

Aspects of the Fishery and Biology of Small Pelagic Fishes at Dar Es Salaam, Tanzania

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Introduction

Sardines and other small pelagic fishes, known locally as "dagaa", are small fish occurring in schools along the coast of Tanzania in shallow waters (Nhwani 1983). These fish usually include species of *Sardinella*, *Stolephorus*, *Leiognathidae* (genera *Leiognathus* and *Gazza*), *Decapterus*, *Rastrelliger*, *Caranx*, *Sphyræna*, *Thryssa* and *Amblygaster*.

Various fishing gears are used to catch these fish, for example, beach seines, ringnets, purse seines, lift nets, dipnets, scoopnets, castnets, trawl nets and stake traps (Nhwani 1981, 1983). The common fishing gear used nowadays is the purse seine which was introduced to the coast of Tanzania in 1961 by Greek fishermen (Losse 1964).

Along the coast of Tanzania, dagaa is the group of fishes on which ordinary people depend as a cheap source of protein food. Because of its importance as a source of protein, it was considered pertinent to investigate its seasonal availability, distribution, abundance and aspects of the biology of its constituent species.

Materials and Methods

This study was carried out at Banda Beach, one of the fish landing stations in Dar es Salaam. Fish samples and other information were obtained, regularly, early in the morning at Banda Beach from artisanal fishermen. The information obtained by interviewing fishermen included the type of gear used and its length, the number of fishermen involved on that day, the fishing ground, time spent fishing, the number of hauls made and the weight of fish caught by each boat. In the laboratory, fish samples were sorted out into different species and weighed. Then, each individual fish was measured (total and fork lengths).

The information and data were processed using an Olivetti Personal Computer and the following parameters were computed; catch rates, monthly catches, percentage species composition, percentage

composition of each maturity stage, sex ratio, average number of boats fishing per day, length of the gear used and its average mesh size.

Results

Basic structure of the fishery

Fishing for small pelagic fish is done by both semi-industrial fishing companies (e.g., DARFISH) and artisanal (small scale) fishermen. The artisanal fishery uses small purse seine nets of an average length of 140 m and average mesh size in the bag (bunt) of 8.6 mm. The boats, which are powered by outboard engines, have an average length of 10 m and average width of 2.8 m. Each fishing boat has one or two lamp skiffs of about 2 m.

There were between 15 and 20 registered small purse seine boats at Band Beach landing station, Dar es Salaam in 1986. Out of these, an average of eleven boats fished every day during the fishing season. The increase or decrease of the number of fishing boats depended on many factors, e.g., the season, availability of fuel and spare parts, the state of the boats and gear, as well as weather conditions.

Fishing of small pelagic fishes was normally carried out during moonless nights, about 20 nights a month. Fishing involves the attraction of schools of fish to bright lights, then encircling them with a net before hauling the catch on board. The most common species caught in Dar es Salaam were *Sardinella gibbosa*, *S. albella*, *Stolephorus* spp., *Decapterus* spp., *Herklotsichthys punctatus*, *Amblygaster sirm* and *Rastrelliger kanagurta*.

The most popular fishing ground was off Sinda Island where 37.8% of all fishing between January and December 1986 was done. Other popular fishing grounds were Msasani (19.0%), Mnrani (16.4%), off Upanga (11.5%), Bongoyo (9.6%) and Kunduchi (2.6%). Less popular fishing places were Fungu Yasin (1.3%) and Gezzaulole (0.5%). In only a few occasions (0.5%)

were the fishing grounds not reported. All fishing grounds are within a radius of 10 km from the Banda Beach landing station in Dar es Salaam.

Fishing effort

A summary of the fishing effort expended in the purse seine fishery is presented in Table 1. For the period of eight months from January to December 1986 except for May, July, August and September when no data were recorded, the average number of purse seiners which fished per day was 10.8. Each fishing unit spent four hours a day fishing and made 2.8 hauls of the net per night. The lowest fishing effort was expended in October and the highest fishing effort was in November.

Catches and catch rates:

The estimated monthly fish catches from the artisanal purse seine fishery landing at Banda Beach in 1986 are summarized in Table 2.

The estimated mean catch rates (kg/boat/night) are shown in Table 3. On the average, 66 kg/boat/night were contributed by *Sardinella gibbosa*, followed by

Amblygaster sirm (31.1 kg/boat/night), *Rastrelliger kanagurta* (18.2 kg/boat/night), *Stolephorus heterolobus* (14.1 kg/boat/night) and *Leiognathus leuciscus* (13.95 kg/boat/night). The other species ranged between 0.05 and 9.4 kg/boat/night.

Species composition

The average monthly species composition by weight of catches for 1986 is summarized in Table 2. As might be seen, *Sardinella gibbosa* dominated the catch (41.2%) followed by *Amblygaster sirm* (23.7%). The other species contributed between 0.6% and 7.4%.

Maturity and Spawning

The percentage composition for each maturity stage of the important species caught were analyzed for the period between January and April 1986. The results show that most of the species caught between January and April were immature. The proportions of fish in the spawning state between January and April 1986 are also summarized in Table 4. The results indicate that the majority of the fish were not spawning, except for *Stolephorus indicus* of which 71.4% were in spawning condition in April.

Table 1. Summary of fishing effort data for the artisanal purse seine fishery off Dar es Salaam in 1986.

Items	Jan	Feb	Mar	Apr	Jun	Oct	Nov	Dec	Mean: Jan to Dec
Boats fishing	6.2	7.8	11.0	15.2	15.0	5.0	10.0	5.4	10.8
Fishermen/boat	10.8	9.7	8.7	9.5	10.0	10.0	11.0	10.4	9.7
length of gear (m)	186.0	113.6	94.3	-	-	90.0	130.0	100.0	140.5
Bag mesh size (mm)	3.9	9.9	-	-	-	-	-	-	8.6
Hauls/day	3.0	2.7	2.9	2.8	2.0	3.0	6.0	2.9	2.8
Time fishing (h/day)	4.8	4.7	5.3	2.8	-	1.5	4.0	6.9	4.1

Table 2. Estimated monthly catches and percentage species composition of artisanal purse seiners in the Dar es Salaam area in 1986.

Species	Catches (kg)									
	Jan	Feb	Mar	Apr	Jun	Oct	Nov	Dec		
<i>Sardinella gibbosa</i>	4888	6632	25997	17121	2097	4676	1882			
<i>S. albella</i>	58			867	134		2600			
<i>Spratelloides delicatulus</i>		692								
<i>H. punctatus</i>	8360	390	700	217						
<i>A. sirm</i>		6386	406		50762	2985				
<i>S. heterolobus</i>	191	11978		6771						
<i>S. indicus</i>		60		136						
<i>Thryssa baelama</i>		60								
<i>Gazza minuta</i>	1800	2830	90	170						6552
<i>L. leuciscus</i>	6265			1616						
<i>S. barracuda</i>	175									
<i>Atherina breviceps</i>		196	20							
<i>R. kanagurta</i>	285	1038	904	1802	81	1082	13207			2164
<i>D. russelli</i>		220	840		808	2796	9958			
<i>D. labi</i>		170	90		1293					
<i>Alectis indicus</i>				272						
Other Carangidae		75								
TOTAL	22020	30727	29047	28972	52863	8093	15716			2642

Table 3. Average catch rates (kg/boat/night) of fish species caught by artisanal purse seines in the Dar es Salaam area, 1986.

Species	Jan	Feb	Mar	Apr	Jun	Oct	Nov	Dec
<i>S. gibbosa</i>	36.6	49.7	113.0	55.2	-	20.9	233.8	17.1
<i>S. albella</i>	0.4	-	-	2.7	-	1.3	-	23.6
<i>Sprattelloides delicatulus</i>	-	5.1	-	-	-	-	-	-
<i>H. punctatus</i>	62.6	2.9	3.0	6.9	-	-	-	-
<i>Amblygaster sirm</i>	-	47.8	1.7	-	16.9	29.8	-	-
<i>S. heterolobus</i>	1.4	89.8	-	21.8	-	-	-	-
<i>S. indicus</i>	-	0.4	-	0.4	-	-	-	-
<i>Thryssa baelama</i>	-	0.4	-	-	-	-	-	-
<i>Gazza minuta</i>	13.4	6.2	0.3	0.5	-	-	-	-
<i>L. leuciscus</i>	46.9	-	-	5.2	-	-	-	59.5
<i>S. barracuda</i>	1.3	-	-	-	-	-	-	-
<i>Atherina breviceps</i>	-	1.4	0.5	-	-	-	-	-
<i>R. kanagurta</i>	2.1	7.7	3.9	5.8	-	0.8	5.4	120.0
<i>D. russelli</i>	-	1.6	3.6	-	2.6	27.9	49.7	19.8
<i>D. tabl</i>	-	1.2	0.3	-	4.3	-	-	-
<i>Alectis indicus</i>	-	-	-	0.8	-	-	-	-
Other Carangidae	-	0.5	-	-	-	-	-	-
TOTAL	164.7	214.7	126.3	99.3	176.1	80.7	288.9	240.0

Table 4. State of maturity of fish in artisanal purse seine catches in Dar es Salaam area, 1986. (Imm. = Immature M. = Mature Sp. = Spawning fish; in %).

Species	Imm.	Jan M.	Sp.	Imm.	Feb M.	Sp.	Imm.	Mar M.	Sp.	Apr Imm.
<i>S. gibbosa</i>	100	0	0	46	54	8	79	21	6	100
<i>S. albella</i>	-	-	-	-	-	-	-	-	-	100
<i>H. punctatus</i>	42	58	2	56	44	0	100	0	0	100
<i>A. sirm</i>	-	-	-	8	93	5	44	56	0	-
<i>S. heterolobus</i>	-	-	-	44	56	11	-	-	-	17
<i>S. indicus</i>	-	-	-	67	33	33	-	-	-	0
<i>R. kanagurta</i>	100	0	0	44	56	33	-	-	-	50

Sex ratio

Table 5 summarizes the percentage sex composition of fish in the artisanal purse seine catches from January to April 1986. From the results obtained, the sex ratio for all species caught during that period shows that males dominated females. In April, only females of *Herklotsichthys punctatus* were present.

Discussion

Fishing effort data in terms of number of boats fishing per day and time spent fishing indicate that the least effort was expended in October. This coincides with the lowest catch and catch per boat which were also realized in October. The highest catch was landed in November.

Table 5. Percentage sex composition of fish species in artisanal purse seine catches: January - April, 1986; only the percentages of males are given; (the percentage of females can be obtained by subtraction from 100).

Species	Jan	Feb	Mar	Apr
<i>S. gibbosa</i>	-	57.6	54.7	-
<i>H. punctatus</i>	96.8	80.0	100	0
<i>A. sirm</i>	-	65.8	80.0	-
<i>S. indicus</i>	-	66.7	-	-
<i>R. kanagurta</i>	-	66.7	-	84.6
<i>A. breviceps</i>	-	75.0	-	-

The fluctuations in catches and catch rates of artisanal purse seiners are related to the presence of suitable conditions for fishing. Reduced fishing effort may have been a result of bad weather conditions as October is at the end of the southeast monsoon winds which are generally stronger than the northeast monsoons and result in rough sea states. Also, the northward flowing East African Coastal Current is quite strong during the southeast monsoons, which would affect the success of purse seining. However, this may not be the only reason for reduced fishing success as fishing data are available for only one month during the southeast monsoon season. The fact that November was the most successful month and that the month preceding this season, June, had the second highest landing may lead to doubts as to the basis for the above explanation. Nevertheless, the catch rates of the boats shown in Table 2 confirm that fishing appears to be more successful between November and March (during the northeast monsoons) than between June and October (during the southeast monsoons). This has also been observed from the purse seine catches in Zanzibar (Nhwani 1981, 1983).

The species composition of the monthly catches presented in Table 2 shows the dominance of clupeids (*Sardinella*, *Herklotsichthys* and *Amblygaster*) in every month, their contribution being as high as over 90% (e.g., in March) and averaging over 65%. Other families individually contributed less than 10% of the average monthly catches except in certain months when

carangids (e.g., *D. russelli* in October) and Scombridae (*R. kanagurta* in December) were present in significant quantities. It is therefore quite clear that the artisanal purse seine fishery exploits mainly the clupeids (sardines) of the coastal waters.

Data on maturity, spawning and sex ratio were analyzed for only the first four months (January to April) of 1986. As reported elsewhere (Nhwani and Makwaia 1988) these are the months when most small pelagic fishes recruit to the purse seine fishery. It is therefore not surprising that the catches in these months consist mainly of immature fish. Because of their immature state, it is possible that the highly skewed sex ratio reported here may be biased.

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Management Issues on the Maputo Bay Fisheries, Mozambique

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The Maputo Bay Fisheries

Three different fisheries are conducted in Maputo Bay, Mozambique, (Fig. 1) which has a surface of 686 km², a mean depth of 8-10 m and is close to the country's capital, an important fish market. They are the gillnet fishery for kelee shad (*Hilsa kelee*, Clupeidae), the shrimp fishery and the hook and line fishery for demersal fishes.

Of these, the fishery for kelee shad gives the highest yield, while the shrimp fishery gives the highest economic returns. The kelee shad fishery gave an annual yield around 3000 tonnes of which about 90% came from the artisanal fishery. The shrimp fishery which is conducted by trawlers and by beach seining has produced a yield of about 200-800 tonnes per year for the period 1971 to 1984 (Ulltang 1980, Sousa 1986).