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SRI LANKA

Status Paper on Coastal Fishery Resources

by

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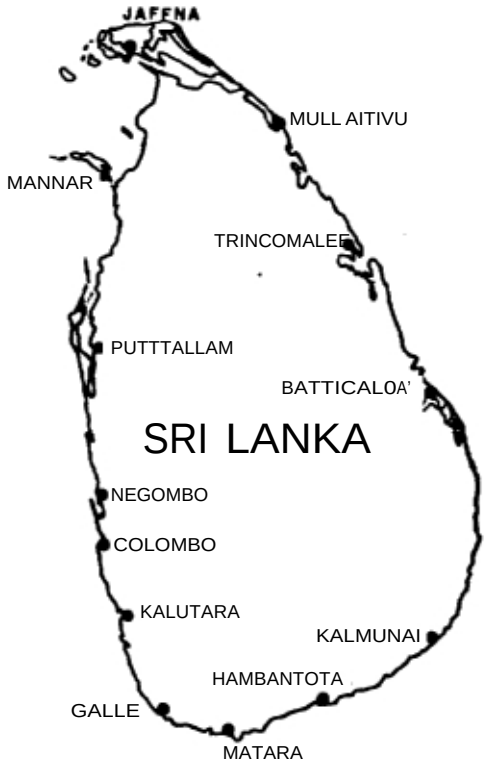

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1. Introduction

Sri Lanka is situated in the Indian Ocean, south east of India, between latitude 6-10 degrees North and longitude 80-82 degrees East (Fig. 1). The coastline is 1,1 00 miles in length. Fishing takes place all round the coast. It is concentrated primarily within the continental edge, which is an area rarely extending beyond 25 miles, and averaging 14 miles in width. In this area, there are good resources of pelagic and demersal species with an annual sustainable yield of 250,000 tons (Saetersdal and de Bruin, 1979). In the offshore and deep sea fisheries from the edge of the shelf to the boundary of Sri Lanka's EEZ, the fish are mainly large migratory pelagic species. There is a further substantial fish resource available in this area. There are 344,000 acres of inland tanks and reservoirs and 300,000 acres of brackish water lagoons, estuaries, and mangrove swamps available for stocking and harvesting fish. The potential annual yield from these resources depends on the intensity of fish stocking but the harvest could be raised to 50.000 tons.

The fisheries sector in Sri Lanka has a relatively high importance in the economy compared to that in most countries. The total value added by domestic fish production to the GDP in 1978 was Rs. 69.9 million. Total full-time employment in the fishing industry is 79,000 persons. There is a further considerable number of part-time employees. The industry supplied a substantial proportion of the animal protein consumed by the population in 1978. Fish exports were valued at Rs. 233 million, while fish imports were valued at Rs. 34 million.

The bulk of the fish production in 1978 came from the coastal fishing fleet. About 65,000 persons were employed by this fleet, which comprised 23,000 vessels of less than 32 ft. in length, 7,000 of which had inboard or outboard engines. The production of this fleet was 135,000 tons representing 87% of the domestic fish supply. This represented 52% of the potential sustainable yield. Fishing activity was relatively intense in Negombo, Puttalam, Mannar and Jaffna districts where about 50% of the marine fish catch was taken. The resources on the east coast were more lightly exploited. Drift netting was the major method used by nearly 50% of the vessels. Shore seining, cast netting, handlining, trawling, pole and lining and long lining were other popular methods.

Despite the rising total income and output of the coastal fishing sector, most fishermen still suffer from primitive living conditions and relatively low income which inhibit savings and investment. About 16,000 tons of fish, 10% of the domestic fish supply in 1978, came from inland waters. Many of the fishermen in this fishery are seasonal migrants from coastal areas. Over 1000 non-mechanised boats of traditional design are used in the harvest. Most of them use gill nets. There are also a substantial number of fishermen who fish from the edge of the tanks using cast nets. The living conditions and incomes from the inland fishermen are worse than those of the coastal fishermen.

Domestic fish production in the offshore and deep sea fishery was only 3,000 tons. The small catch was due to the small number of domestic fishing vessels capable of operating in deeper waters. Most of these operated at below capacity either because they were very old and suffered frequent breakdown or that they were very new and suffered teething troubles. Nevertheless, after the introduction of new 38 foot boats under the South West Coast Fishery Project, the results have been encouraging and substantial catches have been landed.

2. Fishing Grounds

Several research programmes have been conducted by the Ministry of Fisheries to locate fishing grounds for tuna, prawns, lobsters, baits and demersal fish resources. The results of the above work are briefly described.

2.1 Tuna and Shark

Sivasubramaniam (1969) discussed the distribution of predatory pelagic sharks in the tuna grounds in the Indian Ocean. His conclusions are as follows:

> The pattern of distribution of tuna and shark species arrived at earlier has been confirmed. There is a notable decline in the number of species of sharks and other varieties in the catches made in the fishing grounds south of 30ºs. The number of shark species appearing in the long-line catches in the equatorial region declines towards the higher latitudes of the south and north.
>
> The mackerel shark *(Lamna litropis)* appears in the catches from grounds south of 30ºS, the lancet fish *(Alepisaurus borealis)* appears in the long-line catchesfrom all latitudinal ranges but probably more frequently in the latitudes of the south. In the central part of the north — equatorial region *Lamna falciformis* has the highest 'density of distribution for any shark species in the tuna ground of the Indian Ocean.

Sivasubramaniam (1975) states that of the estimated annual production of 100,000 tons of fish, skipjack tunas contribute about IO-12% which comes mainly from the drift net fishery. The potential for increased production is expected chiefly from the surface and sub-surface tunas, marlin and shark resources in the offshore and oceanic ranges.

2.2 Prawns

The Fisheries Research Division of the Department of Fisheries undertook surveys of the seas and lagoons of Sri Lanka during the last 20 years with a view to ascertain whether any unexploited resources of prawns existed. Untapped prawn resources were located at the north of the island, a new fishery ground between Kachchativu and Rameswaram temple, and a narrow stretch of prawn ground from Pesalai at depth of 3-5 fathomextendingalong the Palk Strait up to Dhanuskodi Point. A new resource was also located south-east of the Mullaithivu Light House at depths 8-12 fathom stretching southwards to a point west of Pullimoddai. The above findings are reported in the bulletins of the Sri Lanka Fisheries Research Station (De Bruin, 1965, 1970 and 1971). The narrow coastal stretch extending from Colombo to Chilaw at depths of 3-10 fathom is a prawn ground that has been used for a long period of time.

2.3 Spiny Lobster Resources

Investigations into the resources of spiny lobsters in Sri Lanka waters were first begun in 1958. Initially it was carried out at night by skin-diving surveys of sand-stone and rocky areas. Lobster traps of different designs were introduced later. These investigations revealed lobsters in large concentrations especially on the south-west, south and west coasts (De Bruin, 1960, 1962 and 1969). One of the most productive areas discovered during later surveys was the sand · stone reef lying at depths of one foot to six fathom between Galle Buck, Light House and Mount Lavinia Hotel (De Bruin 1962). Fishing in a restricted area of 52,000 sq.ft. for two consecutive years, six months per year and seven days per month, showed no effect on the modal or mean carapace length of the population or on the average catch per day. The total catch for this period was 8,000 lobsters, the average catch in two hours by two skin divers being 50 lobsters. This indicates that the maximum sustainable yield for this area is over 8,000 lobsters or approximately 8,000 lbs (De Bruin, 1962).

2.4 Bait Fishing Grounds

According to a live bait survey carried out by the vessel *Hingura* very good catches of live bait varieties were found in the north east, west, east and southwest coasts. The above survey and another survey by the vessel *Kosei Maru* showed that most of the bait species were concentrated in the belt between 4-15 fathom around the coast and the pelagic types, such as the sardines, showed a wider scatter within this belt than some of other types such as the red bait which showed definite concentration between 6-10 fathom range (Sivasubramanian, 1977).

2.5 *Demersal Fish Grounds*

(i) Wadge Bank

In 1967, it was estimated that 15,000 tons of good quality fish could be harvested each year by trawlers operating on this bank. It was suggested that 20 trawlers similar in size to the ones being operated by the Ceylon Fisheries Corporation, namely, 110 ft. in length and 238 tons in weight, could exploit this resource.

More recently in 1972, the survey carried out by the Russian research ship SRTM *Optimist* (500 GRT) was able to show that 5-6 trawlers of that class could operate on the Wadge and Pedro Banks to bring in 10-15,000 tons of fish annually.

(ii) Pedro Bank

The quantity of fish that could be taken annually from Pedro Bank was estimated to be 2,600 tons as seen from the report on the survey carried by *Optimist.*

(iii) Deep Water Trawling

In *1972, Optimist* carried out a series of deep water trawling outside Sri Lanka's territorial waters. Such trawlings were limited as only a very small part of the continental shelf lies outside Sri Lanka's waters. Accordingly bottom trawling was only possible in the Gulf of Mannar at latitude 8°31' and on the continental slope in the south of Sri Lanka.

Generally such trawlings were carried out at 200-350 metres depth from where several species of fish were taken. Many of them were of no established commercial food value and could be used only for fish meal. No estimate was made of the quantities of fish available in these deep waters. In addition to fish, several species of deep water crustaceans, spiny lobsters, shrimp and crabs were also found. While the lobsters and shrimps are of commercial importance, the crabs in these deep waters could only be used for production of fish meal. No estimates of quantity of these varieties were made.

(iv) Small boat trawling in coastal waters

Since 1953, surveys have been carried out to determine the feasibility of conducting small boat trawling in coastal waters. These surveys along with the mechanisation of the indigenous crafts and the introduction of mechanised boats for coastal fishery has paved the way for coastal trawler operations in the southwestern, north-western and northeastern coastal waters. Catches have been found to be encouraging particularly in Palk Bay where the yield for one hour's trawling varied between 200 and 500 kg. Small boat trawling could be profitably carried out in the northeastern area going right up to the Pedro Bank and even exploiting the shallower area of the Pedro Bank proper.

(v) Handlining for Ground Fish

There are areas in our continental shelf, where trawling is not possible even by small trawlers due to the nature of the sea bottom. In such areas, handlining could be conveniently carried out. A specific area in the southeast sector of the island includes the waters around the Little and Great Bases light houses. The JAMARAC (Japan Marine Fishery Resource Research Centre) survey in 1975 indicated unexploited resources of breams and flame snappers, thirty or more miles from the shore in the northeast coastal sector. The survey also highlighted the presence of demersal fishes around the edges of the continental shelf in the southern waters of the island.

3. Census of Fisheries

The first census of fisheries was conducted during the months of October, November and December 1972, on the primary features of fish production, fishing households, fishing man-power, fishing effort, fishing craft and gear, etc. for the purpose of: *(i)* clarifying the structure of the fishing industry as basis for the formulation of fishery development plans, and *(ii)* providing a

suitable frame for designing a continuous sample survey for the measurement of fish production, fishing effort and other current fishery statistics. The census covered all fishing or fish processing households in the entire marine sector including brackish water fisheries of the country and in the fresh water fishery region, 23 major irrigation tank areas where fishing is of commercial importance.

The census in marine areas was planned **to be** carried out in three stages namely:

(i) Identification and listing of fishing and fish processing household so as to provide the necessary frame for the census.

(ii) Complete enumeration of fishing households listed in a fishing village to obtain basic data relating to the number of fishing households, fishing population, ownership and type of fishing crafts and gear in use, type of participation in fishing and fishing grounds and source of income and

(iii) Sample enumeration of selected fishing management units and fishing partner and labour households to obtain additional data relating to fishing activity and socio-economic conditions of the fishing population. A total of 104 fishing villages was selected for this purpose.

The Ceylon Fisheries Corporation, being a government owned enterprise was excluded from the census. Arrangements have already been made to conduct the second fisheries census during the latter part of 1980. The following basic data were obtained from the census of fisheries — 1972 (Preliminary report, Census of Marine Fisheries, 1972).

Table 1

Number of Fishing Villages by Size

Size (households)		No. of villages	No. of fishing or fish processing households
Small	(1-19)	497	3,939
Medium	(20-99)	352	16,029
Large	(100 and above)	120	23,684
	Total	969	43,652

Table 2

Fishing and Fish Processing Households

Category	No. of Households
Fishing only	43,194
Fishing and fish processing	3,075
Fish processing only	83
Total	46,352

Table 3

Number of fishing crafts used by type, both mechanised and non-mechanised, with percentages in brackets

Type of craft	Total	Mechanised	Non-mechanised
(a) Introduced Crafts			
(i) 3½ ton boats	1,859	1859(100)	—
(ii) Fibreglass boats	***874***	***874(100)***	—
(b) Indigenous crafts			
(i) Planked	***2,474***	***106(4.3)***	***2306(93.2)***
(ii) Dugout with outrigger	***7,189***	***259(3.6)***	***6930(96.4)***
(iii) Dugout without outrigger	1,155	57(4.9)	1098(95.1)
(iv) Lografts	6,015	1896(31.5)	***411 9(68.5)***

Table 4

Number of fishing management units by major type of gear used with percentage in brackets

Type of fishing gear	No. of fishing management units
1 . Gillnet	9,648(42.9)
2. Cast net	***5,700(25.4)***
3. Hook and line	***2,506(11.2)***
4. Stationary gear	***2,371(10.6)***
5. Seine net	1,658(7.4)
6. Shrimp drag net	***504(2.2)***
7. Trawl	***75(0.3)***
Total	***22,462(100.0)***

4. Methods of Exploitation

There are mainly two types of indigenous crafts operated in the coastal waters. They are :

(i) ***ORUS*** and ***(ii) TEPPAMS.*** ***Orus*** can be further classified according to their sizes, namely, small and large or bala oru. Different techniques are used by different types of crafts and are briefly described below.

4.1 Simple hook trolling line

This method of fishing is principally adopted by small ***Orus*** that are operated on surface or little below the surface by 3 to 4 trolling lines. The principal species caught are Seer fish (Scomberomorus spp;) Mackerel Tuna (Eughymus affinis or attavalla) Frigate Mackerel (Auxis thazard, Auxis rochei or Ragoduwa), Skip-jack Tuna (Katsuwonus pefamis or Bafaya), Yellow Fin Tuna (Thunnus albacares or Kelawalla) Horse Macekrel (Carangidae or Paraw). Queen fish (Chroinemidae or katta), and Sharks (Carcharhinidae or mora).

4.2 Multiple hook trolling line

This method of fishing is a special device to catch many fish at a time from a single school. The main species caught are Mackerel Tuna and Frigate Mackerel. This technique is mainly used by small *Orus.*

4.3 Pole and line with barbless hooks

The large type of *Orus (Bala Orus)* use this technique to catch skip jack tuna. They operate around continental edge or near oceanic waters. The operations commence after capturing the bait fish, *Dipterygonotus leucogrammious* (Red Bait or *Hingura).* This is a seasonal type of fishing.

4.4 Various methods are used by *Teppams* or long-raft to catch several varieties of fish. Sharks and skates are caught by bottom set net. Indian Mackerel *(Kumbalawa),* Indian Herrings *(Hurulla)* and Sardines *(Salaya)* are caught using small meshed drift net.

Many of the *Teppams* were replaced by 17-18 ft. fibreglass boats with outboard motors. Small meshed gillnets are used by these boats.

Orus have been replaced partly by 17-18 ft. and 28 footers. Some of the 17-18 footers use large meshed gillnets and this method is also seasonal.

The 28 footers originally used floating long-line and caught Marlin *(Koppara),* Sail-fin (Thala-patha), Yellow Fin Tuna *(Kelawalla)* Big eye Tuna (Asgedi Kelawalla) and Shark. The catch decreased mainly due to bait problem and thus these boats became uneconomical. Today a few boats are operated off Negombo, Beruwala and the south coast. This technique is also used during the height of the season for these fish.

Now the major fishing gear used by these vessels is the large meshed gillnet to catch Mackerel Tuna, Frigate Mackerel, Skip jack Tuna, Yellow Fin Tuna, Sharks of various species and Marlin.

Sivasubramaniam recently studied the average catch per set of 30 nets for six centres, and it was revealed that the 28 footers do not use more than 20 nets. Furthermore, it has been noted that catch rate for 30 nets has been halved and this indicates a shift in abundance. It should also be noted that size of all species has reduced to a great deal indicating that the lowered catch rate may be due ta fishing.

4.5 Shore seining — (Madel a)

It is a common gear operated from a 20-30 feet long, wide flat bottomed boat known as Madel *Paru.* The nets are manually operated, the operation being paddling the boat with this net out to sea, shooting the net and then hauling the net on to the shore.

This method of fishing can be successfully carried out only in calm waters. The operation is also limited to a radius of 1 to 1½ miles from the shore where the bottom of the sea has no sharp rocks or other obstacles (De Bruin, 1977). The species of fish caught are small varieties such as Herrings, Indian Mackerel, Sardines, Silver Bellies and juveniles of larger species such as Horse Mackerel, Queen fish, Travelly, Spanish Mackerel, Mackerel Tuna, Frigate Mackerel, Sharks and Skates. The following table gives production data from 1975 to 1979, from shore seining.

Year	Production in tons
1975	4946
1976	7644
1977	8179
1978	7263
1979	8822

Although total landings from beach seines appear to be high, it is not a very efficient form of fishing, considering the large number of people employed in a single operation and that the catch per man-hour is only about 8 lb (De Bruin, 1977).

5. The fish production for different varieties for the years 1973 to 1979 is given in Appendix 1 (a) to 1 (g) and the number of different fishing crafts for the years 1977 to 1979 in Appendix II.

6. Resources Surveys

Several research programmes have been conducted by various national and international agencies in collaboration with the Ministry of Fisheries. Following is a brief description of the above work.

6.1 *Survey by Fridtjof Nansen*

In an agreement under the general programme fcr development cooperation between the Governments of Norway and Sri Lanka, the services of the fishery research vessel "Dr. Fridtjof Nansen" were made available to Sri Lanka for a period of 1½ months during August to September 1978. During the period of 16-22 August, the vessel undertook a survey of the NW coast of Sri Lanka. The task in this area was to map and study more closely the deep water trawling grounds for lobster and shrimp located in 1972 in the Gulf of Mannar. During the subsequent period from 3 to 20 September, the coastal shelf from Colombo southwards and around the island up to and including the Pedro Bank was covered.

During the final part of the survey, from 22 to 27 September, certain parts of the shelf area on the south west and west coasts were covered in more-detail. Theoverall objective of thesurvey was to describe and assess the demersal, semi-demersal and pelagic resources available on the Sri Lankan coast, principally over the shelf banks. Because of the extreme shallow waters of the Palk Bay and Strait, these areas could not be included.

The study mainly covered the following:

(a) Bottom conditions

(b) Hydrographic features

(c) Fishing grounds

(d) Estimate of fish biomass

A summary of the findings of the above survey is given below :

(i) Observations on the type of bottom confirmed the previous findings that areas of good trawling grounds are limited, mostly to the shallow inshore parts of the shelf and the shallow northern area.

(ii) Hydrographic observations enabled a description of the water masses along and on the continental shelf, the depth of the thermochine and the oxycline. The content of dissolved oxygen below the oxycline was, in most cases, around 1 ml/l. In this environment, significant quantities of commercial types of fish were not available.

(iii) Invastigation of the deep sea trawling ground in the Gulf of Mannar was carried out. Trawlable area was located and mapped, but found to be rather limited in extent, only about 2 by 6 nautical miles. Catches comprised deep sea lobsters, deep sea prawns and deep water fish, in the approximate ratio 1:3:8.

(iv) According to the echo records, different types of resources were identified. The two most important were (i) demersal and semi-demersal large fish such as snappers, groupers, breams and travellys and (ii) smaller pelagic schooling fish such as scads, sardines, silver bellies etc.

Based on acoustic survey preliminary estimates of total biomass in some areas of Sri Lanka, as made by this vessel, are as follows:

Area	Biomass in 1000 tonnes	Bank area inside 100 fathoms (nm^2)	Type of resources
(1) Negombo Galle	220	1,350	Mostly demersal and semi-demersal
(2) Hambantota	100	940	Demersal with some small pelagic
(3) East Coast	120	1,300	Pelagic and demersal
(4) Trincomalee to Mullaitivu	50	500	Mostly small pelagic
(5) Pedro Bank	30	1,020	Demersal and pelagic

6.2 Exploratory Fishing under the Colombo Plan 1955- 7960

6.2.1 The Department of Fisheries had already carried out experimental fishing with other types of gear such as trawls, bottom long lines, drift nets, shark lines, hand lines, troll lines, and lift nets with light attraction, in collaboration with Canadian fisheries biologists under the Colombo Plan.

A summary of the results of the operations using two 45 ft. wooden Canadian boats, "North Star" and "Canadian" are as follows :

Table 5

Average catch per man-hour for gears used by "Canadian" and "North Star" from April 1, 1955 March 30, 1957
Operations by M.F.V. "Canadian"

Gear	Catch (lb)	No. of man hours	Catch/man- hour
Otter trawl	10,207.00	1223.2	8.3
Mid-water trawl	8.00	28.0	0.3
Gillnets	1.762.00	2041.5	0.9
Hand lines	2,965.00	521.5	5.7
Troll lines	2,533.00	2816.6	0.9
Ring net	285.00	16.4	17.4
Lift net	18,941 .00	224.4	77.5

Average catch per man-hour from April 1, 1955 – March 30, 1957
Operations by M.F.V. "North Star"

Gear	Catch (lb)	No. of man-hours	Catch/man-hour
Bottom long line	48944	2427.9	20.2
Shark line	17844	417.6	42.7
Drift line	1023	109.5	9.4
Hand line	1075	207.6	5.2
Troll line	1868	1624.4	1.1

According to the results the best catches were obtained by the "Canadian" with the use of light attraction and lift nets. Gillnets, as fished with the "Canadian" were not successful. The best catches obtained by the "North Star" were with bottom long lines and shark lines.

6.2.2 Bottom Long Lining

According tc the results obtained from the survey, another most promising type of gear is the bottom long line. The coast around Sri Lanka is not uniform and for the long lines it was found that some areas are very much better than the others. The following results indicate that long line is a successful gear for the East Coast.

Table 6

Long Lining Operations from April 1, 1955 to March 30, 1957 by "North Star"

Total number of sets	224
Total number of hooks	224,276
Total number of hours fished	809.3
Total catch (lb)	48,944
Average duration of set in hours	3.6
Average number of hooks per set	1,100
Average catch per 100 hooks	20
Average catch per set	218
Average catch per hour fished	60
Average catch per man-hour	20

Table 7

Comparison of long line catches on the east, west and south-west coasts of Sri Lanka from April 1, 1955 – March 30, 1957

Area	No. of sets	Hours fished	Catch (lb)	Catch/1000 hooks
East Coast	154	545.6	38551	22.6
West Coast	44	184.5	3183	7.9
South West Coast	22	72.6	23800	27.5

6.2.3 Shark Lining

Shark lining was carried out between Chilaw and Puttalam on the West Coast and off Mullaitivu on the East Coast in 1956. The research vessel "North Star" obtained the following results from February 1956 **to** March 1957.

Table 8

Summary of shark lining operations of "North Star" from February 3, 1956 to March 30, 1957

Total number of sets	34
Total number of hooks	2632
Total number of hours fished	139.2
Average duration of set in hours	4.1
Average number of hooks per set	77.4
Total catch (lb)	17844
Average catch perset	524.4
Average catch per 100 hooks	678.0
Average catch per man-hour	42.7

In this explanatory fishery survey they also compared the yields of shark lines and long lines. This experiment was done during January, February and March in 1957 and the results obtained are as follows :

Table 9

Comparison of catches made with shark lines and long lines off Galle in January, February, March 1957

	Shark Lines	Long Lines
Total number of days fished	16	22
Total number of hours fished	57.2	72.6
Total number of hooks	1220	23800
Average duration of set in hours	4.6	3.3
Total catch (lb)	13848	6542
Average catch per set (lb)	865.5	297.4
Average catch per 100 hooks (lb)	1135.1	27.5
Average catch per man-hour (lb)	80.7	30.0

According to the results, it is clear that the shark lines are as profitable as long lines, but the fish caught were of a poor quality.

6.2.4 Handlining

The boats "North Star" and "Canadian" also carried out handlining operations off the coast of Sri Lanka between November 9, 1955 and February 5, 1957. The results obtained are as follows :

Table 10

Summary of handlining operations carried out by local fishermen aboard "Canadian" and "North Star" from November 9, 1955 to February 1, 1957

	"Canadian"	"North Star"	Both Vessels
Total number of days fished	32	12	44
Total number of hours fished	129.5	57.2	186.7
Total number of man-hours	521.5	207.6	729.1
Total number of line hours	607.5	234.1	841.6
Total catch (lb)	296.5	1075	4040
Average catch per day out (lb) ..	92.6	89.6	91.8
Average catch per line hour (lb) ..	4.9	4.6	4.8
Average catch per man-hour (lb) ..	5.7	5.2	5.5

Hand lining operations were also carried out on the Pedro Bank off Point Pedro from July 22 to October 25, 1956. The results are as follows :

Total number of days out	35
Total number of hours fished	211.0
Total number of man-hours	1853.0
Total catch (lb)	8976
Average catch per day out (lb)	256.4
Average catch per man-hour (lb)	4.8

6.2.5 Lift net fishing

Lift net fishing with light attraction was carried out in Trincomalee Harbour in July 1956. The plankton, which had been attracted by the bright lights (Two 1000 W bulbs), concentrated under the bulb of low wattage in the form of a red ball about one foot in diameter. Immediately the fish in the vicinity aggregated and started attacking the plankton. The 1" meshed lift net, lying well under the school of fish, was then quickly lifted up. The results are as follows:

Table 11

Operation of lift net with lights in Orlando Cave, Trincomalee, on July 16-17, 1956

Set No.	Time of lifting	Catch (lb)
1	8.15 p.m.	100
2	8.30 „	224
3	8.45 "	280
4	9.00 "	224
5	9.15 "	308
6	9.40 "	182
7	9.50 "	280
8	10.10 "	295
9	10.25 "	125
10	10.35 "	290
11	10.50 "	156
12	11.05 "	127
13	11.25 "	119
14	11.45 "	127
15	Midnight	84
16	0.05 a.m.	118
17	0.35 "	70
18	0.45 "	28
19	1.00 "	89
20	1.15 „	84
21	1.30 "	20
22	1.50 "	84
23	2.00 "	5
	Total	3466

According to the results obtained, it is clear that the best catches are obtained between 8.30 p.m. and 10.30 p.m. After 10.30 p.m. the catches get progressively reduced. The main species caught is the Russel's scad which swarms regularly in Trincomalee Harbour in the months of July and August.

6.2.6 Otter trawling

Otter trawling operations were carried out with "Canadian" using a three-quarter Yankee 35" trawl of the type used by small trawlers.

The trawl had a 40 ft. head rope and a 50 ft. ground rope. The cod end had 35" stretched mesh. The results obtained are as follows:

Area	No. of Tows	No. of hours fished	Total catch (lb)	Catch/two (lb)
Chilaw	48	42.1	605	12.6
Negombo/Colombo ..	12	12.8	574	47.8
Mankerni (East Coast) ..	84	85.1	1093	13.0
Mullaitivu (East Coast) ..	118	1340.0	7399	62.7
Point Pedro (North) ..	2	2.0	89	44.5
Kayts (North)	5	5.8	42	8.4
Palk Bay	20	24.0	405	20.3
All areas	*289*	305.8	10207	35.3

The average catch made by the Canadian in trawling operations was only 30.6 lb per tow of an average of one hour's duration. This is an extremely poor value compared to what might be expected from commercial trawling operations.

6.3 Exploratory Fishing Operations

Apart from those mentioned under section 2, the following are the important works on exploratory survey:

Mr. Illugasson, FAO Master Fisherman, and de Bruin continued exploratory trawling for prawns and fish in the continental shelf areas around Sri Lanka from 1961-I 963 but were unable to locate prawn grounds other than those in previous operations.

6.4 De Bruin (1970) reports on the results of drift net fishing in Sri Lanka waters during 1966-1968 with nylon gillnets. According to the results, drift net fishing was indeed a lucrative method and he further says that a boat, the size of the *Canadian* (45') could bring in an average weight of 1000 lb of fish per day if she were to use 30-40 nylon nets in the operations.

6.5 Sivalingam (1964) outlines the results of bottom longlining and hand lining operations on the Pedro Bank in the month of August 1961. In the bottom longline construction, the ground lines were 18 lb steam-tarred cotton rope, each 50 fathoms long with side lines 18" long. 35 hooks were attached to the line 1½ fathoms apart. Clupeids and squids were used as bait. The trials were carried out northeast of Point Pedro at depths of 10-40 fathoms. The average catch for these trials (8.9 lb per 100 hooks) was very low as compared to the results obtained in 1956 (32.6 lb per 100 hooks) (Jean, 1958).

6.6 Berg (1971) carried out investigations into the bottom conditions and the possibilities for marine prawn and fish trawling on the north and east coasts of Sri Lanka. He mentions that there are 3000 km^2 of soft bottom situated in the Palk Bay and southeast of Mullaitivu and 5000 km^2 of hard bottom on the Pedro Bank and the regions north of Pedro Bank along the southeast coast of India. The soft bottoms consist of mud, including organic material, and the hard bottoms of coral, shell and flat rocks covered with gorgonids and sponges.

6.7 Demidenko (1972) outlines the results of the joint fishery investigation with the Soviet SRTM, *Optimist* during March-December 1972. The survey covered the northwest and northeast of Sri Lanka and the Wadge Bank. The survey included 400 trawl hauls as well as some experimental fishing with gill nets. The major new discovery was the location of a dep water prawn and lobster ground west of Kudremali Point, 79º23'-79º40'E, 08" 30'N-08º 48'N an area of about 200 square miles but the trawlable area was only 12 sq.miles as determined later.

6.8 Joseph (1975) describes the results of purse seining for small pelagic species of fish at the tail end of the northeast monsoon. Surface lamps, each of 500 watts intensity was changed to 1500 watts between December 1973 and January 1974 and again changed to 3000 watts between February and May. On the west coast between November 1973 and April 1974, the major species caught in the purse seine were sardines, and red bait anchovies, in the order of

34.5%, 30.8% and 13.6% respectively. On the southwest coast, during the same period, the major species caught were sardine, herring, anchovy and red bait in the order of 31 .1%, 23.4%, 15.0% and 10.8% respectively. On the northeast coast, the major species were sardine, herring and carangids forming 43.2%, 29.2% and 10.2% respectively, while on the east coast, during the same period, the major species were sardine and herring forming 46.3% and 44.6% respectively.

6.9 Anon. (1975) reports on the programme carried out with the 500 GRT vessel Hoyo *Maru* from January to March 1975 which included hand lining, drift netting and shrimp basket fishing off the northwest and northeast coasts. Demersal fish were located by echo sounders and fished with a vertical baited line. He carried out altogether 544 experiments and found that the best concentrations of demersal fish were located on the continental shelf in the north eastern area. He further says that closer to the coast, the fish schools observed were smaller and only small quantities were caught. In the northwest area, less demersal fish were caught and their sizes were smaller than in the eastern area.

6.10 Sivasubramaniam (1977) described the experimental fishery survey for skipjack and other tuna species by pole and line and drift net method in Sri Lanka conducted by the Japanese vessel *Kosei Maru.* From the results obtained, he explained the possibilities of establishing small-scale pole and line fisheries in Chilaw, Negombo, Colombo and Mullaitivu. Furthermore he says that, to obtain the maximum yield, pole and line fisheries must be combined with drift net fisheries on a year round basis.

6.11 Pajot (1977) carried out an exploratory fishing survey programme for live bait for the skipjack and other commercially important small species of fish around the island from 1972-1977. According to his results there are sufficient live bait resources around the island for an expansion of the existing pole and line fishery as well as for an offshore pole and line fishery. Three types of gear were used for capturing live bait and other small pelagic species. The overall average catch with these three types of gear were 56 kg, 262 kg and 580 kg for the lampara net, half ring net and purse seine respectively. It is concluded that the current yield of 40,000 tonnes does not represent a full exploitation of these resources and the introduction of small purse seines is recommended.

7. Methodology for collection of catch statistics

The island is divided into thirteen District Fisheries Extension Officers (DFEO) divisions for administrative purposes and estimates of catch and effort at DFEO division level (Fig. 1) are separately recorded for the following types of fisheries :

1. Crafts with inboard engines (IB crafts)
2. Crafts with outboard engines (OB crafts)
3. Beach seines
4. Non-mechanised crafts (NM crafts)
5. Inland water fisheries

The boats that are operated in the coastal fishery also operate in lagoons, so that estimates of catch data for lagoons are included in the coastal estimate. As such, a separate scheme is not adopted to estimate data for lagoons. The method of estimation of catch from inland waters is also not discussed in this paper.

A stratified two-stage sampling design with landing centres as primary sampling units (PSUs) and crafts as second stage sampling units has been used for the estimation of catch from the marine sector. The strata consists of 13 DFEO divisions and the DFEO divisions are further stratified into smaller areas known as Fishery Inspector (FI) divisions.

For the purpose of sampling it is necessary to prepare separate lists of landing centres together with the number of boats for each type of craft (e.g. a list of landing centres for IB crafts, a list cf landing centres of OB crafts, etc). These lists will form the basic sampling frame.

The first stage of sampling is the selection of two landing centres from each of the Fl divisions. This is done with probability proportional to the number of crafts operated in each Fl division. Ten crafts are then selected at random from the selected landing centres. This procedure is repeated for OB, IB and NM crafts separately (e.g. two landing centres for OB craft;, two landing centres for IB crafts, etc.).

There are three types of field officers (Fishery Inspectors, Statistical Collectors and Preventive Guards) engaged in the collection of statistics. They are expected to visit the selected landing centres in their divisions twice a week and record the catch by varieties together with other information such as total number of immigrant crafts, total number of immigrant fishermen and total number of fishing days. The completed monthly statistical returns are then forwarded to the Statistical Division of the Ministry of Fisheries through the respective DFEO. The analysis and presentation of catch by DFEO division, months and varieties are done at the head office.

7.1 The method of estimation is similar for all types of craft and is given below in algebraic terms.

Let in a particular sector of fisheries (e.g. OB craft) n out of N landing centres in a DFEO division be selected at random. Let Mi be the number of craft of the corresponding fisheries sector at the ith centre and $M = \sum Mi$ is the total number of crafts in the DFEO division. Let Lij be the number of craft that actually land and lij is the number of sampled boats examined on the jth day at the ith centre. If uijk represents the landing of kth boat on jth day at ith centre, then y the estimated monthly landings at the ith centre is given by

$$= \frac{D}{d} \sum_{j} \frac{Lij}{lij} \sum_{k} yijk$$

where d is the number of observation days at the ith centre (equal to 8 per month) and D is the number of days in a month excluding Sundays.

The DFEO division estimate is then obtained as :

$$Y = M \sum_{1=i}^{n} \hat{Y}_i / \sum M$$

The DFEO division estimates are then summed up to obtain the island total.

7.2 The collection of fishery statistics is carried out by Fishery Inspectors attached to various DFEO divisions. An examination of the existing system of collection of data indicates several deficiencies. The statistical forms have not been properly filled up. There is no uniformity in the reporting of species composition of landings, most probably due to lack of basic knowledge in identification of fish species.

Instructions to collect data on a specified number of bcats have not always been followed, It is apparent that the field staff are not adequately trained. Furthermore, there is a problem of supervision or inspection of the field work in the operational phase.

It is hardly necessary to emphasize that the successful implementation of any survey requires a group of well-trained field staff under adequate supervision and guidance. It is to be ensured that they strictly follow the field instructions given to them and collect data according to a prescribed plan. It is therefore suggested that separate field staff should be set apart exclusively for collection of statistics. They could then be trained and motivated.

In addition to the field staff it is necessary to have some supervisory staff who will supervise, conduct regular inspections of field work and will also ensure timely submission of statistical returns to headquarters. It is needless to emphasize again that both field and supervisory staff should be directly under the control of the Statistician of the Fisheries Ministry.

8. Methods of stock assessment used

Two research programmes have been carried out by the Research Division of the Ministry of Fisheries to estimate the prawn population. In De Bruin's study (unpublished), the major

prawn fishing grounds in the island have been defined, while Sideek (1977) hasseiected Chilaw area in his study mainly because it is one of the most productive centres.

8.1 De Bruin has observed weekly samples from the catches by local fishermen for a long period of time. The number of weekly samples was different from one area to another. He has estimated the production of penaeid prawns from the lagoons and inshore waters of Sri Lanka to be in the region of 1000-l 500 tonnes per annum. It is however, to be noted that these figures were based mainly on eye estimates of catches made over a long period of time from samples of boats of the main productive centres of the island, and raised for the whole island.

8.2 Sideek's study (1977), prawn catches by local fishermen were recorded from 13 January 1977 to 1st March 1977 together with the number of boats operated and number of fishing hours on each day. The catch per hour of effort (C_t) and accumulated catch ($A_,$) were then calculated and C_t was plotted against At for four species of prawns, M. *dobsoni,* P. *stylifera,* P. *coromandalica* and P. *cornuta.* Following De Lury's method and fitting the data to the regression $C_t = a + bA_t$, where a is a constant and b is the catchability, he obtained the following values of the initial population (A_o) of above species of prawns.

Prawn species	Initial population
M. dobsoni	21,166 lb
P. stylifera	7,181 lb
P. coromandalica	
P. cornuta	349 lb

8.3 At present a study has been undertaken by Jayakody of the Research Division, Ministry of Fisheries. The aspects that are covered in his study are :

(a) Total weight of prawns caught and catch per effort.

(b) Determination of the maturation and breeding periods of some commercially important penaeid prawn species.

(c) Species composition of the catches.

(d) Size at maturity of commercially important penaeid prawn species *(P. monodon, P. indicus, P. semisulcatus, P. merguiensis).*

He expects to continue his research along the lines put forward by Sideek (1977). The preliminary results of his study are reported in Appendix lll.

9. Basic biological characteristics

There are three research programmes to ascertain some of the basic biological characteristics of some prawn species conducted by the Research Division of the Ministry of Fisheries.

Mutwal, Negombo, Chilaw are selected for the research work on prawns, as these regions are the most productive centres in the island. Weekly visits are made to these places and the following information is collected from random samples of prawns.

1. Maturation and breeding periods of penaeid prawns
2. Species composition
3. Size at maturity of commercially important prawn species
4. Total weight of prawns caught and catch per effort values.

9.1 Maturity and breeding periods

Random samples were examined from the catches for the maturity stages, undeveloped, developing and developed. Using the above data percentage maturity values were calculated for different species. From the results of the research work carried out during the last year the following tentative conclusions can be put forward:

(i) Mature females of small prawns such as *M. dobsoni* and *P.* stylitera are found throughout the year.

(ii) P. indicus breeds in February, March, April and again in November and December.

(iii) Most of the females of *P. semisulcatus* are caught in November and most of them are mature but it is difficult to determine the breeding periods as the catch is low.

(iv) Diligent observations are carried out for *P. monodon* to determine the breeding periods but it was not possible to do so as the catch of the mature females was poor.

9.2 Size (length group) at maturity

Prawns were categorised into maturity stages and length groups from random samples. This method has been repeated for all commercially important large prawn species and the results obtained are as follows :

P. indicus : Size varies up to 20.00 cm. Below 13.50 cm 90% females are not developed, between 13.50- 18.50 cm gravid, developed and developing females are found.

P. merguiensis : Size varies up to 25.50 cm gravid, developed and developing females were found. Data are insufficient to indicate sizes from which various maturity stages are available.

P. semisulcatus : Size varies up to 20.50 cm. Below 90% females are not developed. Between 14.00-20.5 cm, gravid, developed and developing females were found.

P. monodon : Few gravid females were found throughout the survey period. All were beyond 20.00 cm size. Most of the females found were not developed.

9.3 Breeding cycles of some Penaeid Prawns

Breeding cycles of species *P. indicus, P. semisulcatus. P. monodon* and *P. merguiensis* are being studied from the presence of gravid females in samples obtained throughout the year (1978-1979). Samples of the prawn species were collected off the west coast, mainly from Negombo and Chilaw and the percentages of gravid females of the above species were calculated for the different months.

(1) In Negombo, over 50% of the females of *P. merguiensis* (Banana prawn) were seen to be gravid during the months of October to February- the peak being in February, In Chilaw, it is during December and January.

(2) In Negombo, over 50% of the females of *P. semisulcatus* were seen to be gravid during January and February- the peak being in January, In Chilaw, it is from December to February the peak being in January.

(3) In Negombo, nearly 50% of the females of *P. indicus* were seen to be gravid in February. In Chilaw, over 50% of the females of *P. indicus* wereseen to be gravid during January and February — the peak being in February.

(4) The breeding cycle of P. monodon could not be determined accurately as only a few of them were present in the samples collected. However, specimens of gravid females were present only during the months of November, December, January and February. Its breeding cycle may therefore be similar to other species.

For other fishes, research on basic biological characteristics were not carried out.

References

Anon. 1975 — Report of exploratory fishing in the coastal waters of Sri Lanka by *Hoyo Maru. Japan Marine Fishery Research Centre,* June 1975.

Berg, S. E. 1971 — Investigations on the bottom conditions and the possibility for marine prawn and fish trawling on the north and east coast of Sri Lanka. *Bulletin of the Fisheries Research Station, Sri Lanka, 22(142) : 53-88.*

De Bruin, G. H. P. 1960 — Lobster fishing in Sri Lanka. *Bulletin of the Fisheries Research Station,* Sri Lanka. 9

De Bruin, G. H. P. 1962 — Spiny lobsters of Sri Lanka. *ibid.,* 14.

De Bruin, G. H. P. 1969 — The ecology of spiny lobsters, *Panulirus* spp. of Sri Lanka waters. *Ibid., 20(2)* 171-l 78.

De Bruin, G. H. P. 1970 — The distribution of penaeid prawns in Sri Lanka waters. *Ibid., 21.*

Demidenko, U. 1972 — Information about the results of the joint Soviet-Lankan investigations carried out in waters adjacent to Sri Lanka Island. *Manuscript Report,* Fisheries Research Station, Sri Lanka.

FAO/UNDP Indian Ocean Programme. 1975 — Improvement of national fishery statistics.

Jean, Y. 1958 — Summary of operations of "Canadian" and "North Star" from April 1, 1955 to March 30, 1957. Manuscript *Report.* Canadian Fisheries Project, Sri Lanka.

Joseph, B. D. L. 1975 — Purse-seining for small pelagic fish around Sri Lanka at the tail end of the north east monsoon. *Bulletin of the Fisheries Research Station,* Sri Lanka 26(1-2) : 31-43.

Ministry of Fisheries Sri Lanka. 1980 — Master plan for the development of fisheries in Sri Lanka, 1979-83.

Pajot, G. 1977 — Exploratory fishing for live-bait and commercially important small pelagic fish species. *UNDP-Sri Lanka Fishery Development Project:* Technical Report No. 3.

Pajot, G. 1978 — Fishing gear methods for offshore fishing in Sri Lanka.

Pajot, G. 1978 — Inshore fishing boats, Sri Lanka.

Saetersdal, G. S. and G. H. P. De Bruin (Eds.) — Report on a survey of the coastal fish resources of Sri Lanka. August-September 1978. *Reports on surveys with the R/V Dr. Fridrjof Nansen.*

Sideek, M. S. M. 1978 — **Estimating the population density of prawns by the use of catch per effort data from prawn trawlers.** ***Bulletin of the Fisheries Research Station,*** **Sri Lanka 28.**

Sivalingam, S. 1964 — **Assessment and possible resources of the Pedro Bank.** ***Bulletin of the Fisheries Research Station,*** **Sri Lanka** ***18(2).***

Sivasubramaniam, K. 1970 — **Sri Lanka's tuna long-line fishing effort and catch distribution in the Indian Ocean** ***/bid., 22.***

Sivasubramaniam, K. 1971 — **Apparent abundance of yellowfin and big-eye tuna, in the offshore inshore and near oceanic ranges around Sri Lanka Ocean.** ***/bid., 22.***

Sivasubramaniam, K. 1975 — **An analysis of experimental pole and line fishing conducted around Sri Lanka by Nichimo Company of Japan.** ***/bid., 26(1-2) : 61-82.***

Sivasubramaniam, K. 1977 — **Experimental fishery survey for skipjack and other species by pole and line and driftnet fishing method in Sri Lanka.** ***UNDP-Sri Lanka Fishery Development Project. Technical*** **Report No. 4.**

Sivasubramaniam, K. 1978 — **Pelagic fishery resources of Sri Lanka and its present level of exploitation with special reference to off-shore and deep-sea resources** ***Bulletin of the Fisheries Research Station,*** **Sri Lanka 28.**

Appendix Ia

Estimated Fresh Fish Production by Varieties — 1979

(in tons)

	Seer Fish	Caran-gids	Skip Jack	Yellow Fin Tuna	Other Blood Fish	Shark	Skate	Rock Fish	Shore Seine Varieties	Lobsters	Prawns	Others	Total
Colombo	213	246	153	75	155	94	63	288	183	—	130	48	1648
Negombo	328	278	1279	1440	1076	2364	255	231	8138	05	849	202	16445
Kalutara	124	211	314	288	748	417	322	545	2346	—	01	03	5319
Galle	331	299	422	291	1587	61	92	1493	1611	—	—	269	6456
Mullaitivu	252	433	180	—	21	316	241	2497	6988	24	76	62	11100
Trincomalee	210	1053	886	51	927	650	696	3680	3785	88	86	187	12299
Batticaloa	162	243	514	102	101	153	138	221	1274	—	02	48	2958
Kalmunai	504	403	390	155	1013	149	123	1118	5616	—	02	187	9660
Puttalam	112	15	775	1883	05	147	84	471	13936	40	219	1065	18752
Matara	421	230	2049	1461	1779	626	244	539	2596	—	—	90	10035
Hambantota	302	202	770	295	556	298	129	372	4174	09	56	190	7353
Jaffna	990	5691	447	05	73	1804	1488	5189	15909	55	1132	1399	34182
Mannar	306	667		24	100	741	935	1978	4963	09	785	692	10300
Total	4255	9971	8179	6070	8141	7820	4810	17722	71529	230	3338	4442	146507

Appendix Ib

Estimated Fresh Fish Production by Varieties — 1978
(in tons)

D.F.E.O's Division	Seer Fish	Caran-gids	Skip Jack	Yellow Fin Tuna	Other Blood Fish	Shark	Skate	Rock Fish	Shore Seine Varieties	Prawns	Lobsters	Others	Total	Per cent
Colombo	146	324	158	105	134	103	44	624	957	911	32	7	3545	2.6
Negombo	310	247	1203	1357	1014	2215	176	22	8055	1167	—	42	15808	11.7
Kalutara	276	475	848	562	629	485	243	462	716	—	2	—	4698	4.6
Galle	412	514	1640	605	1030	187	28	650	584	27	—	90	5767	4.3
Mullaitivu	118	324	65	62	19	124	92	739	4115	259	52	7	4976	4.4
Trincomalee	147	863	849	50	962	599	588	3551	3178	81	93	177	11138	8.3
Batticaloa	273	400	879	301	379	465	273	471	2150	108	—	26	4725	4.2
Kalmunai	49	78	262	88	89	122	128	763	5024	—	—	—	6603	4.8
Puttalam	225	656	1510	515	269	193	356	1383	11075	369	379	532	17462	12.0
Matara	243	329	2533	1320	2147	677	139	953	1467	—	—	126	9934	7.4
Hambantota	306	123	475	291	460	196	84	267	2523	3	14	365	5107	3.8
Jaffna	879	5034	396	5	67	1612	1425	5155	15592	1113	51	1378	32707	24.3
Mannar	261	611	—	24	99	678	807	942	5664	770	12	406	10274	7.6
Total	3645	9978	10818	5285	7298	7656	4383	15982	51100	4808	635	3156	134744	100.0
Per cent	2.7	7.4	8.3	3.9	5.4	5.7	3.3	11.9	45.4	3.6	0.5	1.9	100.0	

Appendix Ic

Estimated Fresh Fish Production by Varieties — 1977

(in tons)

D.F.E.O's Division	Seer Fish	Caran-gids	Skip Jack	Yellow Fin Tuna	Other Blood Fish	Shark	Skate	Rock Fish	Shore Seine Varieties	Prawns	Lobsters	Others	Total
Negombo	152	176	1266	1422	961	1117	227	116	10120	935	28	110	1663
Colombo	235	447	424	154	178	288	64	552	545	176	36	2	3101
Kalutara	159	363	900	342	236	429	166	270	883	—	—	—	3748
Galle	313	627	545	259	736	173	124	1296	530	34	3	29	4669
Matara	317	277	1618	1331	1450	860	218	767	1279	30	—	180	8327
Hambantota	263	203	646	310	462	418	208	314	1152	12	106	16	4110
Jaffna	821	3146	539	32	168	558	940	4777	13530	411	15	884	25821
Mannar	229	673	—	19	98	679	,841	883	9853	660	1	221	14127
Mullaitivu	372	439	168	119	15	209	163	989	2878	416	—	85	5853
Trincomalee	227	940	645	72	846	700	753	2128	2549	150	128	149	9287
Batticaloa	294	328	1031	348	417	452	328	352	2366	108	—	88	6112
Kalmunai	169	237	565	126	183	385	390	616	2454	72	—	32	5229
Puttalam	163	764	2852	1123	557	220	187	2294	6597	860	2	748	16367
Total	3714	8620	11199	5657	6307	6488	4609	15354	54736	3864	319	2544	123411

Appendix Id

Estimated Fresh Fish Production by Varieties — 1976

(in tons)

	Seer Fish	Caran-gids	Skip Jack	Yellow Fin Tuna	Other Blood Fish	Shark	Skate	Rock Fish	Shore Seine Varieties	Prawns	Lobsters	Others	Total
Negombo	245	429	2001	2934	509	2828	560	273	9837	22	415	319	20372
Colombo	107	180	13	8	61	339	325	189	221	45	152	—	1640
Kalutara	289	188	798	392	206	407	324	446	640	—	—	22	3712
Galle	513	692	343	130	579	253	225	848	861	25	55	57	4581
Matara	167	314	1813	1141	1541	407	356	1167	1020	22	2	109	8059
Tangalle	268	338	1056	408	562	627	215	889	727	63	—	6	5159
Jaffna	833	2474	657	—	106	897	1007	2858	13209	94	761	593	23409
Mannar	332	1003	231	17	41	1102	814	1738	6321	3	196	378	12236
Mullaitivu	577	138	192	—	88	639	226	727	3261	3	934	434	7220
Trincomalee	597	706	628	89	26	600	1062	1725	2968	75	521	393	9390
Batticaloa	204	218	972	459	376	407	253	150	1204	7	903	387	5540
Kalmunai	353	236	569	192	344	417	318	663	1801	6	165	60	5114
Puttalam	112	567	2667	1037	622	516	82	230	6715	—	728	141	14417
Total	4597	7483	11940	6807	5061	9439	5828	12903	48785	285	4832	2889	120849

Appendix le

Estimated Fresh Fish Production by Varieties-l 975

(in tons)

District	Seer Fish	Carangids	Blood Fish	Shark and Skate	Rock fish	Shore Seine Varieties (1)	Shore Seine Varieties (2)	Other Species	Total
Negombo	338	114	5996	4023	506	144	6062	1201	18384
Colombo	27	350	95	121	190	206	1322	611	2922
Kalutara	139	85	3086	481	155	335	924	73	5278
Galle	281	364	2299	94	386	60	253	236	3973
Matara	75	162	3862	660	656	333	515	165	6428
Tangalle	300	164	2467	343	454	220	1006	117	5071
Jaffna	748	1534	4110	3209	5150	574	4532	2228	22085
Mannar	218	862	89	1490	1324	1767	4874	416	11040
Mullaitivu	370	591	741	241	166	2205	2515	483	7312
Trincomalee	288	818	1573	390	1949	633	1269	299	7219
Batticaloa	244	206	1296	446	308	212	1436	1324	5472
Kalmunai	109	113	455	308	305	63	1076	263	2692
Puttalam	283	656	3622	842	986	1116	6238	1395	15178
Total	3420	6019	29731	12648	12535	7868	32022	8811	113054

Appendix If

Estimated Fresh Fish Production by Varieties and by Districts — 1974

District	Seer Fish	Caran-gids	Blood Fish	Shark and Skate	Rock Fish	Rock Fish (Small)	Shore Seine Varieties (1)	Shore Seine Varieties (2)	Other Species	Total
Negombo	185	589	4868	5816	203	114	51	1834	1760	15420
Colombo	72	239	181	1	286	84	19	255	130	1267
Kalutara	182	57	1846	1570	102	15	58	300		4130
Galle	135	141	1837	134	245	99	67	287	63	3008
Matara	669	65	2546	331	429	64	495	505	263	5367
Hambantota	287	143	2781	601	536	93	61	206	64	4772
Jaffna	1359	3481	1211	2598	2852	3066	1439	6657	1453	24116
Mannar	210	1164	153	958	299	641	385	4982	484	9276
Mullaitivu	513	717	335	271	310	296	195	1300	646	4583
Trincomalee	377	1120	1328	576	1070	748	834	3492	217	9762
Batticaloa	92	132	1072	406	85	171	157	749	1007	3871
Kalmunai	91	257	437	171	89	247	64	1910	366	3632
Puttalam	181	659	3396	1468	482	654	414	1983	776	10013
Total	4253	8764	21991	14901	6988	6292	4239	24460	7229	99217

Appendix 1g

Estimated Fresh Fish Production by Varieties — 1973

	Seer Fish	Caran-gids	Blood Fish	Shark and Skate	Rock Fish	Rock Fish (Small)	Shore Seine Varieties (1)	Shore Seine Varities (2)	Other Species	Total
Negombo	25%	168	3177	10352	233	108	144	1014	532	15986
Colombo	107	133	131	2	246	17	33	456	294	1419
Kalutara	148	44	1484	709	169	14	127	312	2	3009
Galle	87	146	1294	126	206	77	103	393	129	2561
Matara	60	106	2258	507	317	74	671	633	142	4768
Hambantota	169	173	2704	405	459	60	18	72	332	4392
Jaffna	1356	1709	1521	1986	4003	3086	1344	5536	1905	22446
Mannar	331	1367	586	1088	313	564	1044	4438	299	10080
Mullaitivu	38	102	43	144	32	138	184	483	232	1396
Trincomalee	295	812	1570	570	1218	677	633	3073	191	9039
Batticaloa	72	243	1249	214	169	3011	113	653	104	4038
Kalmunai	93	227	446	73	138	266	141	1530	652	3566
Puttalam	496	438	2033	802	293	549	251	1600	712	7174
Total	3510	5665	18496	16977	7800	5932	4806	20242	6446	89874

Appendix II

Number of crafts operating at the beginning of 1977

D.F.E.O. Division	Inboard	Outboard	Non-mechanised	Total
Colombo	79	52	592	723
Kalutara	113	30	612	755
Galle	103	99	853	1055
Matara	294	04	951	1249
Tangalle	199	202	907	1309
Kalmunai	31	32	553	616
Batticaloa	80	124	563	767
Trincomalee	77	72	1193	1342
Mullativu	97	397	430	924
Jaffna	414	1401	1597	3412
Mannar	132	511	481	1124
Puttalam	304	926	2629	3859
Negombo	239	1192	930	236
Tota l	2162	5042	12291	19495

Number of crafts operating at the beginning of 1978

Colombo	79	52	602	733
Kalutara	113	30	634	777
Galle	103	99	916	1118
Matara	288	04	923	1215
Tangalle	199	16	1164	1379
Kalmunai	31	32	872	935
Batticaloa	82	124	1890	2096
Trincomalee	77	72	1207	1356
Mullativu	97	397	426	920
Jaffna	426	1470	2029	3925
Mannar	133	511	481	1125
Puttalam	304	1022	3016	4342
Negombo	239	1201	1584	3024
Total	2171	5030	15744	22945

Number of fishing crafts operated as on 30-6-1979

D.F.E.O. Division	Inboard	Outboard	Non-mechanised	Total
Colombo	37	37	230	304
Kalutara	117	35	634	786
Galle	118	131	1040	1289
Matara	328	381	924	1633
Tangalle	219	106	1300	1625
Kalmunai	29	200	334	563
Batticaloa	49	143	561	763
Trincomalee	120	239	1633	1992
Mullativu	35	668	445	1148
Jaffna	471	1979	1689	4151
Mannar	266	446	1152	1152
Puttalam	535	1728	1276	3539
Total	2626	6740	11063	20452

Appendix III

Yield trends over the months against fishing effort:
Station — Negombo

Pra wns

Year 1979

Month	Total Catch	Ibs	No. of boats operating	Catch/effort value (Catch/Boat/Day)
February	Small prawns	22,467.26	1825	12.311 Ibs
	Large ..	1,627.07		0.892 "
March	Small ..	85,856.72	2000	42.928 "
	Large ..	3,980.85		1.990 "
April	Small ..	62,318.19	1975	31.554 "
	Large ..	3,301.91		1.67 "
May	Small ..	19,195.65	725	26.477 "
	Large ..	1,597.65		2.203 "
June	Small ..	26,212.16	1325	19.783 "
	Large ..	1,658.88		1.252 "
July	Small ..	21,880.80	1075	20.354 "
	Large ..	2,624.12		2.441 "
August	Small ..	50,226.94	1700	29.569 "
	Large ..	3,752.46		2.207 "
September	Small ..	54,938.87	2025	27.13 "
	Large ..	4,653.50		2.29 "
October	Small ..	37,746.54	2100	17.97 "
	Large ..	2,439.45		1.162 "
November	Small ..	34,668.40	2065	16.15 ,,
	Large ..	1.886.55		0.506 "
December	Small ..	28,333.04	1881	14.485 "
	Large ..	990.31		0.506 "
Year 1980				
January	Small ..	30503.25	1413	21.587 "
	Large ..	1.094.00		0.774 "
February	Small ..	28,728.65	1188	24.182 "
	Large ..	1,275.90		1.073 "
March	Small ..	30,417.45	1952	19.106 "
	Large ..	1 ,1 19.97		0.703 "

Appendix III — (Contd.)

Yield trends over the months against fishing effort: Station — Chilaw

Prawns

Year 1979

Month	Total Catch lbs		No. of boats operating	Catch/effort value (Catch/Boat/Day)
February	**Small prawns**	**15,522.80**	1975	**7.859 lbs**
	Large ..	**13,026.75**		**6.595 "**
March	Small ..	**24,920.17**	1950	**12.780 "**
	Large ..	**28.289.38**		**14.5071 "**
April	**Small** ..	**7,204.99**	1925	**3.743 "**
	Large ..	**19,561.89**		**10.162 "**
May	**Small** ..	**12,213.73**	**1725**	**7.080 "**
	Large ..	**16,079.31**		**9.321 "**
June	**Small** ..	**13,577.20**	**1600**	**7.146 "**
	Large ..	**10,486.71**		**5.519 "**
July	**Small** ..	**17,213.21**	**1075**	**16.012 "**
	Large ..	**6,582.06**		**6.123 "**
August	**Small** ..	**12,327.84**	**950**	**12.977 "**
	Large ..	**8,819.46**		**9.284 "**
September	**Small** ..	**6.820.75**	**1356**	**5.03**
	Large ..	**7,090.20**		**4.8896 "**
October	**Small** ..	**21,967.74**	**1450**	**15.15 "**
	Large ..	**7,090.20**		**5.8896 "**
November	**Small** ..	**43,981.60**	**1875**	**22.55 "**
	Large ..	**10,732.54**		**5.50 "**
December	**Small** ..	**48,824.448**	**2000**	**23.552 "**
	Large ..	**6,660.94**		**3.213 "**
Year 1980				
January	**Small** ..	**23,552.0**	**1275**	**18.472 "**
	Large ..	**4,933.75**		**3.869 "**
February	**Small** ..	**19,194.25**	**1563**	**12.28 "**
	Large ..	**3,403.50**		**2.235 "**
March	**Small** ..	**7,656.43**	**1163**	**6.583 "**
	Large ..	**6,910.64**		**5.942 "**