SOMALI FISHERIES DEVELOPMENT AND MANAGEMENT

by

Mohamed Yassin

506A Project Resource Management

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INTRODUCTION

Somalia has a population of 3.5 - 4 million and land area of about 638,000 square kilometers. It is bordered on the west by Republic of Jobouti, on the south by Ethopia and Kenya, on the north for 1000 kilometers by the Gulf of Aden, and on the east for 2000 kilometers by the Indian Ocean.

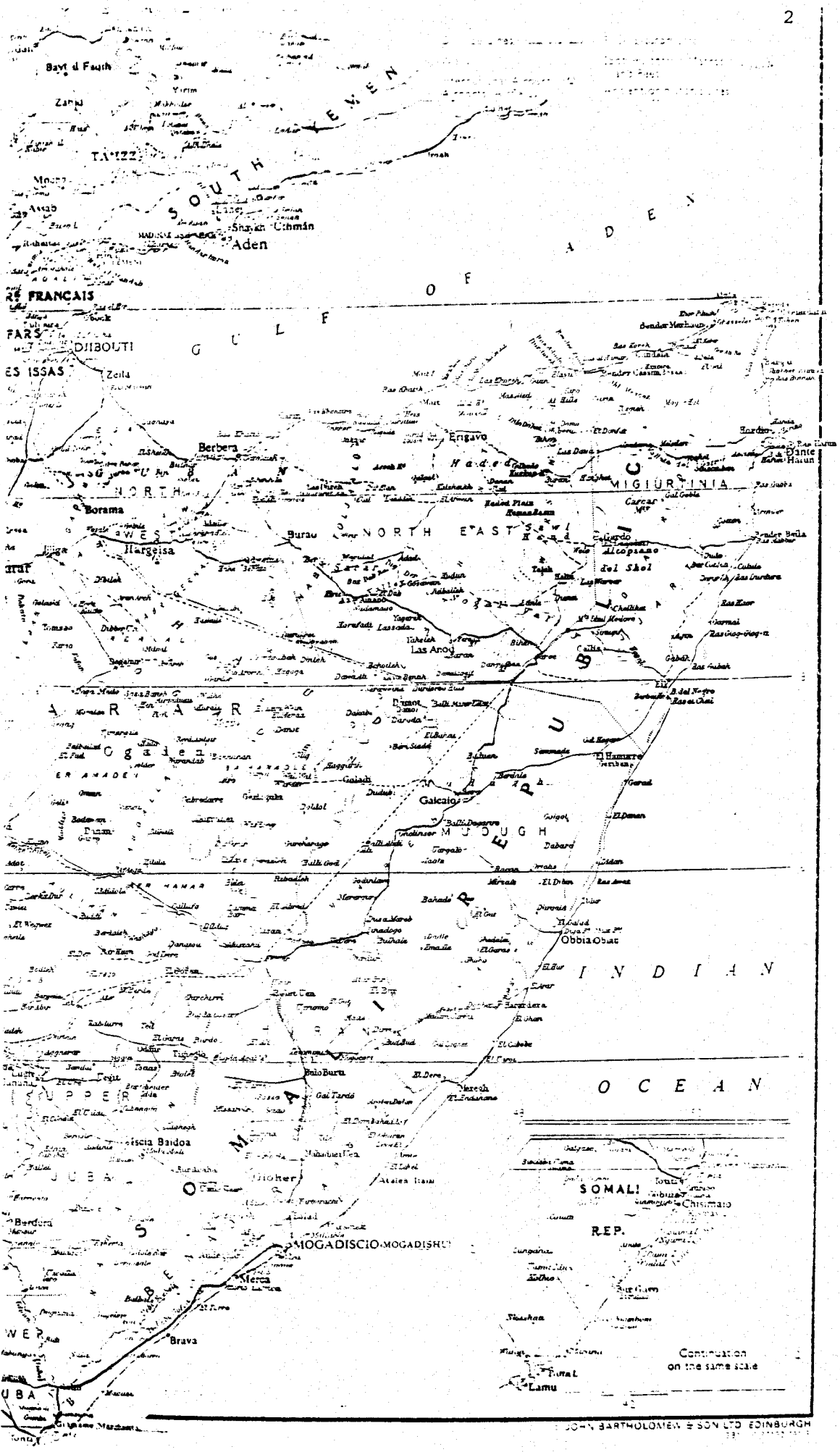
The economy of the country is based on nomadic pastoralism which provides more than 90% of the national export. Subsistence farming is practiced on about 700,000 hectares of an estimated 8 million hectares of cultivable land. The only export crop is bananas. Somalia's net foreign trade position is heavily on deficit.

In the recent years the war in the Ogedan between Somalia and Ethopia and frequent droughts have disrupted the nomadic life. To date Somalia has the biggest refugee population in the world. About 1.5 million are now in refugee camps in Somalia. During the 1973-1975 drought in the Horn of Africa, the Somali government resettled 15,000 nomads on the coast as fishing cooperatives at four locations.

Somalis are not traditionally fish eaters despite the fact that they have the longest coast of Independent Africa. The Somali government in recent years has devoted much effort to overcoming this social taboo by encouraging the utilization of fish and fish products.

This paper presents roughly estimated potential fish resources and the current status of the fisheries refering to the problems and prospects of the fisheries. Recommendations on research, development, and management are included.

Fig. 1 Map of Somali Democratic Republic.



REGIONAL OCEANOGRAPHY

Somalia is located in the Eastern Horn of Africa, between 2° and 12°N. Its coastal waters which border both the Indian Ocean and the Gulf of Aden are biologically productive. The coastline consists of a series of sandy beaches broken at intervals by rocky outcrops and cliffs that often extend into shallow waters. The Continental Shelf is narrow, averaging 15 km, except in the northeast where it reaches 60 km in width.

The most important factor for fisheries production in the area is the coastal upwelling of cold nutrient-rich subsurface oceanic waters. The upwelling results in the enrichment of phytoplankton and zooplankton which, in turn, make the conditions favorable for some small pelagic fish like sardines, herring, and scad (Cushing 1969; Fisher et al 1973).

Most of the oceanographic data available about the Somali Coastal waters, particularly the upwelling regions, were collected during the International Indian Ocean Expedition (IIOE) in 1959-1965, and during the Indian Ocean Experiment in 1979. Off the Somali Coast the monsoon seasonal winds have great impact on the coastal oceanic conditions. During the northern winter the monsoons blow from northeast and during summer from southwest. The Somali current system is produced by the monsoons (Fig. 2). Of these two monsoons, the southwest monsoon is more important and more dramatic in its impact. The reversal of the two monsoons from northeast to southwest takes place in mid-April. Before the onset of the southwest monsoon there is a boundary zone which separates northeastward oceanic flow from southwestward flow. This boundary zone was

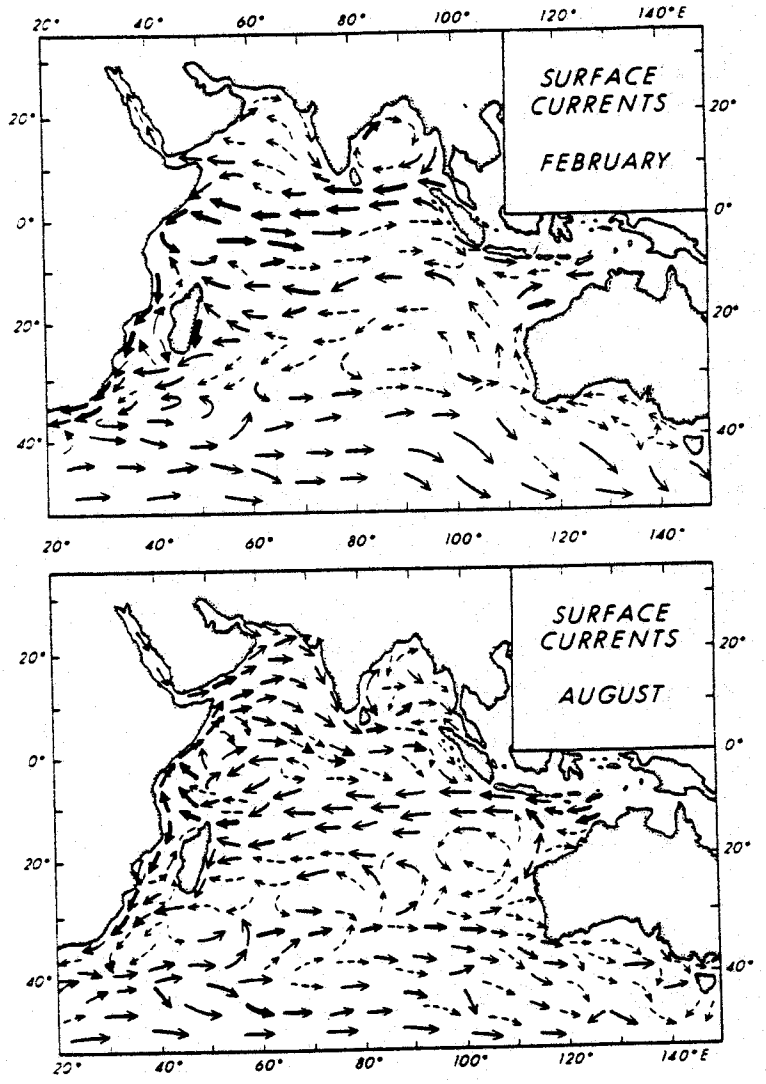


Fig. 1. Surface circulation of the Indian Ocean in February and August according to Monatskarten für den Indischen Ozean, Deutsches Hydrographisches Institut (1960)

located at 1°S during the Indian Ocean Experiment (Düing et al. 1980). As the southwest monsoons start the boundary zone migrates northward in a discontinuous manner (Fig. 3A - 3D). In early May the rate of migration is 24 km/day. By June the zone is located at 4°N. By July the currents attain their maximum strength of 3.5 m/sec (7 knots) (Swallow and Bruce 1966; Currie et al. 1973; Düing et al. 1980). Usually at 8° to 11°N, but some years at 4° to 5°N, the currents separate and diverge from the coast by turning eastward and then southward forming clockwise eddies (Bruce 1979; Brown 1980).

As the current departs from the coast, the isoterms are uplifted at the left side of the current, resulting in horizontal temperature gradients. These temperature gradients provide a means for tracing the patterns of the Somali current and associated eddies (Bruce 1979; Brown et al. 1980). Sattelite and research vessel observations of sea surface temperature in 1979 show the development of large wedge-shaped areas of cold water, which indicate the locations of upwelling areas. The temperature fronts develop as the current intensifies. By June two separate distinct frontal location appear at 4° to 5°N, and 8° to 11°N (Fig. 4). The Satellite observations show the merging of the two frontal location as the currents weaken in August and early September (Fig. 5). The temperature of the upwelling gets as low as 15°-18°C. The upwelling areas extend 300 km along the shore and about 400 km offshore.

Off the Somali coast during the southwest monsoon chemical and biological responses to the physical processes are evident. In the upwelling areas the surface nutrient concentration is high (5 to 20 micromoles of

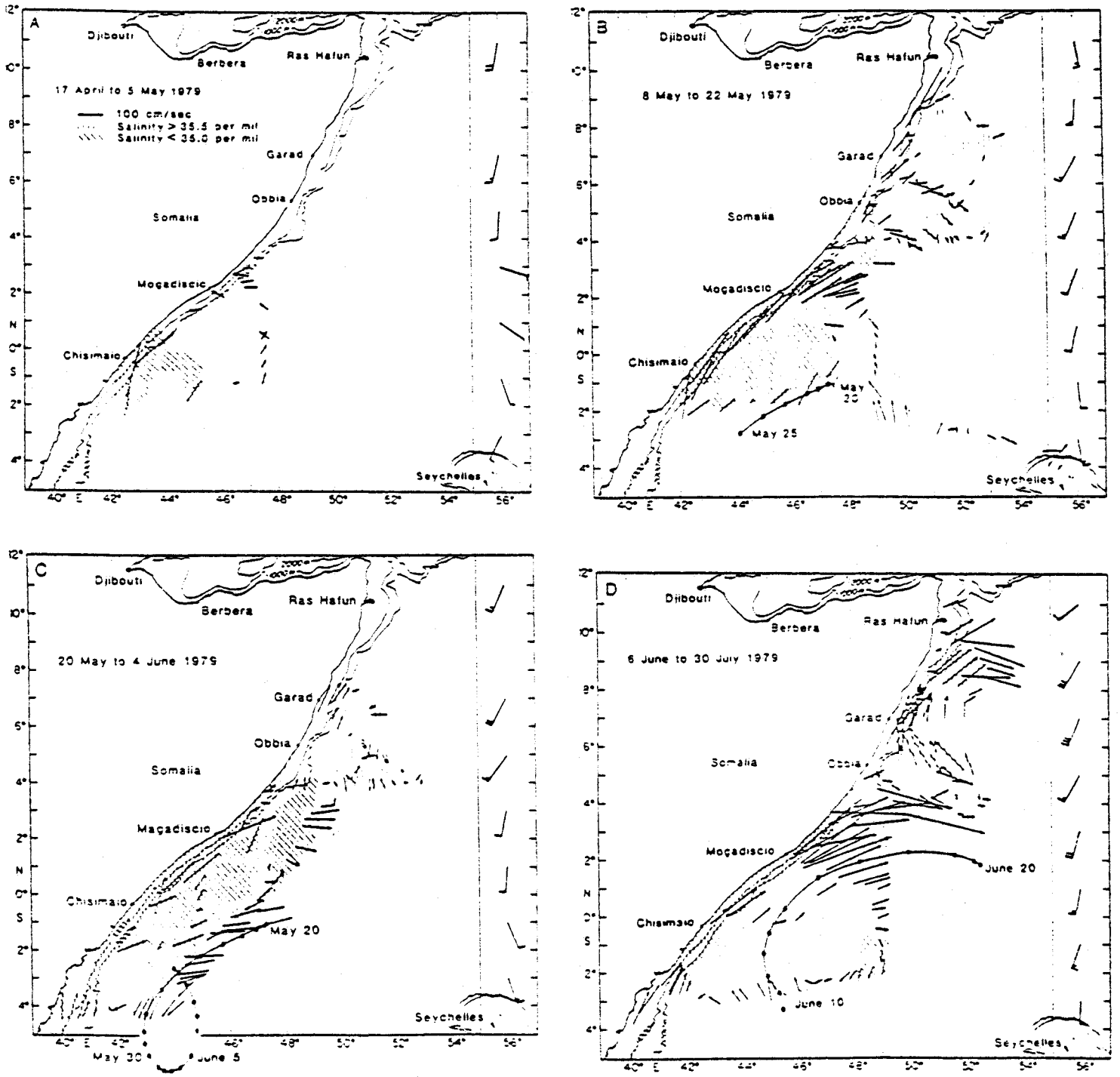


Fig. 3 Distribution of surface currents during the four time periods. Current arrows are centered on the observation point. Wind data collected during this period were averaged across 2° bands of latitude. The heads of the resulting wind barbs are plotted on the center latitude of each band. One half-feather on a barb represents 5 knots of wind. Satellite-tracked buoy trajectories are shown by the lines connecting closed circles (representing days). Adapted from Duing, Molinari, and Swallow (1980).

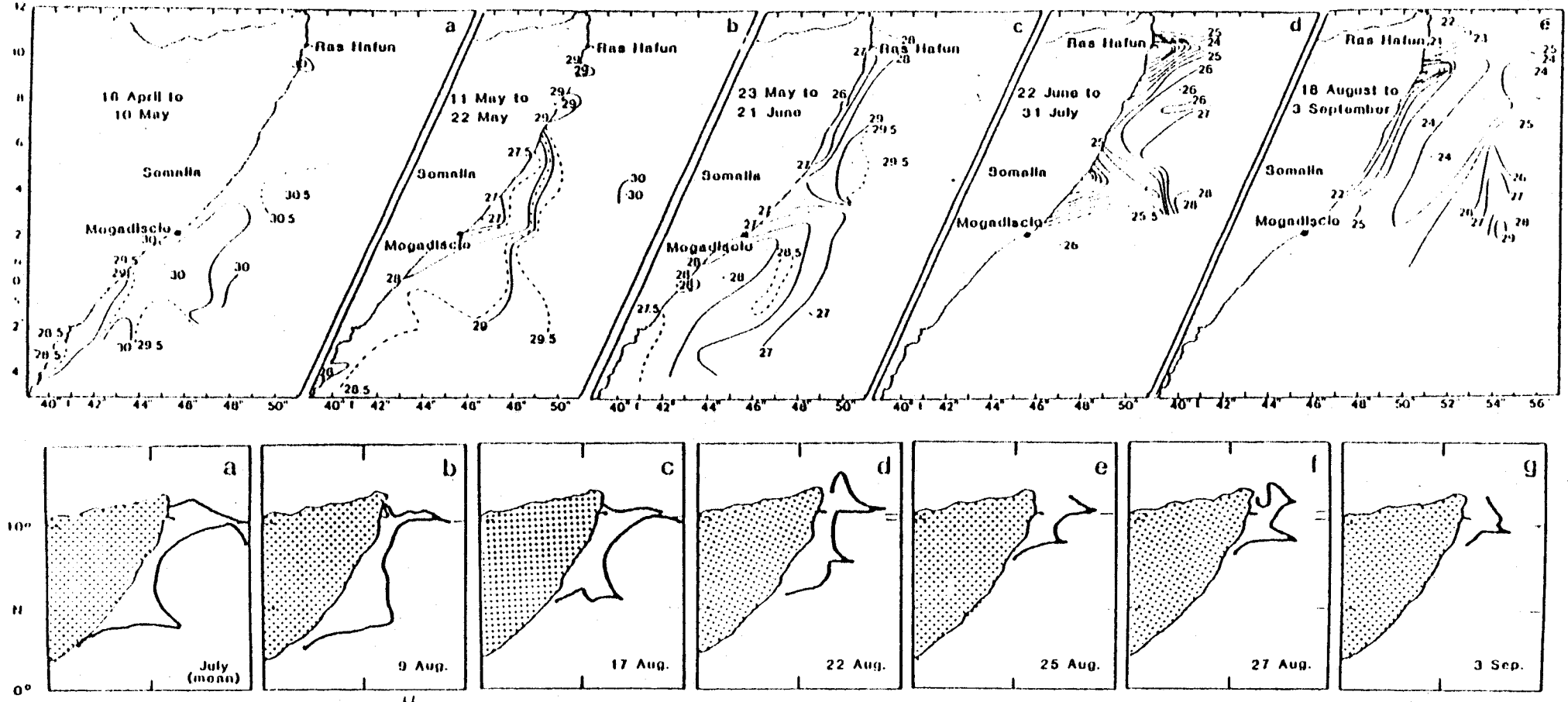


Fig.4 (top). Time sequence of ship-observed SST fields showing the oceanic response to the southwest monsoon of 1979. Fig. 4 (bottom). Time sequence of satellite-observed frontal locations for northern translation of the southern wedge of upwelling water.

Adapted from F. Schoff, and Quadfesel (1980)

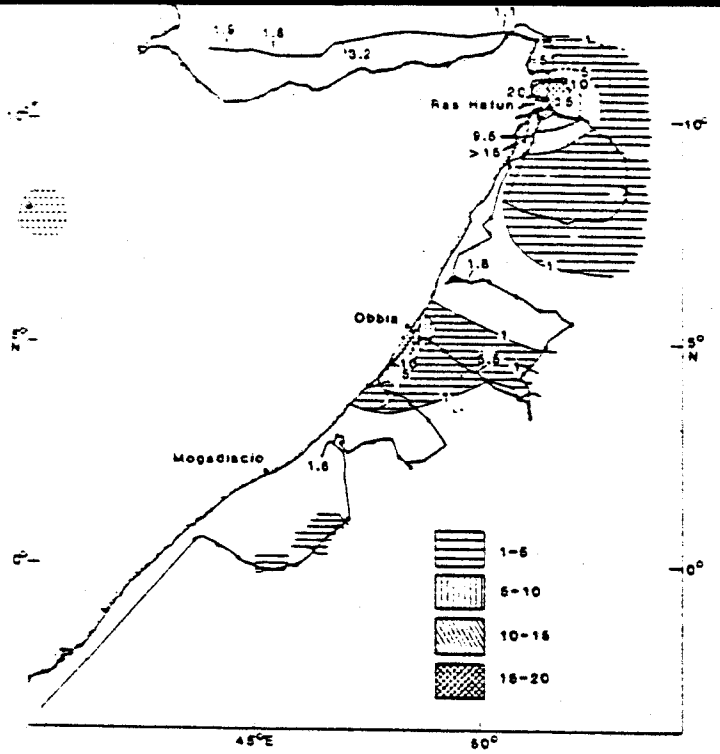


Fig. 1. Surface nitrate concentrations (micromoles per liter) observed off Somalia during leg 3 (7 July to 4 August 1979). Closed circles indicate positions of hydrographic stations.

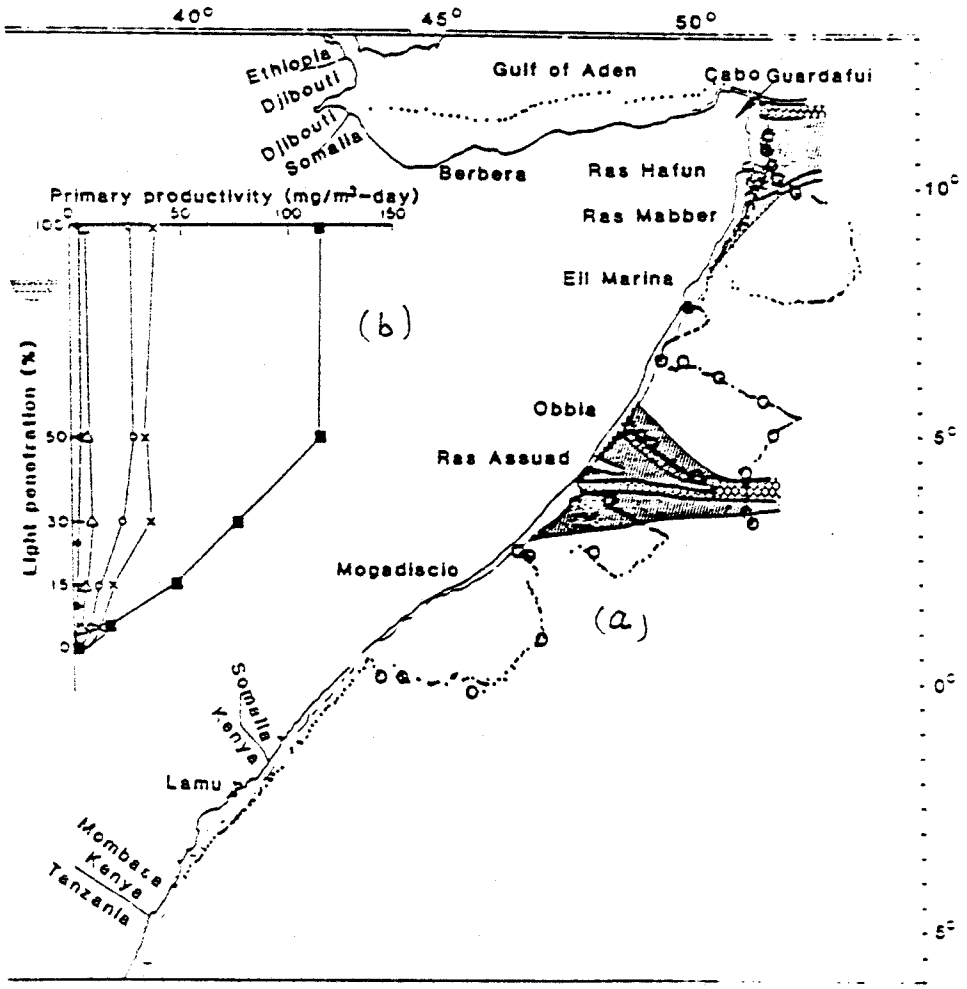


Fig. 7 Surface chlorophyll a concentrations (milligrams per cubic meter) observed off Somalia during leg 3 (7 July to 4 August 1979). Dots indicate positions where samples were taken while under way; circles indicate positions of stations where primary productivity was measured. Stippled areas are those where surface concentrations of chlorophyll a were between 0.4 and 1 mg/m³; crosshatched areas, those where the values were between 1 and 5 mg/m³. Inset shows profiles of primary productivity in terms of carbon from three regimes during the southwest monsoon in areas of upwelling (■), in areas of shoaling thermocline (X), and in areas where sea surface temperatures were greater than 25°C (○); during the northeast monsoon (□), and in the Sargasso Sea (●) (13).

Adapted from Smith and Codispotti (1980)

nitrate per liter). During the Indian Ocean Experiment the highest nitrate concentration was observed around Ras Hafun (10°N) (Fig. 6); suggesting stronger upwelling in the north than in the south (Smith and Codispoti 1980). The primary productivity and chlorophyll concentration of the upwelling areas are high. The primary productivity is as high as 1·7 ± ·8 $gc/m^2/day$ and chlorophyll concentration range from 0·4 - 5 mg/m^2. Primary productivity declines away from the upwelling regions. In areas well outside the upwelling, the primary productivity is 0·7 ± 0·4 $gc/m^2/day$. The surface samples of phytoplankton in the area are dominated by Nitzschia delicatissima with 560 cell per millimeter. In the areas well outside the upwelling samples are dominated by diatoms with an average of 55 cells/ millimeter. During the northeast monsoon the primary productivity along the Somali Coast gets half as productive as the least productive areas during the southwest monsoon and a tenth as productive as the upwelling areas (0·3 + 0·1 $g/m^2/day$). The surface chlorophyll concentration is 2 cells/ milliliter dominated by dinoflagellates and nonphytoplankton (Smith 1980).

FISH RESOURCES

Little is known about the abundance, composition, distribution, and general behavior of the fish stocks off the Somali coast. The fisheries in the area are not developed except for the oceanic pelagic fishery for tuna and mackerel which were traditionally fished off the northern Somali coast. There are few stock assessment and abundance estimation surveys carried out in the area.

Cushing (1971) estimated the tertiary production in the Somali upwelling area to be 1.24 million tons. The tertiary production was derived from priamry and secondary production by taking 1% of the first and 10% of the second. The radiocarbon method was used in estimating primary production during the International Indian Ocean Expedition. The total primary production of the area was given by the main radiocarbon values as $gc/m^2/day$ by area of 95,000 km^2 and a season of 180 days (Table 1). The estimation of secondary production was derived from displacement volume of zooplankton and their generation time and then raised by area and a number of generations in each season. One meter standard net with mesh size of 0.33 mm and a large Judy net, 0.5 m^2 in area with mesh size of 0.26 mm were used in zooplankton sampling. This estimation can not give the seasonal trends of the upwelling area.

Table (1): Carbon Production at Three Trophic Levels for Somali Upwelling

Area and Duration of Upwelling		Primary Production			Secondary Production		
A Area ($km^2 \cdot 10^3$)	B Duration (days)	C $gC/m^2/d$ (as observed)	D ($tons \cdot 10^6$/hr. X 1·45)	E ($tons \cdot 10^6$/yr. rounded, see text)	F Displacement volume (ml/1000 m^3)	G Depth Sampled (m) (or bottom)	H Volume beneath 1 m^2 (ml/m^2)
95	180	0·690	17·10	15	250	200	50

Secondary Production				Tertiary Production			
J Stock (gC/m^2)	K Generation time (days)	L number of generations	M_1 Carbon ($tons \cdot 10^6$/yr)	M_2 (M_1 x 1·33) Carbon ($tons \cdot 10^6$/yr.)	N_1 (M_1/D) Transfer coefficient (%)	N_2 (M_2/D) Transfer coefficient (%)	O (D x 0·01) Carbon ($tons \cdot 10^4$/yr.)
3·25	48	3·75	1·22	1·62	7·0	9·0	17·10

Tertiary Production					
P_1 ($0{\cdot}1\ M_1$) Carbon ($tons \cdot 10^4$/yr.)	P_2 ($0{\cdot}1\ M_2$) Carbon ($tons \cdot 10^4$/yr.)	Q_1 $\frac{P_1}{2} + \frac{O}{}$ Carbon ($tons \cdot 10^4$/yr.)	Q_2 $\frac{P_2}{2} + \frac{O}{}$ Carbon ($tons \cdot 10^4$/yr.)	R_1 (Q_1 x 7·47) Wet Wt. ($tons \cdot 10^6$/yr.)	R_2 (Q_2 x 7·47) Wet Wt. ($tons \cdot 10^6$/yr.)
12·2	16·2	14·6	16·6	1·09	1·24

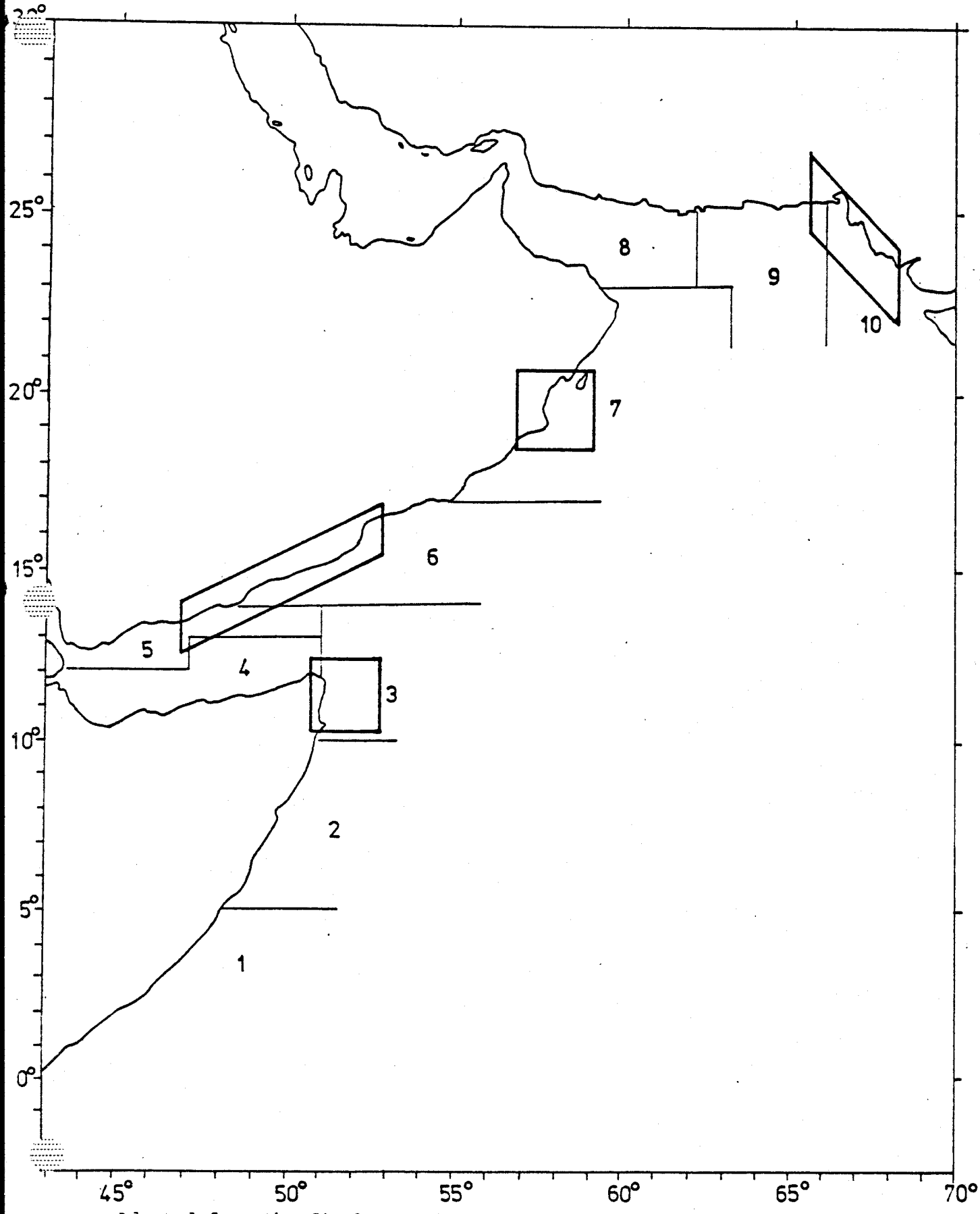
Adapted from Cushing (1971)

Small Pelagic and Demersal Fish Survey

The pelagic fish assessment survey which was carried out on board the research vessel "Dr. Fridtjof Nansen" in February 1975 - December 1976 collected some important data about the coastal pelagic fish and demersal fish off the Somali coast. The survey provided information about identity, abundance, and main pattern of distribution of the major stocks. Ten subareas, four of which are off the Somali coast, were covered in the survey (Fig. 7). The areas were covered on in the spring (February - June), once in the autumn (August - November) in 1975; twice in the spring (January - March and April - June) and once in the autumn in 1976.

The vessel is 150 ft. long, a combined stern trawler and purse seiner, carrying two pelagic trawls, one bottom trawl, one purse seiner, some gill nets, bottom lines and handlines. The acoustic equipment consisted of three simrod scientific echosounders (120, 50, and 38 KHz), two echo integrators, one side scanning sonar (18 KHz) and one netsonde (50 KHz). The two integrators were coupled to the 38 KHz echosounder, integrating depth slices of 8-50, 50-100, 150-150, or 100-250, 150-350, or 250-450 m. The settings of the echosounder with a basic range of 0-100 or 0-250 were as follow: transmitter 10 kw, pulse length 0.6 m/sec, bandwidth 1 KHz, receiver TVG and gain 20 log R-20 dB, recorder gain 6 or 7. The gain on teh integrator were mainly set on to 30 dB and the threshold setting was 1. Echo integrator values were read each nautical mile and average values for each 5 nautical miles were calculated and logged. The 20 KHz and 50 KHz echosounders, were only used at certain times when a close look at some

Figure 2. The survey area with its ten defined sub-areas and the areas of highest abundance of small pelagic fish



Adapted from the final report of pelagic fish stock assessment in the North Arabian Sea, 1978.

recording was necessary. Fishing stations were undertaken for identification of echorecordings and sampling for biological study. The recordings were divided into four categories: small pelagic fish, demersal fish, mesopelagic fish and plankton, and o-group fish. The abundance indices of each sub-area were worked out for each category of fish and the total weight of fish was obtained by multipling the abundance indices by a conversion factor for the acoustic equipment of "Fridtjof Nansen" which was seven.

Survey Results

Sub-area 1 (Somali coast 2°N - 5°N)

In this area the porcupine fish (Dlodon maculifer) and cardinal fish (Synagrops sp.) were the most abundant. Catch rates up to 5 tonnes per hour trawling of cardinal fish (Synegrops sp.) were obtained in the pelagic trawl. Round herring (Eterumeus teres) was found in small quantities in most of the cruises. During April 1976 this species were observed in small schools in depth of 50-100 m at bottom depth of 120-160 m off Mogadishu. The other species observed in this area were sardinella (Sardinella sp.) and spotted herring (Herklotsichthys sp.). These species were not dense enough for commercial fishing with the gear used by "Dr. Fridtjof Nansen" (Table 2). They were more abundant in the autumn then in the spring. Their length range was as follows:

Round herring:	16 - 20 cm
Spotted herring:	7 - 10 cm
Sardines:	10 - 13 cm

Snappers and groupers were the most numerous species of demersals. The catch rates of these species were low in this area. Catch rates up to .3 tonnes per hour trawling were obtained (Table 2).

Sub-area 2 (Somali coast 5° - 10°N)

During the spring the porcupine fish was the most numerous fish in the recordings, but the most important species found in this area was mackerel

Table 2. Estimates of abundance (10^3 tonne) of small pelagic fish and dominated species within each sub area.

	1975		1976		
Sub area	Spring	Autumn	Spring	Spring	Autumn
2° - 5°N	200 porcupine fish	90 herring	1460 mesopelagic fish	160 herring porcupine	90 mackerel* anchovy herring
5° - 10°N	50 porcupine fish	80 various	290 mesopelagic fish	50 mackerel porcupine	80 anchovy
North east Coast	200 sardines	270 sardinella	310 mesopelagic fish	120 sardinella herring scads	370 sardinella herring
North coast (Gulf of Aden)	80 various	30 horse mackerel (o-group)	50 horse mackerel	10 various	20 pony fish
Total Weight:	530	470	2110**	340	560

* Not identified
** Mesopelagic fish gives over estimation of abundance

Source: Final report, Survey results of "Dr. Fridtjof Nansen", pelagic fish assessment survey of North Arabian Sea.

(Scombor sp.). This species was observed along the edge of the continental shelf between 5° and 8°N during spring. During the day the fish formed small schools near the bottom at 300 - 350 m depth and at night appeared as a pelagic scattering layer in 150 - 200 m. With the bottom trawl catch rates of 1·3 tonnes per hour were obtained and with pelagic trawl 0·7 tonnes per hour were obtained. Length ranges of mackerel are given below:

Feb. 1975	April 1976
21 - 26 cm	25 - 29, 32 - 37 cm

The length of mackerel fished February 1975 ranged from 21 - 26 cm while that of April 1976 ranged from 25 to 29 and 32 to 37 cm. Scattered recordings of Anchovy (Engraulis sp. and Stolehours sp.) and scads were observed on all cruises.

Large amount of unidentified demersal species were recorded during the autumn survey of 1975 (Table 3). The recordings were made at depths of 100 and 300 m in the area where the mackerel was observed during the spring. The major species in this group were groupers, snappers and scavengers. A catch rate of 2·4 tonnes per hour trawling was obtained (Table 3).

Sub-area 3 (Northeast Somali Coast)

A high abundance of small pelagic fish was observed in this area during all the cruises. Indian oil sardinella, round herring, and scads were the most numerous species of this group. They were observed near the surface at a depth of 10 to 30 m between Ras Asir and Ras Hafun. These species were found to be more abundant and more available to fishing gear during the autumn

Table 3. Estimates of abundance (10^3 tonnes) of dermersal fishing and dominating species in each sub area.

	1975		1976		
Sub area	Spring	Autumn	Spring	Spring	Autumn
2° - 5°N	60 snapper grouppers	90 various	0	0	50 sponges grouppers
5° - 10°N	100 grouppers	710*	126 snapper grouppers	10 sea bream	90 Barracuda snappers
North east Coast	130 Scavengers 4 Sharks	70 Scavengers	20 various	10 sea bream 4 lizard fish	70 Scavengers Sponges
North (Gulf of Aden)	20 grouppers	30 pony fish	20 grouppers	0	50 various
Total Weight:	210	900	166	20	260

* Not identified

Source: Final Report of Pelagic Fish Assessment of Survey by "Dr. Fridtjof Nansen" in the North Arabian Sea.

than spring. The main biological conditions observed were as follows:

	Spring		Autumn	
Species	Length (cm)	Maturity	Length (cm)	Maturity
Indian oil Sardinella	13 - 16	immature, unripe ripening	16 - 18	ripening nearly ripe
Round herring	13 - 17	immature, unripe	18 - 20	spent
Layang scad	---	---	18 - 20	ripening, nearly ripe, spent

During the autumn the Indian oil sardinella and layang scads were mainly ripening and nearly ripe, and round herring were ripening during the autumn and were spent during the spring. The area appears to be a spawning ground for these three species.

The estimates of abundance for demersal fish showed considerable variation between surveys. The major species in the recordings were scavengers, sea breams, and sharks. Catch rates up to 2·9 tonnes per hour were obtained in bottom trawling (Table 3).

Sub-area 4 (North Somali coast)

Recordings of this group were very scattered. The recordings in table 2 which were erroneously recorded for small pelagic fish originated from mesopelagic cardinal fish. Small scad 6-11 cm in length were obtained offshore of this area in September 1975.

The recordings of demersal fish was quite low in this area and the catch rate except one bottom trawl of 2·2 tonnes per hour trawling was low. Steep bottom slope made the bottom trawling difficult.

Total Area

High abundance of small pelagic fish was observed off the Somali coast, between Ras Asir and Ras Hafun. The most numerous species were the Indian oil sardine (Sardinella longiceps), round herring (Decapterus macrosoma) and scads (Decapterus merudsi). The fish were observed along the edge of the continental shelf between 5° and 8°N. The major species caught in bottom trawls were snappers (Lutjanus spp.), Porgies (Spardidae), groupers (Serrandidae), pony fish (Leiognathus) and red sea herders (Emmelichtys spp.). Figure 8 gives the distribution of the main small pelagic fish.

The standing biomass of small pelagic fish as calculated from the data in table 2 is 450 thousand tonnes. This standing biomass gives a potential biomass of 475 thousand tonnes. The potential biomass of demersal fish is 366 thousand tonnes, which is calculated from standing biomass of 731 thousand tonnes (table 4 and 5). For fasting growing short-lived tropical species, half of the standing biomass of virgin stock gives a rough estimation of the potential biomass (Saefersdal 1978).

Fig. 8. Distribution of small pelagic fish off the Somali east coast in April 1976. 1) Scattered 2) Dense A) Mainly round herring B) Mackerel C) Sardinella (mainly Indian oil sardinella) and scad.

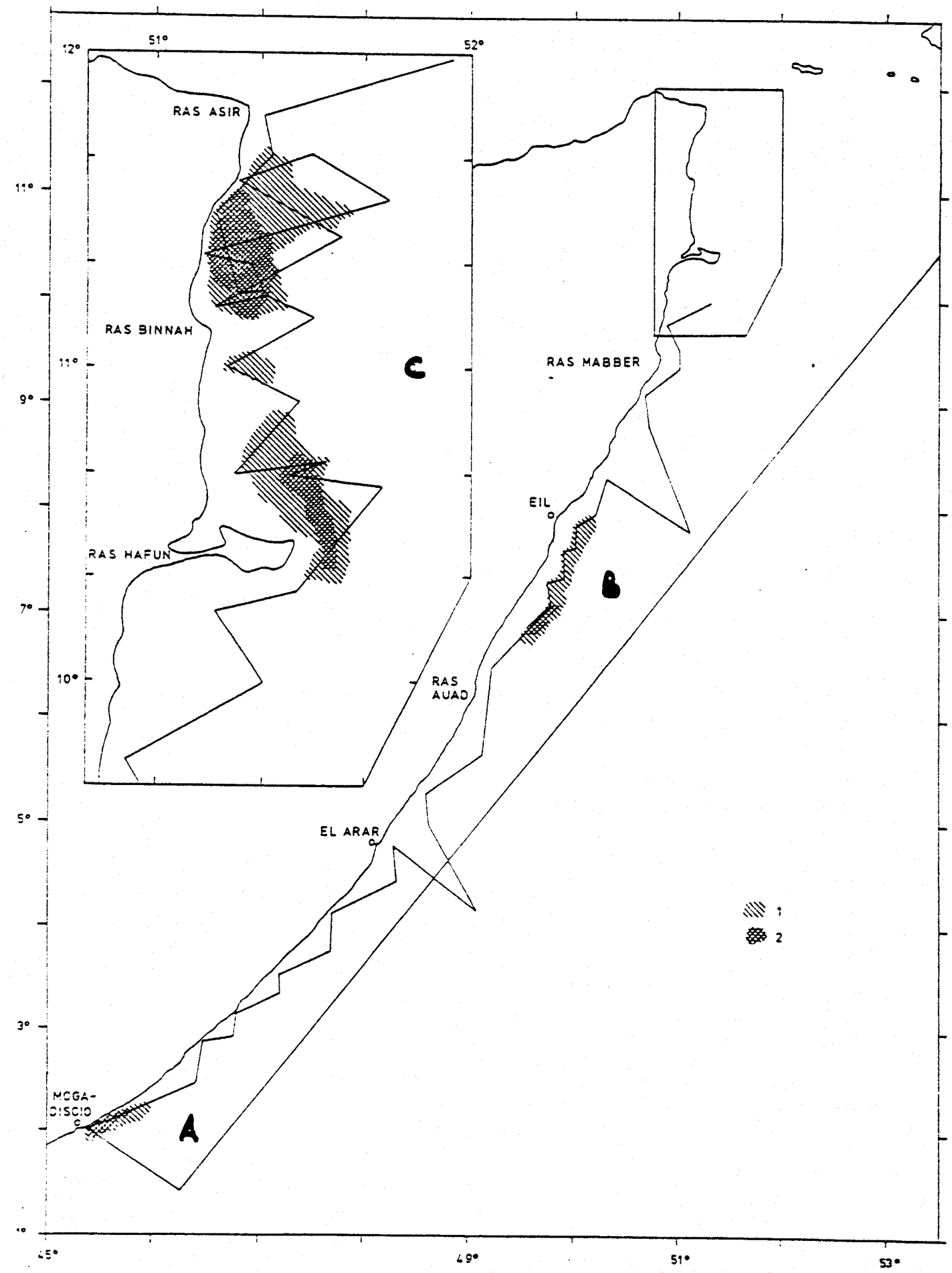


Table 4. Seasonal abundance of small Pelagic and Demersal Fish off the Somali coast.

Group	1975 Standing Biomass (1000 tonnes)		1976 Standing Biomass (1000 tonnes)	
	Spring	Autumn	Spring	Autumn
Small pelagic fish	530	470	340	560
Demersal fish	210	900	93	260

Source: Condensed from Table 3 and 4.

Table 5. Annual potential biomass of small pelagic and demersal fish

Group	Standing Biomass* (1000 tonnes)	Potential Biomass** (1000 tonnes)
Small pelagic fish	950	475
Demersal fish	731	366

* Average of the two years in table 5 is taken.

** For fast growing fish with short life span a rough estimation of the potential biomass is half of the virgin biomass (Saetersdal 1978).

Tuna and Tuna-like Species

These species are being exploited at or near their maximum sustainable yield in the Indian Ocean in general. Off the Somali coast Yellowfin and Skipjack are fished traditionally. A rough estimation gives 8000 tonnes as the potential yield of these species (Christy 1980).

Tunas are directly associated with water types and ocean currents rather than upwelling and high primary productivity (Suda 1973). During the first and the second quarter of the year when Somali upwelling is intense, longline catches of tunas are poor off the Somali coast. In the fourth quarter of the year longline catches are high.

Sharks and Rays

The families represented by these stocks include hammerhead (Sphyrinidae) and grey sharks (Carcharinidae). They are found in all of the coastal areas of Somalia but are more abundant in the Gulf of Aden and the eastern coast. The standing stock is estimated to be 50,000 tonnes north of latitude 20°N with potential yield of 30,000 tonnes (Mosl 1971).

Other Species

Spiny lobster, shrimp, turtles, oysters, and crabs are the other commercially important animals off the Somali Coast. All major

East African species of spiny lobster are found both inshore and offshore of the Somali coast.

Palinurus ornatus, P. versicolar, P. penicilatus, P. daspus, P. Japonicus, and P. mossambicus occur in medium depth waters. Puerulus sewoli, P. carinatus, and Nephropos andomenicus are found in deep waters. Catch rates of deep water lobster are as follows:

Locality	Bottom depth	Species	kg/hr	No/hr
N. Kenya Bank	290 m	Puerulus amgulatus	1.2	21
Ras Aud	225 m	Puerulus amgulatus	0.5	7
Ras Binnah	427 m	Puerulus seweli	176.0	1645
Ras Binnah	427 m	Metanephraps andamenicus	2.5	33

The size distribution of these deep water spiny lobster is given in figure 9. The potential yields of deep and shallow water spiny lobster are roughly estimated to be 1000 and 500 tonnes, respectively. The potential yield of shrimps is estimated as 400 tonnes (Christy 1980).

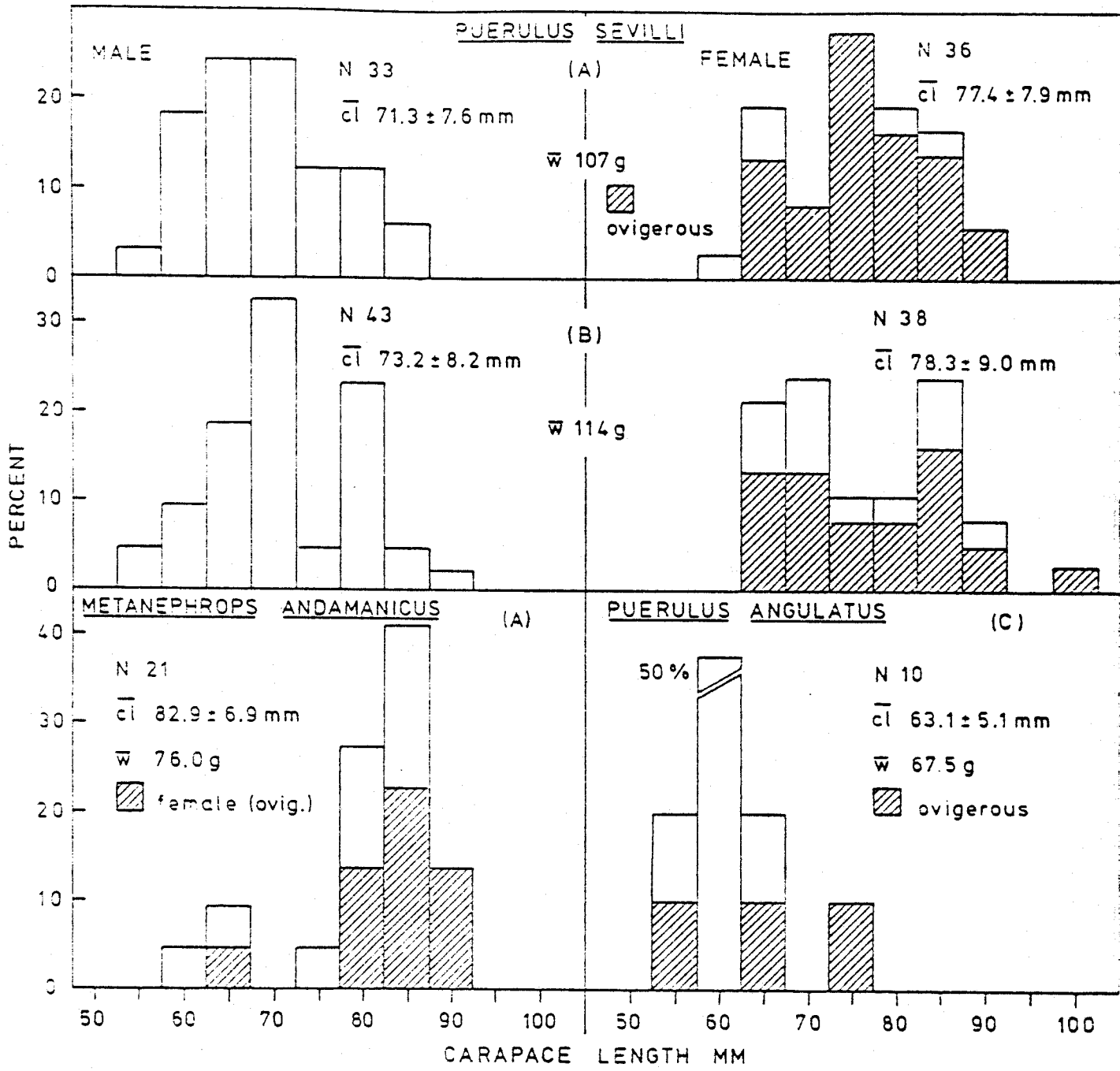


Figure 9. Length frequency distributions of lobsters caught off Kenya and the east coast of Somalia. Fishing depths: A: 230 m, B: 427m, C: 225 - 290m.

FISHERIES

Sixth percent of the Somali population of 3.5-4 million are nomadic pasturalists who view the ocean as a barrier to their "free movement" and not as a food source. The Somali nomadic culture despises fish as food and fishing as a profession. Consequently, the fisheries development is in its earliest stage. Somalia is endowed with few natural resources and the livestock sector, which provides 90% of the country's export, has become vulnerable to drought. These problems together with the increase of urban population prompted the government to focus its attention on the ocean as an alternative source of food, employment, and hard currency. In 1971 the Ministry of Fisheries and Marine Transport was established to develop the fisheries. The Ministry has organized the small number of traditional fishermen into fishing cooperatives by assisting them with technical and financial assistance and through a joint venture established a fishing company. Now Somali fisheries can be conveniently divided into artisanal and industrial fisheries.

Artisanal

This sector of fisheries is composed of 18 fishing cooperatives in the following places:

1. Ras Kambone
2. Kismanyo
3. Bravo (Brawe)

4. El Ahmed (Ceel Axmed)
5. Marca (Marka)
6. Mogadishu (Mugdishu)
7. Adale (Cadale)
8. Eil (Eyl)
9. Bender Bella (Bender Bayla)
10. Obia (Hobyo)
11. Alula (Calowela)
12. Habo (Xaabo)
13. Candala (Qandala)
14. Bossesso (Boosaaso)
15. Las Khoreh (Laas Qorey)
16. Mait (Meydh)
17. Berbera
18. Zeila (Zaylac)

[Note: Somali spelling in brackets]

In 1975 there was a bad famine in Somlia which caused 250 thousand Somlis to lose their livestock and resort to government relief camps. The government settled 15 thousand of these nomads in Browe, Ceel Axmed, Eyl (Beday), and Cadale to become fishing cooperatives. The objective of the resettlement program is to increase the manpower engaged in fishing and thereby to increase fish production and utilization. Now the population of fishing communities along the coast is roughly estimated to be 20,000 people, but of these only 4,000 are full time

and 10,000 are part time fishermen. The rest are administrators, net-menders, processing workers, storekeepers, and watchmen. The fishing cooperatives are not yet self-supporting so the government assists them with food, clothing, medical facilities, and schools. There are many problems deterrent to the development of fishing cooperatives which will be discussed in the following sections.

Boats

Artisanal fisheries involve approximately 2,000 canoes and sailboats and 400 functioning motor boats about 6 meters long. The boats used in the cooperatives are from various origins including Kenya, Greece, Somalia, Sri Lanka, USSR, and Sweden. Haakonsen (1980) reported that the inadequacy of the boats used by the cooperatives and their high rate of breakdown as main deterrents to fishing cooperatives. Of 234 motor boats supplied to Brawe, Cadale, and Badey, only 78 (33.3%) are in working condition (Table 6). This problem is common to all the cooperatives. Particularly Volvo penta-powered fiberglass, which are built in a plastic boat yard in Mogadishu, are designed to be useful for leisure use (Haakonsen 1980). Apart from the problems associated with multiplicity of boats of engine types which cause maintenance, repair, and wastage problems, there is also a shortage of skilled operators and mechanics. FAO and others suggested the standardization of the makes, adequately trained mechanics and operators, and establishment of repair and maintenance workshop and a supply of spare parts could solve some of the problems of the cooperatives. Haakonson made another

Table 6. Motorized boats

	TOTAL			BARAAWE			CADALE			BADEY			CEEL AXMED*		
Boat (Engine)	total	w	nw	total	w	nw	total	w	nw	total	w	nw	total	w	nw
Russian (Doron)	78	14	64	24	0	24	26	0	26	18	4	14	10	10	0
Swedish (Volvo-Penta)	41	6	35	13	1	12	18	2	16	4	1	3	6	2	4
Kenyan (Yanmar)	33	2	31	12	0	12	14	2	12	7	0	7	-	-	-
Kenyan canoes	14	0	14	9	0	9	2	0	2	-	-	-	3	0	3
Greek (Petter)	9	1	8	3	0	3	3	0	3	2	0	2	1	1	0
Italian	2	0	2	1	0	1	-	-	-	-	-	-	1	0	1
Sri Lankan (Yanmar)#	56	55	1	14	14	0	15	14	1	12	12	0	15	15	0
Somali (Mister)	1	0	1	-	-	-	1	0	1	-	-	-	-	-	-
Total	234	78	156	76	15	61	79	18	61	43	17	26	36	28	8
% Operational	33.3%			19.7%			22.8%			39.5%			77.8%		

w: in working condition
nw: not in working condition

* The high percentage of boats in working condition in Ceel Axmed is due to the fact that a team of British mechanics have just replaced the engines of some of the Russian, Greek, and Sri Lankan boats.

Most of the Sri Lankan boats are less than a year old.

Adapted from Haakonsen, 1980.

point which has important significance. Oil prices are rising every day and the machinery from Industralized countries is becoming more expensive to operate due to inflation. Haakonsen suggested the use of sail boats and rowing as the conditions permit. In the southern cooperatives at Ras Kiambone where 90% of the fishing is done with traditional sailboats (Mashu), the catches have increased 100% in recent years (Haakonsen 1980).

Method and Gear

Gill nets made of 150 mm or 30 mm mesh are the most commonly used fishing gear. Gill nets are set on the bottom at depths of 5-20 fathoms. Nets are left in the water for 20-24 hours a day and checked only once in the morning. The boats don't carry ice boxes so much of the catch deteriorates before processing (Haakonsen 1980). The bottom set gill-net method mainly catches low priced fish like sharks.

Other methods which are used to a lesser extent include hindline, troll line, sharkline, and beach seine. There is lack of incentive, initiative, and training as well as poor administration in the cooperatives, so the fishermen don't use labor intensive methods like longlines which probably would catch fish with higher value like small pelagic fish.

Catches

The statistical data about the catches in the artisanal and high sea fisheries are limited. There is no standardized method for recording

catch in the cooperatives. The general classification distinguishes only libaax (shark), kelluun (fish), and argoosto (lobster). The total artisanal catch fluctuated between 4000 and 8000 tonnes in recent years (Christy 1980). This is well below the estimated potential of about 1 million tonnes. The catch per effort for resettled cooperatives has increased from 1978 to 1980 (Table 7). The average catch per effort for the four cooperatives in Brawe, Cadale, Badey, and Ceel Axmed was 53.5 kg with Ceel Axmed having the lowest (34.1 kg) and Badey the highest (226.7 kg) in 1978. The catch per effort increased to 81.6 in 1979 and to 130.9 in 1980. This is attributable to the increased experience and skill of the previously nomadic fishermen as fishing methods have remained basically the same (Haakonsen 1980). The average time which fishing is possible along the Indian coast is estimated by FAO to be 125 days per year, but Haakonsen (1980) reported that resettled cooperatives fished 246 days per year in 1978-80. Therefore, if fisherman are given training in the use of various fishing methods and techniques, in this longer fishing season they can increase considerably their catches.

Industrial

This section of fisheries includes all the fisheries carried out by industrialized or semi-industrialized boats or vessel which are longer than 10 m. It is divided into domestic and foreign fisheries.

Table 7. Yearly fish catches in all settlements

		Total	Shark	Fish	% Shark	Fishing days	Boat landings	Average boats/day fishing	Average catch/boat/day
RARAAWE	1978	122,281	N.A.	N.A.	N.A.	259	2562	10.0	48.0
	1979	120,048	47,836	72,212	39.8%	244	1045	4.3	114.9
	1980*	81,652	37,923	43,729	46.4%	151	702	4.6	116.3
CADALE	1978	215,496	101,085	114,411	46.9%	318	6314	19.9	34.1
	1979	147,560	69,141	78,419	46.9%	284	3832	13.5	38.5
	1980*	126,927	59,756	67,171	47.1%	148	1359	9.2	93.4
BADEY	1978	212,203	137,032	75,171	64.6%	173	936	5.4	226.7
	1979	260,256	170,468	89,788	65.5%	201	930	4.6	279.8
	1980*	299,431	165,011	134,420	55.1%	122	1051	8.6	284.9
CAXMED	1978	67,604	28,685	38,919	42.4%	237	1729	7.3	42.4
	1979	83,663	29,178	54,485	34.9%	253	1690	6.7	49.5
	1980*	73,522	35,876	37,646	48.8%	146	1330	9.4	55.2
TOTAL	1978	617,584	N.A.	N.A.	N.A.	987	11541	11.7	53.5
	1979	611,527	316,623	294,904	51.7%	982	7497	7.6	81.6
	1980*	581,532	298,566	282,966	51.3%	567	4442	7.8	130.9

* First six months only.

Adapted from Haakonsen, 1980.

Domestic

The domestic industrial fisheries started with the establishment of the Ministry of Fisheries in 1973. The Somali Ministry of Fisheries has established a joint venture company (Somalfish) with the Soviet Ministry of Fisheries in order to catch, process, and market fish. This company operated with ten trawlers until 1977, when the political relationship of the two countries became strained. The catch of this fleet is roughly estimated to be 3500 tonnes of fish (mainly demersals) and 1500 tonnes of spiny lobster per year. The cessation of Soviet participation and the withdrawal of the vessel temporarily eliminated industrial fisheries in Somalia. Somalfish, now owned by the Somali government, has purchased two 28 m Australian-built shrimp trawlers. The Ministry of Fisheries also purchased recently nine 28 m Yugoslov-built multi-purpose vessels. The catches of this new fleet are not yet available.

Foreign

Somalia claims sovereignty over territorial waters up to 200 miles. Fishing in the territorial sea is reserved for vessels flying the Somali flag and other authorized vessels. Seven Italian freezer trawlers fish demersal finfish, spiny lobster, and shrimp in Somali water under government permit. Japan, Republic of Korea, Taiwan, and the U.S.S.R. are the countries which fish in the Indian Ocean and for mainly Tuna. Off the Somali coast yellowfin tuna is fished by these distant fishing

fleets (Tusing 1974). Shůmora (1970) noted: "recently a number of long range trawlers from Greece and USSR and Japan have worked off the southern coast of Arabia and northeast coast of Somalia, reporting catches of 30 tons a day, the number of these ships has decreased since the Suez Canal was closed."

The most important concern for Somalia at this time is the extensive increase of People's Democratic of Yemen Fisheries in the Gulf of Aden and the Indian Ocean. With the assistance of the Soviet Union, South Yemen has increased its annual catch by 20% in the recent years. Its annual catch averages 136,666 tonnes of which 90,000 tonnes are Indian oil sardinella (FAO 1978). It seems likely that South Yemen is fishing the same stock of small pelagic fish off the northeast coast of Somalia, so this necessitates Somlia to have a bilateral agreement with South Yemen about the management of these shared resources.

LAND BASED FACILITIES

The poucity of land based facilities is a severe deterrent to the development of Somali fisheries. The berthing, maintenance, preservation, and processing facilities as well as the communication and transportation systems are in their earliest stage.

Ports and Harbors

There are few natural harbors along the Somali coast and the only ports which can provide anchorage to large vessels are at Berbera, Mogadishu, and Kismenyo. All have mechanical and repair facilities as well as ice plants. Kismenyo also has a slipway which is mainly used by the Somali Navy. Merchant ships have priority over the fishing vessels in using the port facilities.

Most of the cooperative fishing boats are landed on the open shore as there are no berthing and anchorage facilities (Fig. 10). The Ministry of Fishery has in its current three year plan, establishment of fishing harbors in some of the areas where the fishing cooperatives are located.

Preservation and Processing Facilities

The lack of preservation and processing facilities is another handicap to Somali fisheries development. The dominant processing method used by the fishing cooperatives is salting and drying (Fig. 11).

In Kismenyo there is a small freezer-cold storage plant with a flake ice manufacturing unit. The plant was primarily designed for processing

Figure 10. Boats used for fishing at Braawe cooperatives anchored on open beach. Adapted from Glantz (1980).

and export of lobster and shrimp. It was previously owned by a private commercial company but now is owned by the Somali government. It was overhauled and now freezes spiny lobster from the Kismeanyo region. The tuna canneries in the north at Habo, Candala, and Las Khoreh have a problem with fish supply and none of them have been operated at capacity in recent years. Habo and Canadala were built about 1935 and have a combined capacity of 40 tonnes per day. Las Khoreh was built in 1966 under Soviet assistance. It consists of cold storage area, a freezer, can-making unit facility, a reduction plant with its own boilers, and a diesel electric pwoer plant. Its capacity is 20 tonnes per day. The three canneries are supplied by a fleet of traditional boats (huris) and small open-powered boats.

Las Khoreh has been impacted by the collapse of the Somali-Soviet relationship as the Soviets stopped supplying spare parts and expertise to the factory. The Bolimog factory has a capacity of freezing 50 tonnes of fish a day and converting 25 tonnes to meal and oil. Bolimog offers protected landing facilities. The municipal cold storage in Mogadishu and privately owned ice-making plant in Berbera are the other supporting fish preservation facilities.

Communication and Transportation

In the last decade the road system in Somalia has been developed considerably. In 1975 there were 8,700 miles of dirt roads and tracks, 630 miles of gravel roads, and 660 miles of asphalt-surfaced first class

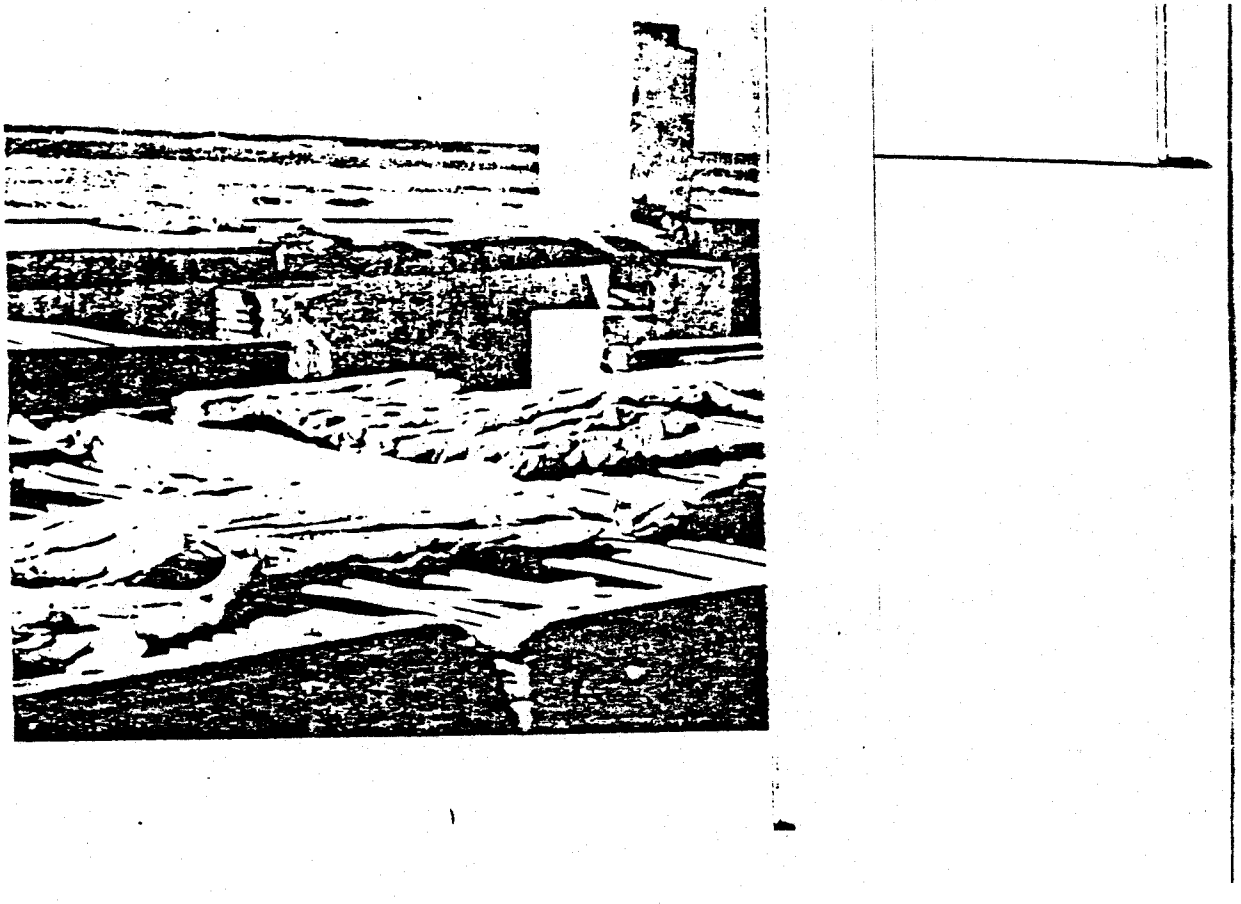


Figure 11. Fish being dried at processing plant in Brawe.

roads. Most of the development program (1974-1978) proposing the increase of total paved road mileage to 1,063 miles has been carried out. The vital south-north road of 649 miles from Beltweyn to Burao has been completed with the assistance of the Peoples Democratic of China. The Berbera-Burao road and Berbera-Hargeisa road have been completed also. The other roads which are under construction or under study are Golweyne to Jamaame, Hargeisa to Boorame, and Burao to Hargeisa. These new roads have eased the communication in the country in general; however, sizeable areas including most of the coastal regions remain without all-weather roads and most of the fishing cooperatives have access only to rudimentary dirt tracks. The northeast coast, which is a potential fishing ground, is connected to the other parts of the country with very rough dirt roads. The nature of the landscape in that region which is mainly composed of mountains and valleys makes the road construction costly so development of a marine transport system is more feasible at this time.

UTILIZATION

Fish had never been a subsistence diet for the Somalis. In 1854 Richard Burton noted a common taunt used by the Somalis "speak not to me with the mouth that eateth fish". This aversion to fish still persists among the Somalis. In Bajun Islands in the south and limited areas at the coast, there was a thriving export trade with China in shark fins, tortoise shells, and dried fish. This trade stopped in 1964. The Somali government moved the people in Bajun Islands to Ras Kiambone at the coast where accessability is easier than in the Islands. They are organized into fishing cooperatives through which they get technical assistance and training from FAO. The government put much effort into increasing the utilization of fish and fish production. A constant compaign is conducted to educate the people to be conscious of this resource. Two fish days each week are introduced in Mogadishu in which meat is not available in the market and educational programs about fish have been carried out in the mass media. As already stated in previous sections, the resettlement of nomads as fishermen was part of the compaign to increase the production and utilization of fish. The organization of the fishermen into cooperatives has been part of the same objective of promoting the role which fishery plays socio-economically in Somali life. Through the cooperatives the government can pursue its objectives more than it can when the fishermen are operating as individuals. The government objectives included fish:

1) to provide animal protein for food;
2) to provide income and employment to the local people;
3) to provide exchange earnings.

To attain the first two objectives, the government increased the manpower, engaged in fishing, and provided them with technical and financial support. To attain the third objective which is capital intensive and export oriented, industrial fisheries have been developed through joint ventures.

The per capita consumption of fish in Somalia is 0.4 pound (Tussing 1974). Primarily as a result of the government compaign the fish consumption has increased considerably. FAO (1975) estimated the local annual consumption to be 1200 tons. This number has increased to 10,000 tons. Fish is at least a part of the daily food of the 20,000 people in the fishing cooperatives. The hospitals, boarding schools, the army, and prisons are supplied periodically with fish by the government. In the bigger towns at the coast including Mogadishu, the fish has become more acceptable. A factor attributable to that, apart from the government compaign, is the enormous increase in the price of meat. One kilo of meat costs up to So Sh 30 or about US $5, in Mogadishu, while fish prices ranges So Sh 4.50-6.50 per kilo depending on species (Haakonsen 1980). When monsoons are intense in the summer the demand for fish becomes very high and the price of 1 kilo of fish rises to So Sh 20 in the black market indicating that fish is becoming more acceptable. All these problems discussed in earlier sections associated with preservation, processing, and transportation are limiting the consumption of fish by the coastal communities and the introduction of it to inland markets. Without preservation facilities the fish spoils quickly in the hot temperature of Somalia which most of the time is above 30°C at the coast. As a result

the fish becomes inedible shortly after capture. Except for the cooperatives closer to the bigger towns, these problems prohibit them from marketing fresh fish. In the north and northeast cooperatives are located close to rich fishing grounds and are connected to the probable local market with long rough roads. If preservation facilities are provided to these cooperatives, transportation has to be by sea. FAO (1978) gave the following recommendation: "Road Communications are extremely difficult and some do not exist. Villages such as Eil are extremely isolated and marketing of produce is a serious problem. Since the development of a network of roads is a long and expensive process, a quicker alternative would be a system of carrier boats suitably equipped with refrigerated holds which could call at these villages. Periodically to collect the fish for marketing in the urban areas such as Mogadishu or for export." Sea transportation also is not easy as the natural harbors and ports are few in that region, but less costly than a road system. The cooperatives in Ras Kismbone, Brawe, and Ceel Axmed have better access both to the local market and ports. The Ministry of Fishery has provided refrigerated trucks to Ceel Axmed and Braawe to transport their fish to Mogadishu. The Japan International Cooperation Agency has offered to assist these cooperatives in setting up preservation facilities and to organize a domestic market structure. In the North, Berbera fishing cooperative has a potential domestic market. It is connected to both Burco and Hargeisa with paved roads and can supply both of them with fresh fish if the preservation and transportation facilities are provided. The Russians were planning to provide these facilities before the collapse of their relationship with Somalia. The Ministry of Fishery has to

assist the cooperative in the installation of these facilities and the development of the market. Berbera used to supply Hargeisa with one tonne of fish per day before the breakdown of Berbera ice making plant (FAO 1979).

The fish which most of the cooperatives produce are salted and dried. Somalfish had a monopoly on the marketing of that fish from the cooperative until September 1980 when the coastal development project was given control over the marketing of the dried fish. The cooperatives feel that the price which the government agency pays for their fish is very low. The price is So Sh 3.50 per kilo, no matter how good or bad it is. This fixed price besides being low, has provided little incentive for the fishermen to catch high value species and to improve their fish handling and processing techniques to produce high quality end products.

The dried fish is exported to East Africa and the Middle East. Somalfish exported 5,480 tonnes in 1975 (FAO 1979). In the recent year Somalfish has had a problem in marketing the fish and there is no significant increase in dried fish exports. Haakonsen (1980) suggested that it may be advisable to let local merchants handle the export marketing as many have trade connections with the Middle East and Kenya and expressed interest in getting involved in fish marketing. Market study and assessment are needed for dried fish as well as fresh fish.

Somalfish exported about 10-20 thousand tonnes of frozen spiny lobster and finfish yearly from 1973 to 1977 to Europe and East Africa. When Somalfish was jointly owned by the Somalis and Soviets it has no problems in marketing the fish as most of the fish was bought by the Soviets. The Soviet trawlers were also well equipped long range trawlers.

The new Somali fishing fleet faces problems as the land based facilities are poorly developed, including ports and preservation facilities. Where the catches of the new fleet will be marketed is not known but the Middle East, Kenya, and Mauritius are potential markets.

GOVERNMENT POLICY

Government policy gives high priority to the development of fisheries. In the current three-year plan, 1979-81, the government defined its fishery policy as follows:

1) To attain economic growth through utilization of the fishery resources.
2) To maximize fish production and the income from it.
3) To increase foreign exchange earnings through greater export of fish products.
4) To improve the socio-economic conditions of the people in general and fishing settlements in particular.
5) To create gainful employment for the greatest number of people that a viable fishing industry can sustain.
6) To increase the domestic consumption of fish as food.

The goals of the government policy are fisheries to provide food, employment, and foreign exchange. In achieving these objectives both labor and resources have to be mobilized. Artisanal fisheries which are labor intensive and industrial fisheries which are capital intensive have to be equally developed. The Ministry of Fisheries and its affiliated agencies are responsible for achieving these objectives. The Ministry of Fisheries was established in 1977 as a separate Ministry under the following directives:

1) To formulate the fishing program of the party.
2) To build up a socialist maritime economy.
3) To obtain benefits from marine resources.

4) To improve the gear and the other materials of the cooperatives.

5) To develop a program to make the coastal settlements self-supporting.

6) To organize and operate all the maritime schools.

7) To organize fishing supporting industries such as boatyards, and to make new types of vessels.

8) To construct technical infrastructure such as ports, and cold storage.

9) To build a sea fishing fleet.

10) To disseminate information on the preparation and consumption of fish.

These directives are very general and vague. Well defined policy and more explicit laws are needed for fisheries development and management. The above directives, unless explained with more detail, can cause confusion among different ministries. Directive 2 gives the Ministry the power in building up a socialist maritime economy. At the same time the Ministry of Marine Transport and Ports has been given the same responsibilities. Similarly directive 3, 4, 6, and 8 makes the functions of Ministry of Fisheries overlap with those of the Ministries of Mineral Resources, Education, and Union of Somali Cooperative Movements (USCM).

Since its establishment the Ministry of Fisheries has been exercising all the functions related with fisheries development and management without explicit law. The six departments in the Ministry are:

1) Fishing Cooperatives Development.

2) Financial Administration.

3) Fisheries Research.

4) Fisheries Industrialization.

5) Manpower and Training.

6) Planning.

The Ministry has more than 300 established positions and less than half of these are filled (Christy 1980). The Departments of Planning, Research, and Fisheries Industrliazation are not active mainly due to lack of skilled personnel.

The Coastal Development Project established in April 1977 is a semi-autonomous entity under the supervision of the Minister of Fisheries. The responsibilities of the project are to provide technical assistance to the fishing cooperatives and to develop coastal infrastructure for fisheries activities. The Project employs about 450 staff and is organized into the five departments of Construction, Social Affairs, Administration, and Fisheries and Transportation. At this time, the project has its main operation at the four resettled fishing cooperatives at Bedey, Cadale, Ceel Axmed and Braawe.

Somalfish was originally founded as a joint venture between the Somali Ministry of Fisheries and Marine Transportation and the Soviet Ministry of Fisheries, but now it is owned by the Somali Ministry of Fisheries. The company is engaged in the management of the national fishing fleet which is also owned by the government.

LEGISLATION

There are no separate laws to provide a basis for the development of policites and management of fisheries under the new ocean regime but there are a number of laws affecting activities in the fishing sector.

Basic fisheries legislation is contained in the maritime code of 1959. The maritime code makes a distinction between major and minor fishing activities. The major fishing activities include all those carried out by fixed gear or large nets, including trawling on the high seas using any propelled vessel. Minor fishing includes all the rest. The major fishing activities conducted by Somali or foreign nationals may only be conducted pursuant to concession. The concession is nonexclusive permission to fish in a specified area (which must be 500 meters beyond the shore). Where permission is granted for trawling over large areas, adequate preservation and processing plants must be established on shore. Concessions are subject to payment of annual rent determined according to the nature and value of the concession. Concessions may be revoked at any time the public interests require and they may be cancelled for reasons attributable to fault of the concessionaire, in which case no indemnity is due. Minor fishing activities require an annual license issued by the maritime authority.

No regulations concerning fisheries have been made under the maritime code. However, the several fishing permits issued to the Italian trawlers tacitly fulfill the role of concessions under the code. These permits allow specified vessels to fish in Somali waters for periods of one year. The licensee is required to land 20% of catch for

the Ministry of Fisheries or to pay the equivalent value in cash. The vessels are required to carry a 50% Somali crew. The licensee is required to radio daily reports as well as to maintain and permit inspection of ships, fishing logs, and other records.

The limits of the territorial sea are set (law No. 37 of 1972) at 200 nautical miles and fishing in the territorial seas is reserved for vessels flying the Somali flag and other authorized vessels.

There are several other laws relevant to fisheries. The law on cooperative development in Somalia (law no. 40 of 1973) provides for the formation and organization of cooperatives in all sectors of the economy including fisheries. Law no. 26 of November 1961 for exemption from custom duties of imports for establishment or expansion of industrial and agriculture enterprise, etc. Foreign investment law no. 7 of 1977 encourages establishment or expansion of production enterprises including agriculture, fisheries, and agriculture.

The Somalia fisheries legislation contained in the maritime law is of little use for present fisheries management and regulations so the need of separate explicit fisheries management law is emminent.

MANAGEMENT

The objectives of the Somali Government policy on fisheries development are to maximize fish production and income from it consistent with a sound fishery plan (Christy 1980). These objectives consider both the input or cost and the output or revenue. As the country is not endowed with other natural resources, the policy makers view the fisheries as a source of food, employment, and earner of foreign exchange in the future.

In the recent years the Government denoted considerable effort to attaining these goals. About 15 thousand nomads were resettled at the coast as fishing cooperatives. This resettlemtn program is to increase the utilization of marine resources by local residents. The commercial fishing industry has also been built up to increase the exportation of fish for foreign exchange. Moreover, foreign vessels have been issued permits to fish in Somali waters, to pay rent, and provide employment to Somali nationals. The factors which are initiating the development of fisheries in Somalia are the current need for food, employment, and hard currency and the belief that the Somali coast has potential fish resources.

Despite the fact the Government mobilized both resources and manpower to develop fisheries, Somali fisheries still remain in an infant stage. The present data indicate the catches are well below the potential sustainable yield. The annual catch is about 30,000 tonnes (~~1978~~ FAO 1978) while the combined potential annual yield is roughly estimated at 1 million tonnes.

Gulland and other fisheries exports noted that management and development of fisheries should be considered as integral parts of the same process. As learned from previous experience of overexploited fisheries, the earlier the management plan is developed and implemented the better. At later stages of development when catches reach a level beyond the limit which the stock can sustain, the management measures become more costly, difficult, and problematic. Just to emphasize the same point, there is always a tendency in all administrations to wait until the painful level is reached. That is true also with Somali fishery administrators. So far there is no separate law or act relating to fishery management. The only law which concerns the regulation of fisheries is contained in the "old maritime law" which is discussed in previous sections. It is not yet too late to develop a fisheries management and development plan. The plan has to be realistic. It is not necessary that the plan be costly and complex. Gulland (1974) noted: "The difference between taking no management action and taking quite a simple action may be large (in extreme cases, the life or the death of the fishery) and the benefit from such action will greatly exceed the cost including the costs of data collection. Some of these actions, even though they are not always simple, include the collection of information about the resources and about the performance of the fishery. As an example, effectively organized collection of catch and effort data can provide fishery administrators and managers with very important information on which to base decisions. Somali fishing is centrally planned and the Ministry of Fisheries is the main agency responsible for administration and management. The fishing cooperatives are not independent from the

Ministry as it provides them with technical and financial assistance. The Ministry also issues fishing permits. In that case it has effective leverage to impose management measures on the artisanal and industrial fisheries. At this stage the Ministry has to put effort into assisting the cooperatives improve their catch record and report to the Ministry periodically. The data recording has to be standardized in all the cooperatives and they have to give more data than they do now. The Department of Fisheries Research has to formulate a method of data recording for the cooperatives. Even though the foreign vessels by concession are to report their daily catches to the Ministry, it must be in a form useful to policy makers and managers.

The major management oriented steps taken by the Ministry of Fisheries so far include the establishment of the Fisheries Research Department and the formation of a licensing and taxation policy on foreign vessels.

Much is not known about the different fish stocks in Somali waters, but the management of migratory species and those which may extend to the waters of neighboring countries as well as to the high seas beyond the 200 mile limit under Somali jurisdiction need international and regional collaboration. So far Somalia does not have any reciprocal fishing agreement with the neighboring countries of the Republic of Jabouti, Peoples Democratic Republic of Yemen, and Kenya. Such an agreement is particularly needed with South Yemen about the managment of coastal small pelagic fish in the Gulf of Aden and the Indian Ocean. It is also equally important for Somalia to play an active role in regional and international fishing commissions including Indian Ocean Fisheries Commission, Committee

on Tuna Management, Near East Fisheries Commission, and the Cooperative Investigation in the North and Central Western Indian Ocean (CINCWIO) which is initiated by the Intergovernmental Oceanographic Commission (IOC).

The development of an unmanaged fishery is explained in a simplified way with stop-light analogy by Gulland (1974). Green, when greatly increased catch can be taken from the resources; yellow, when the limit of the productivity of resources is being approached; and red, when the resources are fully exploited. The yield curve depicts that (Figure 12a). At the bottom left corner of the curve, the catch increases with the fishing effort and therefore fishing could be expanded, but at the top, the total catch reaches maximum; any further increase beyond that point will actually decrease the total catch and, therefore, the output.

If catch data as well as fishing effort data are collected and assessed adequately, the fishery status could be followed and regulations can be imposed accordingly, considering also the other variables related to fisheries.

Some other information which can provide guidance to fisheries development can be derived from a yield curve (Figure 12b). This figure shows where the net economic yield from the fishery is maximum. The marginal yield, the value to the fishery as a whole, is high initially but declines rapidly as fishing increases. At some point the marginal yield will be equal to the cost of the effort and adding extra effort probably will not increase productivity. This is the point where net economic yield is maximum. Any additional amount of fishing will cost more than the increase in the total value produced by the fishery and therefore not be worthwhile. The fisheries manager also has to consider the social aspect in his plan of economic yield maximization.

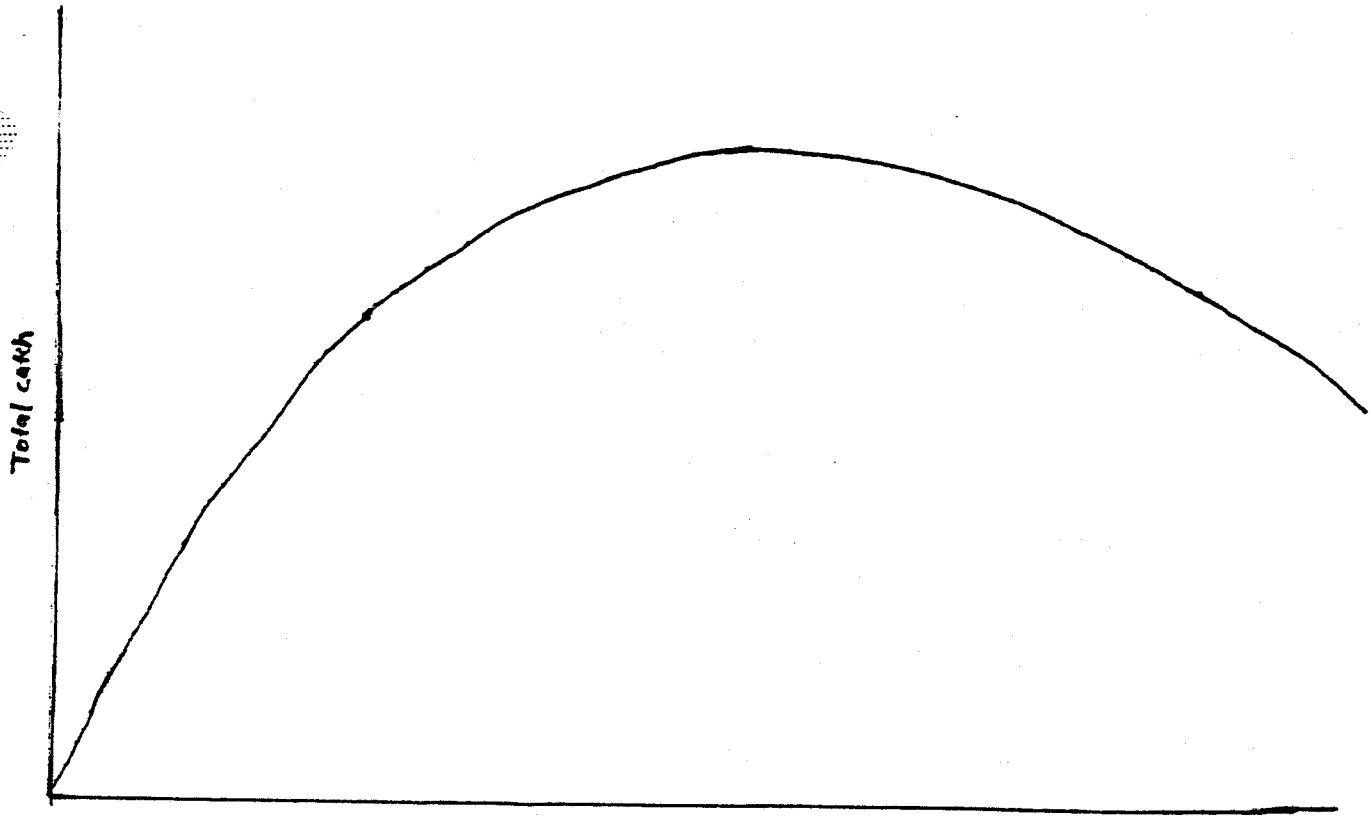


Figure 12a. Amount of fishing effort.

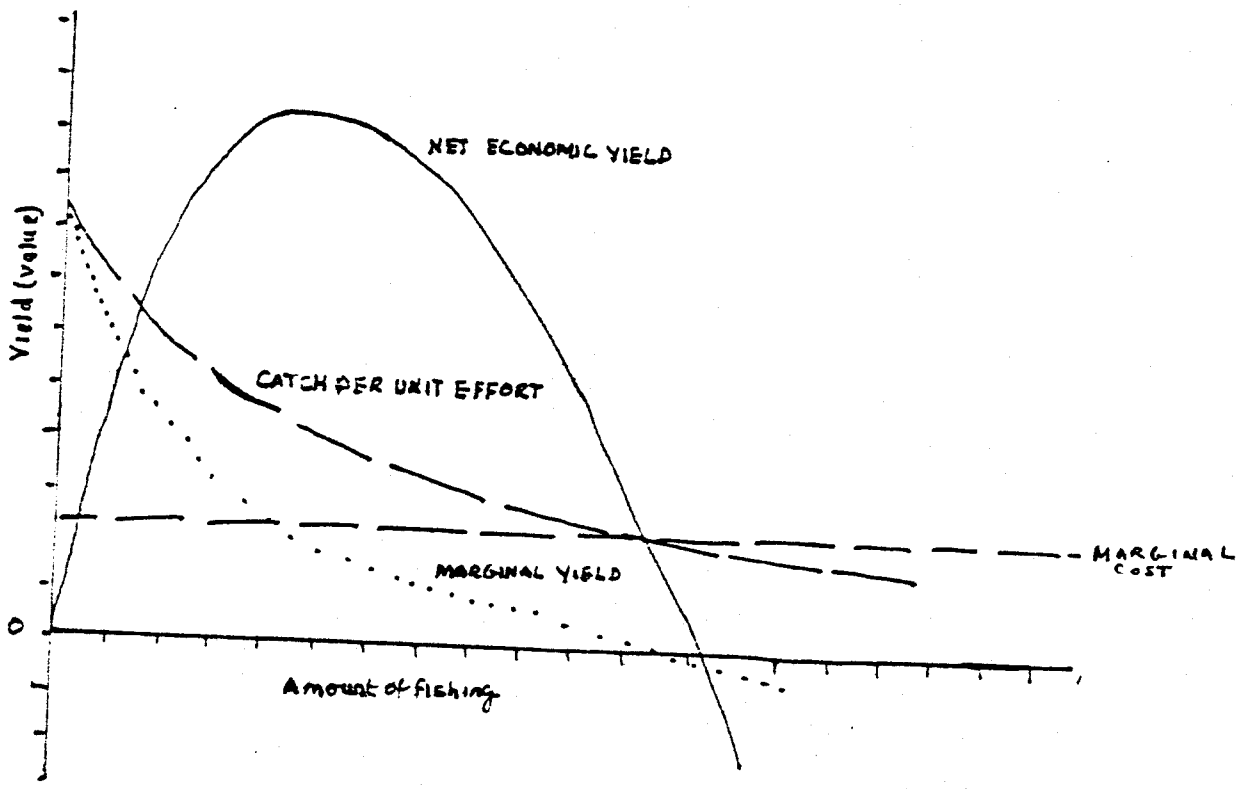


Figure 12b.

In Somalia the regulatory actions taken to date have been through license limitation. Actions like gear restriction, closed areas and season, control of effort and capacity, allocation of quota, and other restrictions of efficiency have not been used. Most of these restrictions are not appropriate at this stage, except for some cases where local overfishing may take place. It is likely that expanding industrial fleets may concentrate on particular areas and certain species like spiny lobster and shrimp. Special attention should be given to such cases at the appropriate time.

RECOMMENDATIONS

Stocks of small pelagic fish off the northeast coast of Somalia, large demersal fish, tuna-like fish, deep and shallow water spiny lobster, shrimp and turtles should be assessed by Somalia for the purpose of utilization and management in collaboration with international organizations and interested nations and universities.

The extent, productivity, of mangroove swamps in southern Somalia as well as their importance to the coastal ecosystem should be surveyed and studied for management and conservation.

A detailed and explicit fisheries development plan should be formulated for fisheries by the Ministry of Fisheries in collaboration with the Ministry of Planning and the National Academy of Science and Art.

Somali fisheries should be developed with sound management and development plan, as the present catch is well below potential harvest level.

Fishing vessels, gear, and other machinery appropriate to Somali conditions should be selected with assistance and guidance of international organizations and developing countries like India and Pakistan which have been fishing traditionally in the Indian Ocean.

Ports, harbors, preservation and processing facilities should be developed and improved through bilateral arrangements to facilitate the development of both artisanal and industrial fisheries and increase the feasibility of Somali-based fishing operations.

As the road system in most of the fishing areas is poorly developed a system of carrier boats should be explored to collect the fish from these areas to the market and ports.

Local and export fish markets should be developed particularly in the neighboring African and Arabian countries.

The potential advantage of fishing cooperatives should be more clearly developed and explained to stimulate larger and more active participation in them for mutual benefits.

Quality control measures should be introduced both in handling and processing of fish and fish products, as the quality of fish is the most fundamental factor in marketing and is in need of significant importance.

Fisheries management law should be developed as a part of the fisheries development plan to maintain the fishery at or below its sustainable yield.

A system for collection of statistics on catch and effort and method of data assessment should be introduced and put into effect by the Ministry of Fisheries in collaboration with the Department of Statistics in the Ministry of Planning and the international organizations.

Local fisheries officers should be trained in collection and analysis of diverse data necessary for effective management decisions.

The fisheries management act should contain provisions regulating foreign and domestic fishing vessels by defining the vessel numbers and characteristics, the area and the other terms of access.

Offenses should be defined clearly in the management law and enforcement power granted.

It is recognized that much needs to be done in many respects but it is important to start by developing priorities and getting on with doing something.

It will take much time, effort, coordination and cooperation but that should not deter a meaningful start on a broadly based, soundly developed comprehensive program.

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