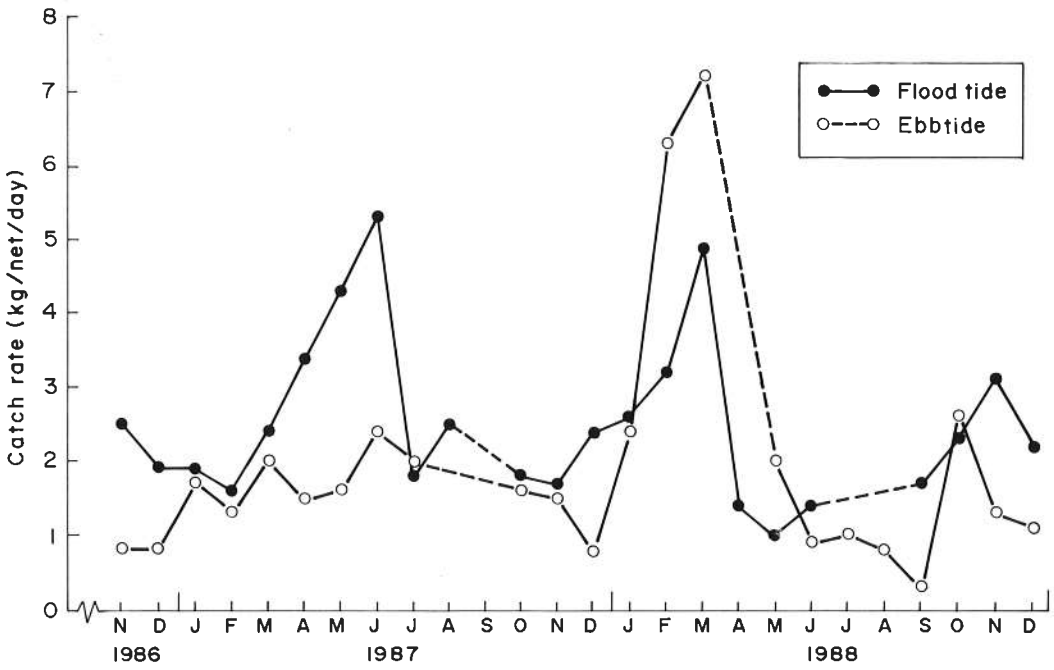

Fig. 3. Mean monthly catch rates in artisanal shrimp fishery off the Cross River estuary, Nigeria, in kg/net/day, November 1986 to December 1988. Note difference between tidal regimes and exceptional values in February and March 1988.

Catch rates, when related to moon phases (Fig. 4) showed higher catches during new and full moon (spring tides) than at other times (neap tides). The weighted mean of all catch rates obtained within two days before and after the beginning of new and full moon (as estimated from tide tables) was 3.0 kg/net/day; the same carried out for the intermediate periods was 2.0 kg/net/day, which is significantly different (t-test, $\alpha = 0.05$).

The price (N = Naira; US$1 ≈ 7.5 N) per kilogram of fresh shrimp (Fig. 2b) varied only little between months, and yielded an annual mean of 1.63 N/kg. However, the peaks in July 1987 and June/July 1988 coincided with the periods of poor catch rates. The regression of N/kg on catch rates for the year 1987 gave a significant inverse correlation ($r = -0.66$, $\alpha = 0.05$). However, for the year 1988, the same analysis yielded a correlation not significantly different from zero ($r = -0.47$, $\alpha = 0.05$). The mean price per kilogram of shrimp, however, increased from 1.43 in 1987 to 1.92 in 1988, i.e., by over 34% in one year.

With an overall mean of catch rate of 2.3 kg/net/day, a mean price per kilogram of 1.63 N/kg, and 23 fishing days per month, the estimated annual shrimp yield for one net is 2.3 x 23 x 12 = 634.8 kg, and the estimated income per net is 1.63 x 635 = 1035 Naira. Note, however, that most fishermen encountered in this study used either 5 crew members or between 15 and 25 nets (boat owners).

Discussion

The fishery is year-round, with very few off-fishing days which are not predictable, but appear to be based on experience (e.g., of rough sea) by the fishermen in the preceding days. Thus, the extensive "holiday" period reported by Garcia and Le Reste (1981) in the Côte d'Ivoire and by Marioghae (1981) between July and September in the Niger Delta, Nigeria, do not occur here.

Many reports on Cross River "crayfish" fishery assert that the bulk of the catch consists of larvae and juveniles of *Penaeus notialis*, mixed with *Macrobrachium* spp and *Palaemon hastatus* (Esen 1989; Moses 1980, 1989; Nawa 1982; Nsentip 1985). This is at variance wih the results of the present study. Not even one single specimen of *Penaeus notialis* or *Macrobrachium* sp. was found in the 50 samples collected during a period of over two years. Of these earlier authors, only Nawa (1982) had given the proportion of *P. notialis* in the catches. His figure was 14.6%, but he maintained that this species formed the bulk of artisanal shrimp catches.

It is curious to note that Esen (1989), Moses (1989) and Nawa (1982) all discuss the catches of the "crayfish" fishery without even a cursory mention of *Nematopalaemon hastatus*, which according to Sivalingam (1968), constitutes three-quarters of the catches of the fishery, and about 82% (by weight) in the present analysis (see Table 1).

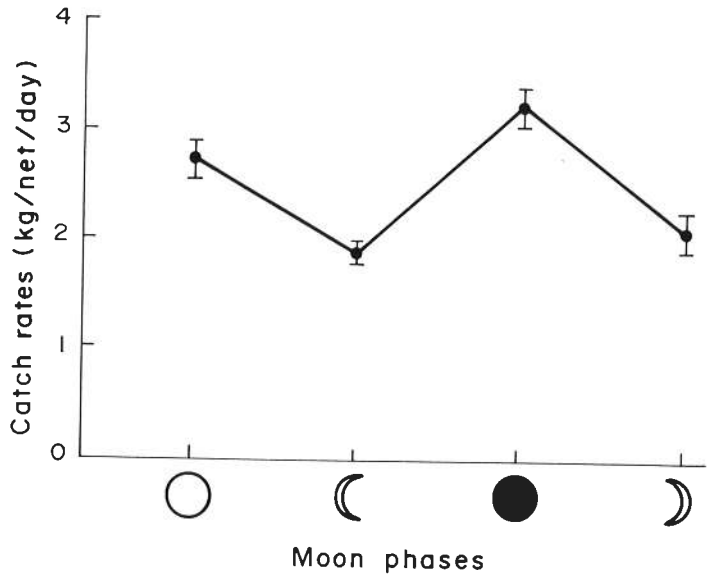

Fig. 4. Weighted mean catch rates (and 95% confidence intervals) of the artisanal shrimp fishery off the Cross River estuary, Nigeria, in kg/net/day, from November 1986 to December 1988, plotted as a function of lunar phases.

It is not clear how the earlier assertions concerning the alleged role of Penaeus notialis in the artisanal shrimp fishery of southeast coast of Nigeria came about. There is no evidence that any of these statements were based on an empirical analysis of samples from the fishermen's catches. There is a strong possibility that what these authors refer to as "juveniles" of *Penaeus notialis* were actually *Nematopalaemon hastatus*.

The peak of catch rates between March and June has also been reported by Marioghae (1981), Moses (1980) and Nsentip (1985). The second peak in October-November was also noted by Marioghae (1981). These peaks are probably related to pulses of recruitment of the species to the fishery. The higher catch rates at floodtide in this study is at variance with results obtained by Garcia and Le Reste (1981) and Marioghae (1981) who reported maximum catch rates at ebbtides. Within the estuary, the differences in catch rates can be attributed to the stronger tidal currents during ebbtides. In the open coastal waters, the influence of the differences in strengths of tidal currents may be less. Here, the role of salinity which may be optimal for *Nematopalaemon hastatus* during floodtide may be more important than the relative strengths of tidal currents.

The higher catch rates during new and full moon agrees with the observations by Garcia and Le Reste (1981) and are related to stronger tidal currents and greater volume of water filtered by the fixed trap. However, Marioghoe (1981) reported that fishing is more intensive during neap tides in the Niger Delta.

The decrease in annual mean of catch rate of only 8.3% between 1987 and 1988 shows the relative stability of the stock abundance during the two years reported upon here. The lack of correlation between catch rates and price per kilogram of fresh shrimp in 1988 suggests that the 34.3% increase in price per kilogram between 1987 and 1988 was not mainly due to reduction in catch rates. Other factors such as the increased rate of inflation in Nigeria during 1988 might have been a contributing factor.

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