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TUNA FISHERIES OF THE EXCLUSIVE ECONOMIC ZONE OF INDIA : Biology and Stock Assessment

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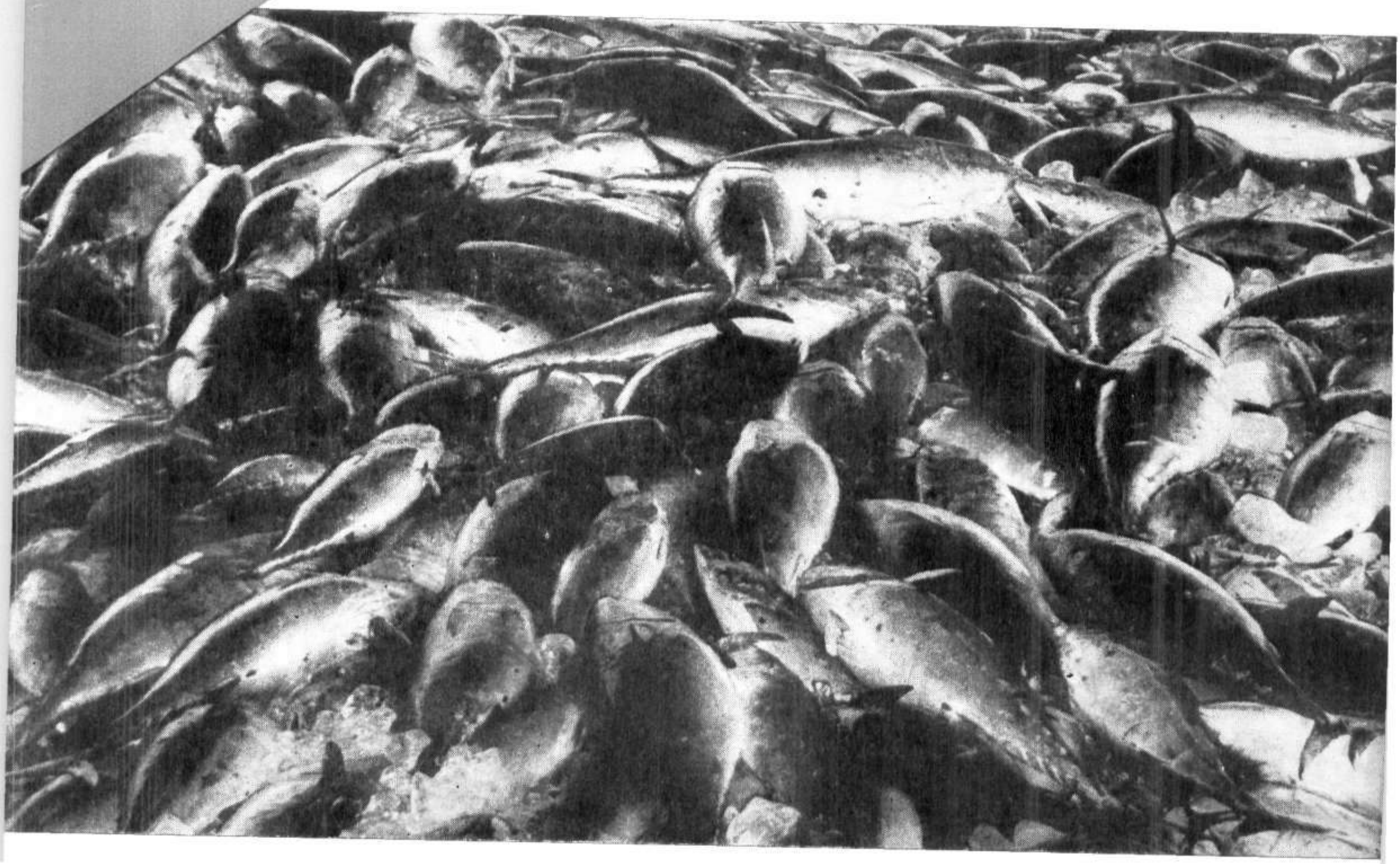

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INDIAN TUNA FISHERY DEVELOPMENT—PERSPECTIVES AND A MANAGEMENT PLAN

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Speaking at an International Conference ' Fisheries development in 2000 A.D. ' (New Delhi, 1985) Dr. W. Philip Appleyard in a global context opined that the marine demersal catches could be increased from 22 million to 37 million tonnes ; the marine pelagic catches from 24 million to 50 million tonnes ; tuna catches from around 3 million to at least 8 million tonnes and cephalopods from around 1 million to 10 million tonnes. A potential saving of post-harvest losses of 11 million tonnes may also be added to these to exceed 110 million tonnes of fishes needed by 2000 A.D.

The production of tunas has shown spurts of increase from time to time, mainly due to the new areas of operation of purse seiners combined with market demand. Estimates of larger stocks of skipjack tuna have been made from different oceanic areas. The South Pacific Commission (SPC) have estimated about 8 million tonnes of skipjack resources from the South Pacific Area. Apparently, these optimistic estimates have resulted in projecting a trend to yield about 8 million tonnes of tunas from the world oceans by 2000 A. D. With the most sophisticated development in tuna fishing, particularly with the use of the modern purse seiners—taking into consideration the development during the past 2 decades, and international marketing constraints, it would appear to us a herculian task to double today's world production of tunas within the next fifteen years.

A review of the production trend of tunas in recent years for the Indian Ocean and for India has been presented earlier. The prime requirement in the planning of tuna fishery development is the need to maintain and improve production targets with good management measures. We propose that by 2000 A.D. the tempo of tuna fishery development programme by India should achieve a commercial production target in terms of quantity (tonnes) as follows :

Areas	Present catch (t)	By 1990 (t) (Silas & Pillai 1982)	By 2000 A.D. (t)
Coastal species (Drift gillnetting, pole and line (live-bait) fishing and other methods of coastal fishing ..	@19,000	45,000	75,000
Skipjack and young yellowfin tunas (Purse seining) ..	..	50,000	1,50,000
Large oceanic tunas (Longlining) ..	@ 100	20,000	60,000-75,000
	19,100	1,15,000	2,85,000-3,00,000

In order to achieve the above objectives, the major input-output items in the tuna fishery development programme and the sectors through which they could be effectively implemented are :

(i) Augmenting production through improvement in the traditional small scale fishery sector (Drift gillnetting, coastal purse seining, surface trolling, FAD's)

(ii) Development and improvements of medium commercial sector fishery (Pole and line (bait-boat fishing) fishing and FAD's)

(iii) Development of large scale commercial fishery sector (Large scale high seas purse seining and long-lining).

Tuna Fishery in the Small Scale Sector

Currently, tuna fishery is limited exclusively to the small scale fishery sector and immediate attention should be paid for an expansion and diversification within this sector. Bulk of the catches from the shelf waters is taken by drift gillnets, shore seines, surface troll lines and hooks and lines, using non-mechanised boats such as canoes and catamarans and 'pablo type' mechanised boats. It is estimated that about 2600 gillnetters and 133,000 non-mechanised boats are in operation in 1980 (CMFRI 1982) along the coasts of India (Figures from Maharashtra, Lakshadweep and Andaman and Nicobar Islands not included).

Augmenting production of coastal species of tunas through diversification in the small scale fishing with greater use of drift gillnets and other suitable gears and crafts needs priorty attention. A recent trend in the motorisation in the small scale sector is the rapidly increasing number of canoes fitted with outboard engines, which have increased the operational range of these boats further offshore. Silas and Pillai (1982) reported about the non-mechanised canoes which are towed by mechanised boats for gillnetting in the deeper waters along the Calicut coast. Under a planned programme, adoption of this method in other areas where gillnetting is not practised at present would help in augmenting the production of larger pelagics such as tunas and seerfishes.

The major strategies for further development in the drift gillnet fishery have been discussed earlier (Silas *et al.* 1984). At present, storage facilities in the boats are lacking and when there is good catch of larger pelagics, about 10-15% of the catch is landed in deteriorated condition due to the dumping of the catch on the deck space. Proper icing and storing facility on board the boat which may merit structural modifications of the boat to store the catch are the problems which need serious consideration. Further by employment of energy saving devices, such as the use of sails, the area of operation of the mechanised gillnetters could be increased. Hauling of the net is normally done manually and it is time consuming. Installation of suitable mechanical net hauler would help in increasing the soaking time by reducing the hauling time. Another area which needs attention is the development of the bottom-set gillnetting (sub-surface fishery) practised by fishermen during certain seasons to catch quality fishes such as seerfishes and in which tunas are caught in good numbers.

Increasing drift gillnet operations in the areas such as Ratnagiri southwards to Calicut, in the Gulf of Mannar and along the coasts of Orissa and West Bengal would enhance the production of tunas to a considerable extent. The results of a case study on the drift gillnet fishery during 1981-'82 at Cochin (Silas *et al.* 1984) is indicative that it would not be difficult to increase the production from the present level from the inshore waters. A more intensive tuna fishery programme will be necessary in the shelf waters along the south-east and south-west coasts of India and the Wedge Bank Area with a concurrent product development programme and an internal marketing strategy.

Diversification in the fishery is often spoken of in order to reduce effort on shrimp trawling. The seasonal conversion of mechanised boats involved with shrimp trawling as efficient gillnetters with mechanised hauling system needs consideration. Since these boats range in size between 9.6-13.0 m OAL, the operational range, better storage facility and longer period of stay away from the port should be considered even if it involves modifications in the design.

Drift gillnetting for tunas also results in the landings of quality by-catch of other pelagics such as seerfishes, sharks, carangids, pomfrets and catfishes which fetch good prices at the landing centre (Silas *et al.* 1984). Assuming that each boat could harvest annually or seasonally 25-30 tonnes of larger pelagics of which about 20 per cent will be tunas, the average catch of tunas per boat per annum will be to the tune of about 6 tonnes.

Small purse seiners (OAL 11.5-13.5 m) also land good quantities of tuna from the shelf waters and regulated purse seine fishery for tunas along the south-west coast of India should yield good results. The annual catch of one such purse seiner may be from 400-500 tonnes of pelagic fishes such as mackerel, sardine, horse mackerels, pomfrets and tunas, among which tunas constitute about 20 per cent of the total annual catch. There are about 350 such purse seiners operating in the shelf waters of Maharashtra (Ratnagiri, 25) Goa (50), Karnataka (200) and Kerala (Cochin, 60). The sharing of resource between this and the drift gillnet fishery sectors need careful study and appraisal.

The major effort expended in the skipjack tuna fishery is in the surface fishery using pole-and-line and live-bait. Presently, about 120 mechanised boats are engaged in the pole-and-line fishery in the Lakshadweep Islands. Some of the major constraints in the fishery is the availability of live-bait, desirable bait species, scouting time for tuna shoals, behaviour of tuna shoals and fuel energy cost in running the boats (Silas and Pillai 1982). There is strong evidence that tampering of the Island lagoon ecosystem by dredging adversly affects the natural habitat of baitfishes. Minicoy lagoon is a good example where siltation is taking place in part of the lagoon and reef area. Regulatory measures to protect the lagoon ecosystem for stabilising natural resources of baitfishes is a pre-requisite for the successful surface tuna fishing in these Islands. Further, culture production of baitfishes for better development of pole-and-line fishery in the small scale fishery sector will be an effective step for augmenting tuna production. At present, pole-and-line live-bait fishery for tunas in the Lakshadweep Island involves only daily fishing. It was suggested by Silas and Pillai (1982) that the introduction of larger boats for bait-boat fishery involving voyages of a few days and improvements in operational techniques may pave the way for augmenting tuna production in these Islands. In this connection, the major aspects which need attention are the designing of the boats with bait tanks, chilling tank and fishhold ; availability of required quantity of baitfish ; fueling and servicing base facilities ; frozen on shore storage facility ; tuna cannery ; trained manpower and other infrastructure including fresh water.

Larger boats of 15-20 m OAL with greater operational range could be used to fish around these islands for 4-5 days carrying enough live-bait and chilling and storing facilities for the catch. Each boat may require about 2.5 to 3 tonnes of live-bait per annum for operation, It is estimated that the operation of one such boat could produce 200 tonnes of skipjack and young yellowfin tuna per annum and to start with an introduction of 100 boats of this type in the Lakshadweep and Andaman and Nicobar Islands should enhance the yield of skipjack and yellowfin tunas to about 20,000 tonnes annually.

However, recent trends indicate that development priorities in the Lakshadweep Islands may take a different turn. A programme of sand mining from the lagoons for cement production and other industrial developments are being planned which we feel will undoubtedly adversely affect the island lagoon ecosystem on the reefs to even create major ecological imbalances. For one thing, siltation resulting in denudation of the reefs and other changes will naturally adversely affect natural baitfish occurrence and abundance in the lagoons which may negate any planned tuna development programme in the islands involving the pole and line-bait system. Even now, serious consideration should be given to see whether species of anchovies and sardines from along the mainland coast could be used as substitute bait.

Recent development in the tuna fishery by the employment of different types of anchored fish aggregating devices have been discussed by Silas and Pillai (1982). The use of FAD's to attract and hold schools of surface and pelagic fish species including tunas is one of the significant recent developments in the tuna fishery. The attraction of pelagic fishes including tunas to floating objects has been investigated by several authors (Hunter and Mitchell 1967, 1968 ; Inoue *et al.* 1968 ; Prindle and Walden 1976; Prindle 1981; Preston 1982). Murdy (1980) and Matsumoto *et al.* (1981) reported on the different types of FAD's employed in tuna fishing off Mindoro, Negros and Mindanao islands in the Phillippines and in the Hawaiian waters. Christy *et al.* (1981) mentioned of trials to be undertaken in the Republic of Maldives. Recently a comprehensive report on the FAD's mooring systems in general use in the Pacific Island countries has been published (Boy and Smith 1984).

The major impact of FAD's will be in the artisanal sector as fishing around these structures results in increased catches, reduction in the scouting and voyage times form the shore which conserve fuel energy and also it is a satfey factor for the operation of small boats. The traditional fishing methods employed for catching tunas were by hooks and lines, but recently commercial purse seining has been introduced in several localities.

As one of the steps towards augmenting the production of tunas in the artisanal sector it is desirable to use the fish aggregating devices as the 'Payayos' in the Philippines and Indonesia and the FAD's in the Pacific Island countries. Preferred areas are to be demarcated for setting up these devices and employment of efficient fishing methods suitable for the same all along the east coast of India particularly outside the shelf waters of the Tamilnadu and Andhra Predesh and around Lakshadweep and Andaman and Nicobar Islands. However, the problem of maintaining the fish aggregators is not a new or simple task as it involves anchoring at depths of 1000 m or more and a knowledge of the ocean currents in such areas. Fish aggregation around the FAD's is due to the concentration of small fishes in the area and hence large concentration of young tunas could be anticipated in these areas. Thus it is to be noted that these devices may lead to growth overfishing in view of the nature of aggregation of tunas. The report of landings of large quantities of early juveniles and young skipjack (weighing 70-100 gms each, 12-14 cm in length) to the tune of 100 tonnes per day during the 1981 season at General Santos City, Philippines, by the commercial ring net and purse seine fishery (Floyd and Pauly 1981) is one such instance. According to them, it is possible that *payaos* have apparently contributed to growth overfishing in Philippines because they render small tunas accessible to the fisheries. Installation of FAD's and strict monitoring of the catch for size and species, if not adhered to from the beginning, will lead to negative results as reported above.

A gap analysis would indicate that the difference between today's and projected production from the small scale sector by 2000 A.D. is about 60,000 tonnes of tunas. The known distribution of tunas and the information on the fishery which are indicative enable us to suggest that we may be able to enhance the production of tunas by planned development of the small scale fishery sector. The areas which require immediate attention and encouragement is the intermediate level of operation in the artisanal sector in our country. Of the total targeted production, about 25,000 tonnes of tunas could be taken by development and diversification in the fishery involving operation of catamarans, canoes with outboard engines and mechanised boats (32' size) for gillnetting; about 30,000 tonnes by medium sized purse seiners and about 5,000 tonnes by employing bait boats using pole-and-line gear.

Purse seine fishery

Under the large scale commercial tuna fishery from the surface waters of the high seas, a concerted effort should be made for the proper development and management of purse seine fishery. Under the plan for the management of tuna fishery in the Indian Ocean, Silas and Pillai (1982) discussed different aspects of the surface fishery for tunas in the Indian Ocean *in vitro*. Successful surface fishery for tunas can be established by large scale purse seine operations through joint venture/ownership arrangements. Immediate effort should be made to develop the operational facility for tuna purse seining in areas such as Andaman Sea which has a high potential for surface species. In this context training programme for personnel on the operational side for operation of large purse seiners will be necessary. Further, for the proper development and management of the purse seine fishery, environmental parameters such as the thermocline structure and current pattern are prerequisites. Information presented earlier by Silas and Pillai (1982) are indicative of the prevailing conditions in the Indian Ocean. Satellite imagery of sea surface characteristics will form an important tool to pinpoint areas of concentration of surface shoaling tunas such as skipjack young yellowfin and albacore. The development of surface fishery will result in harvesting of young yellowfin tuna which if not regulated will have an adverse effect on the fishery for adults which are taken by the regular longline gear.

In the present context, the production target by 2000 A.D. through the operation of larger purse seiners from the surface waters of the high seas is about 150,000 tonnes. A total of about 110,000 tonnes of tunas per annum from the EEZ and contiguous high seas could be produced by employing two categories of large purse seiners such as 10-12 purse seiners each of annual production capacity of 6000 tonnes and 20 purse seiners each of 4000 tonnes production capacity.

Longline fishery

Silas and Pillai (1982) dealt with in detail different aspects of longline fishery including the operational methods, constraints and management problems from within the EEZ of India and the high seas. In order to increase production of oceanic tunas, and to achieve production targets, it is imperative that we should enter into tuna longline fishery, especially deep longlining for deep swimming tunas such as bigeye tunas, initially through joint venture. It is estimated that about 150 longliners each with capacity to produce around 450 tonnes of tunas annually are required to achieve the production target of 60,000-75,000 tonnes by 2000 A.D. In this connection, better utilisation of by-catch such as pelagic sharks economically is another area needing attention.

Infrastructure priorties

Embarking in tuna fishery in a large way is highly capital intensive and it will not be economical to fish the tuna resources of the EEZ of India and contiguous high seas with only an internal market in view. While some amount of coastal species such as tuna-like fishes will find an internal market, the major option should be augmentation of exports of tunas and tuna products as part of an overall strategy of diversification of exports of marine products. In connection with the large scale production of tunas by large purse seiners and longliners, foreign market demand for selling the products should be taken into consideration. It is estimated that a demand for about 150,000 tonnes of tunas (whole weight) or about 125,000 tonnes of frozen and canned tuna products could be expected for the external market. Initially joint ventures with buy back arrangements should accellerate development.

Building up of infrastructure for export of tunas and tuna products is an essential pre-requisite and this would involve :

— Harbour and facilities for landing, handling and transporting ;
— Frozen storage
— Product development
— Export oriented canneries (with production capacity of 6000-10,000 tonnes) provided with required water and electricity supply and pollution preventive measures ;
— Quality control and streamlining for inspection for export.

The current trend of events indicate that even for the present production of tunas, a proper internal marketing system has not been developed nor have we done any major improvements in post-harvest technology. In India, average landing of tunas from the coastal waters during 1982-'83 was about 19,000 tonnes. Silas and Pillai (1982) pointed out the imperative necessity for the development of post-harvest technology for the better utilisation of tunas harvested from the coastal waters. There is considerable scope for the exploitation of the 'red meat' tunas *E. affinis*, *A. thazard* and *A. rochei* and it will be necessary to develop internal market for these species in fresh, frozen and processed form through improved post-harvest technology. The following basic infrastructures should be considered while charting out options for the development of internal market for tunas and tuna products :

— Landing facilities ;
— Cold storage facilities ;
— Transportation of iced and frozen tuna meat ;
— Larger product on of "masmin" a smoked dried product and products such as fish paste;
— Tuna canneries to produce canned packs of tunas for internal consumption ;
— Processing of tuna wastes for animal feeds.

In the tuna fishery development and management programme by India, a favourable point is the availability of abundant skilled and semi-skilled labour. We feel that in the field of small scale boatbuilding and replacement of boats, the existing facilities can be utilised with regard to manpower. For the production of fibre glass and intermediate type of boats (60') existing facilities are to be modernised and new facilities added to them. For the manpower requirement to construct larger purse seiners and longliners, joint venture programmes, purchase agreements as well as indigenous construction through the development of yards or commissioning of new yards are required. Financial assistance in the form of subsidies for constructing suitable fishing vessels is one of the options available for tuna fishery development in India. In the programme of augmentation of tuna production through the channels discussed earlier, available manpower could also be effectively utilised in the fishing operations on board the vessels, shore based establishments, handling of fish at harbour, transportation, internal marketing and in the processing of tunas into products for export and internal markets.

Under the 'Options open for tuna fishery development in the EEZ of India and the contiguous high seas' Silas and Pillai (1982) suggested the following :

—Augmentation of the production of coastal species of tunas through diversification in the small scale fishery with greater use of drift gillnets and other suitable gears ; introduction and development of surface fishery for skipjack and other tunas ; introduction of larger boats for live-bait pole-and-line fishery in the Lakshadweep for undertaking prolonged fishing trips and improvements in operational techniques ; baitfish culture and production for better development of pole-and-line fishery ; entry into longline fishery and large scale purse seine fishery initially through chartering or joint venture programmes ; identification of productive areas for tuna fishery, their spawning and feeding grounds and other environmental features including satellite technology for locating tuna aggregating areas ; financial assistance for building up infrastructure and acquiring or constructing suitable fishing vessels ; development of alternate source of energy in tuna fishery for making operations more viable and economical and viable in small scale sector ; augmentation of production in the island areas and along the coasts by use of FAD's ; and improvements in the post-harvest technology, product development and marketing combined with infrastructure for demand for tuna within the country and in the export market'.

With a view to benefit the tuna fishing industry, in a series of charts (Figs. 1-5) showing the linkages and the infrastructure facilities involved in the operation of tuna longline fishery, tuna purse seining, pole-and-line (live-bait) fishery and drift gillnetting for tunas and the infrastructure facilities required for the general use of the FAD's are presented. The proformae (I-V) given at the end are for data acquisition for stock assessment.

PROJECTIONS

The present level of cost of tunas is indicative of the fact that based on the production targets for 2000 A.D. mentioned earlier, the total revenue from the surface and sub-surface fisheries for tunas in the shelf waters and from the EEZ and contiguous high seas of India could be as follows:

(i) *Yellowfin and bigeye tuna*

Graded as category 'A'; for about 75,000 tonnes at the rate of Rs. 15,000 per tonne—Rs. 112,5000,000.

(ii) *Skipjack tuna*

Graded as category 'B'; for about 150,000 tonnes at the rate of Rs. 5,000 per tonne—Rs. 75,0000,000.

(iii) *Coastal tunas*

Graded as 'C'; for about 75,000 tonnes at the rate of Rs. 3000 per tonne—Rs. 22,5000,000.

Total revenue is thus estimated as Rupees 210 crores for an estimated production of about 300,000 tonnes of tunas by 2000 A.D. To achieve this, the most important single factor today is a Policy decision on—whether India should seriously enter tuna fisheries in a large way or not.

Fig. 1

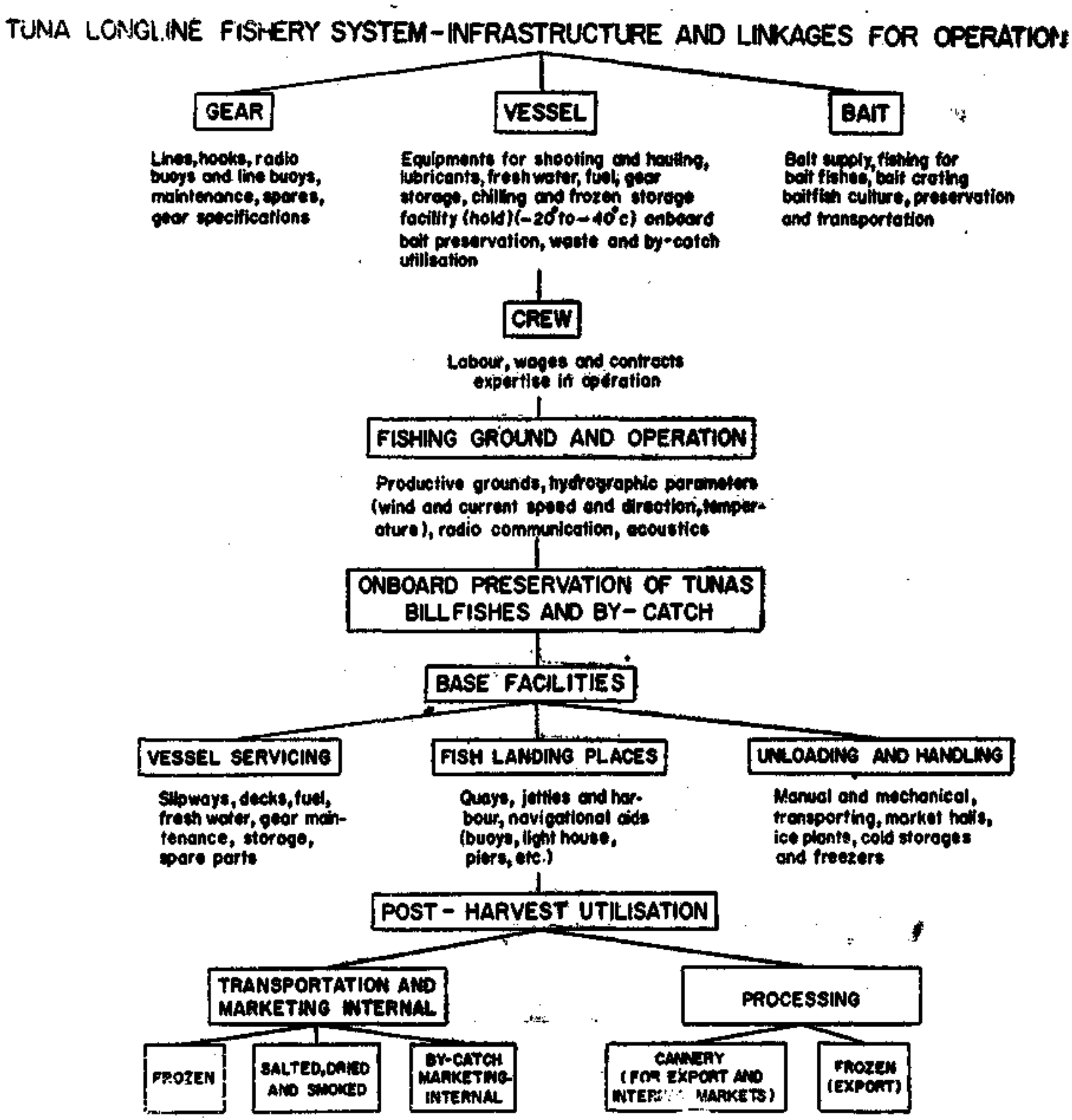

TUNA LONGLINE FISHERY SYSTEM-INFRASTRUCTURE AND LINKAGES FOR OPERATION
GEAR
Lines, hooks, radio buoys and line buoys, maintenance, spares, gear specifications
VESSEL
Equipments for shooting and hauling, lubricants, fresh water, fuel, gear storage, chilling and frozen storage facility (hold) (-20° to -40°c) onboard bait preservation, waste and by-catch utilisation
BAIT
Bait supply, fishing for bait fishes, bait crating baitfish culture, preservation and transportation
CREW
Labour, wages and contracts expertise in operation
FISHING GROUND AND OPERATION
Productive grounds, hydrographic parameters (wind and current speed and direction, temperature), radio communication, acoustics
ONBOARD PRESERVATION OF TUNAS BILLFISHES AND BY-CATCH
BASE FACILITIES
VESSEL SERVICING
Slipways, decks, fuel, fresh water, gear maintenance, storage, spare parts
FISH LANDING PLACES
Quays, jetties and harbour, navigational aids (buoys, light house, piers, etc.)
UNLOADING AND HANDLING
Manual and mechanical, transporting, market halls, ice plants, cold storages and freezers
POST-HARVEST UTILISATION
TRANSPORTATION AND MARKETING INTERNAL
PROCESSING
FROZEN
SALTED, DRIED AND SMOKED
BY-CATCH MARKETING-INTERNAL
CANNERY (FOR EXPORT AND INTERNAL MARKETS)
FROZEN (EXPORT)

Fig. 2

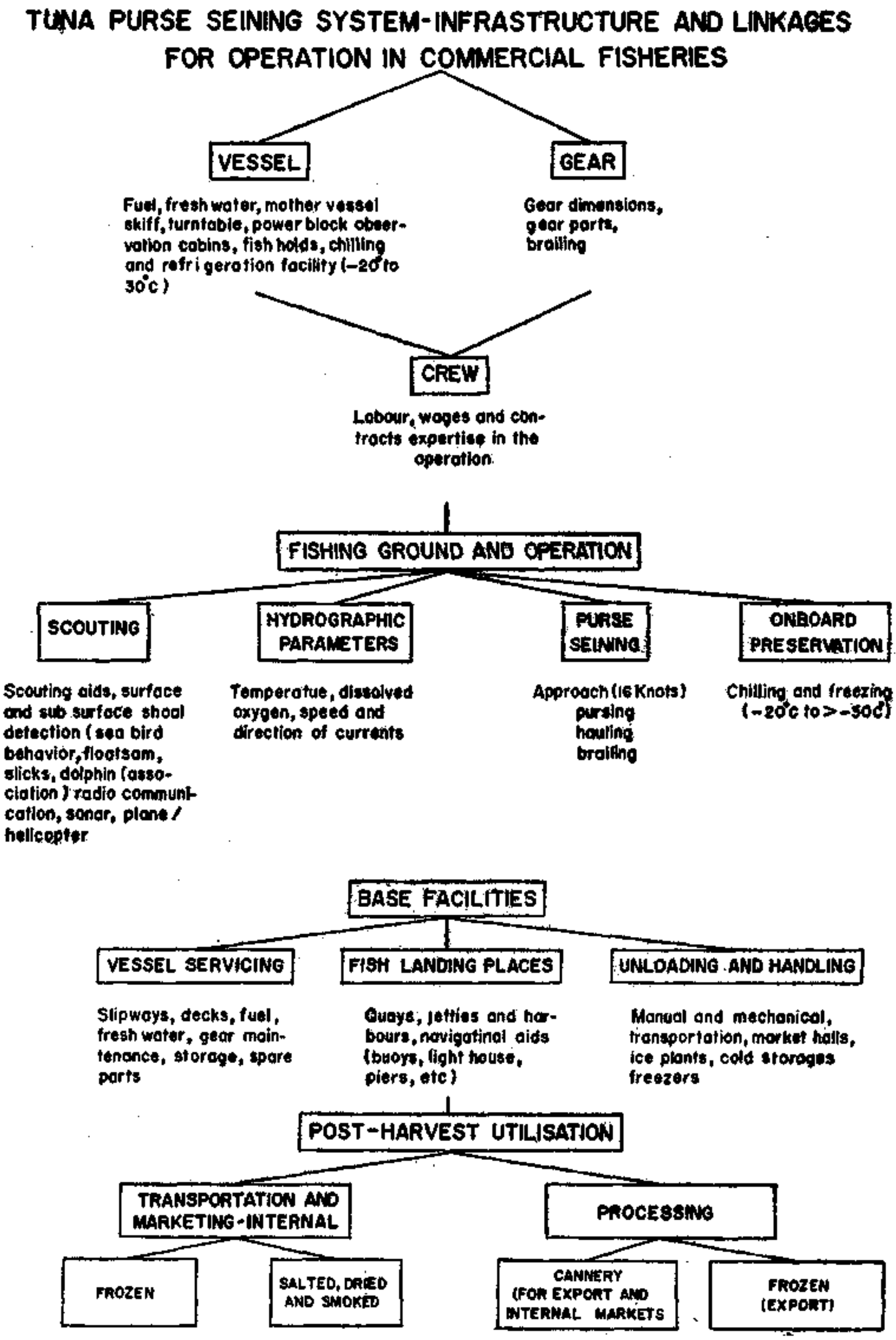

TUNA PURSE SEINING SYSTEM-INFRASTRUCTURE AND LINKAGES FOR OPERATION IN COMMERCIAL FISHERIES
VESSEL
GEAR
Fuel, fresh water, mother vessel skiff, turntable, power block observation cabins, fish holds, chilling and refrigeration facility (–20°to 30°c)
Gear dimensions, gear parts, brailing
CREW
Labour, wages and contracts expertise in the operation
FISHING GROUND AND OPERATION
SCOUTING
HYDROGRAPHIC PARAMETERS
PURSE SEINING
ONBOARD PRESERVATION
Scouting aids, surface and sub surface shoal detection (sea bird behavior, floatsam, slicks, dolphin (association) radio communication, sonar, plane / helicopter
Temperatue, dissolved oxygen, speed and direction of currents
Approach (16 Knots) pursing hauling brailing
Chilling and freezing (–20°c to >–30°c)
BASE FACILITIES
VESSEL SERVICING
FISH LANDING PLACES
UNLOADING AND HANDLING
Slipways, decks, fuel, fresh water, gear maintenance, storage, spare parts
Quays, jetties and harbours, navigatinal aids (buoys, light house, piers, etc)
Manual and mechanical, transportation, market halls, ice plants, cold storages freezers
POST-HARVEST UTILISATION
TRANSPORTATION AND MARKETING-INTERNAL
PROCESSING
FROZEN
SALTED, DRIED AND SMOKED
CANNERY (FOR EXPORT AND INTERNAL MARKETS
FROZEN (EXPORT)

Fig. 3

POLE AND LINE (LIVE-BAIT) TUNA FISHING SYSTEM-INFRASTRUCTURE AND LINKAGES FOR OPERATION IN COMMERCIAL FISHERIES (MEDIUM SIZE)

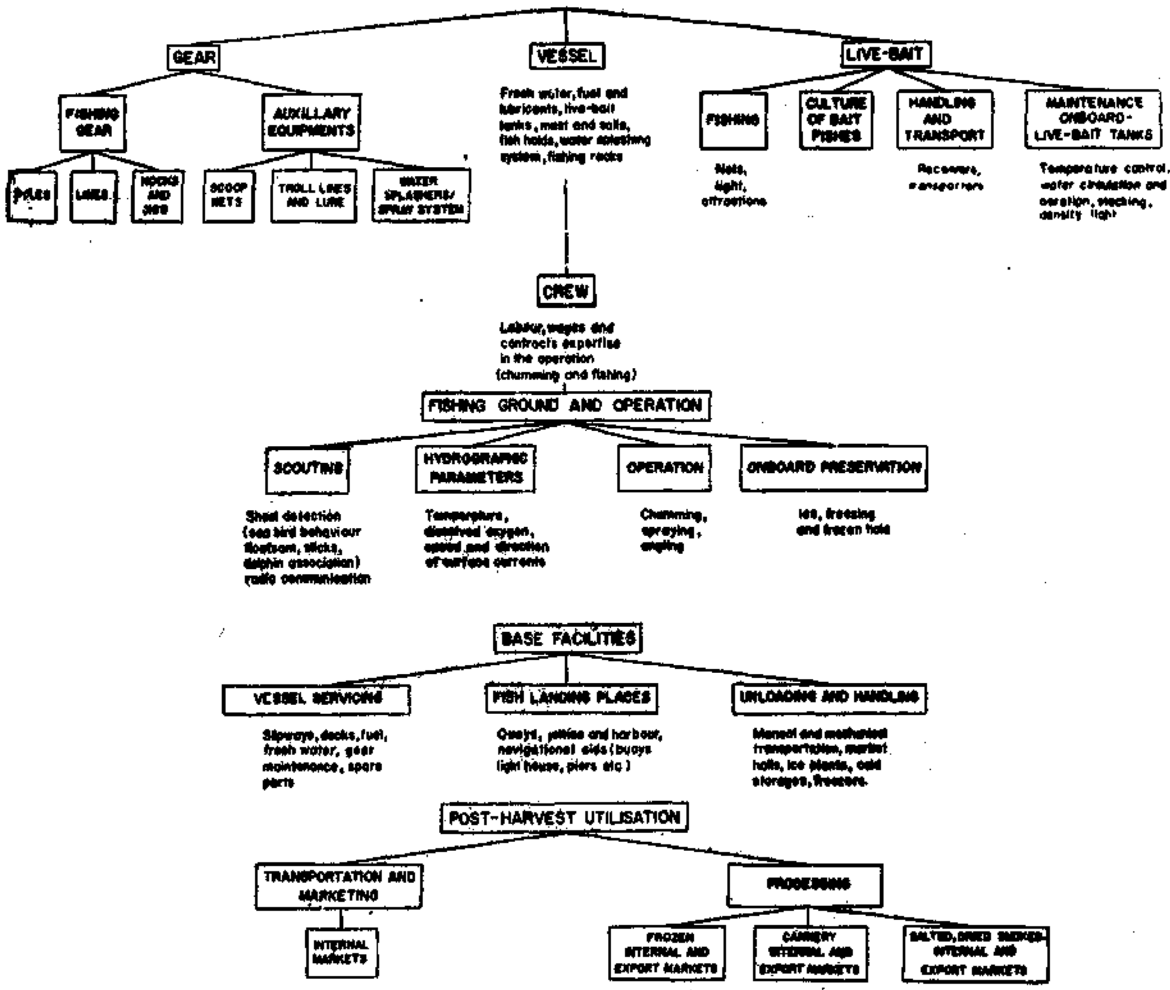


Fig. 4

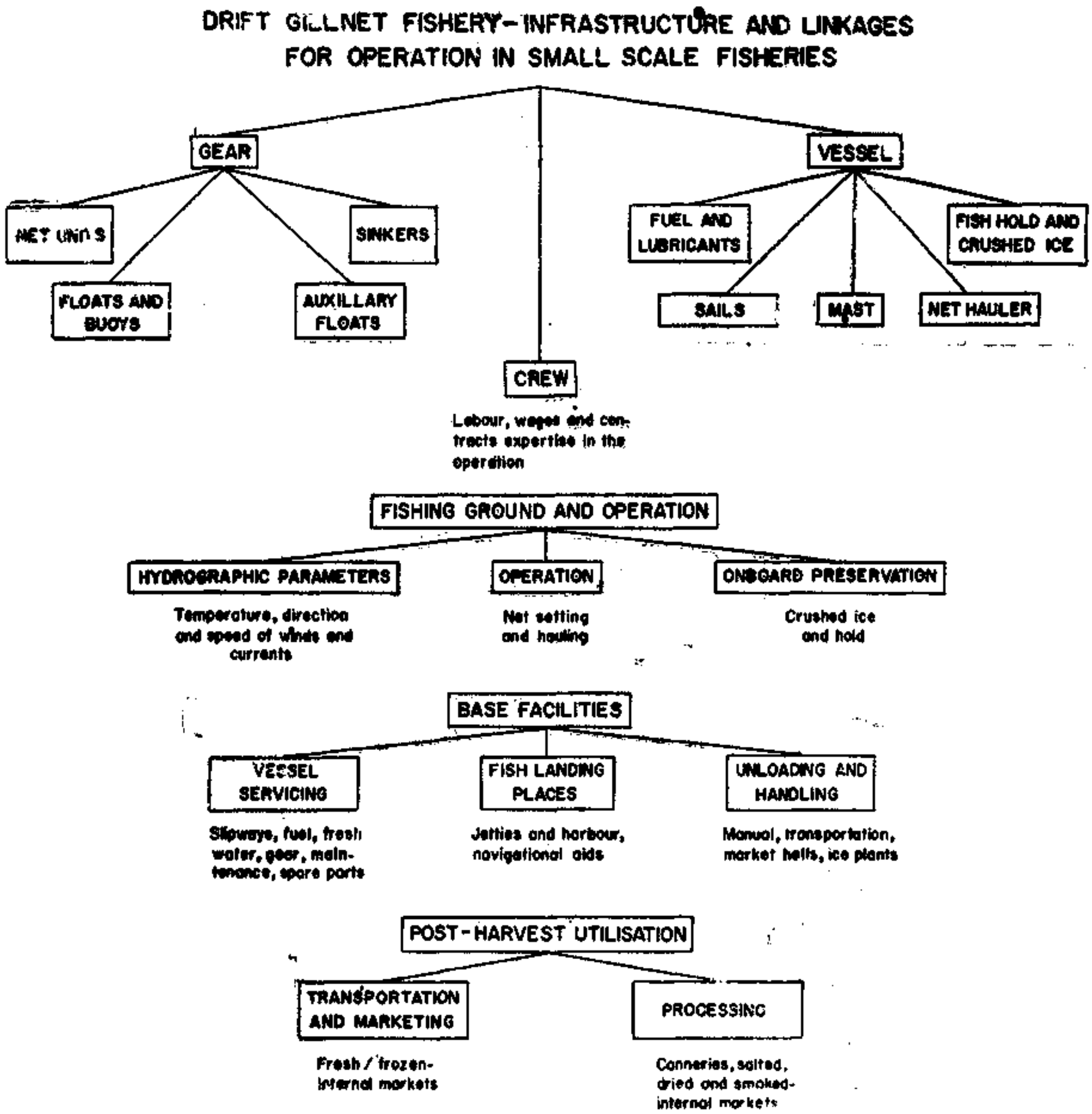
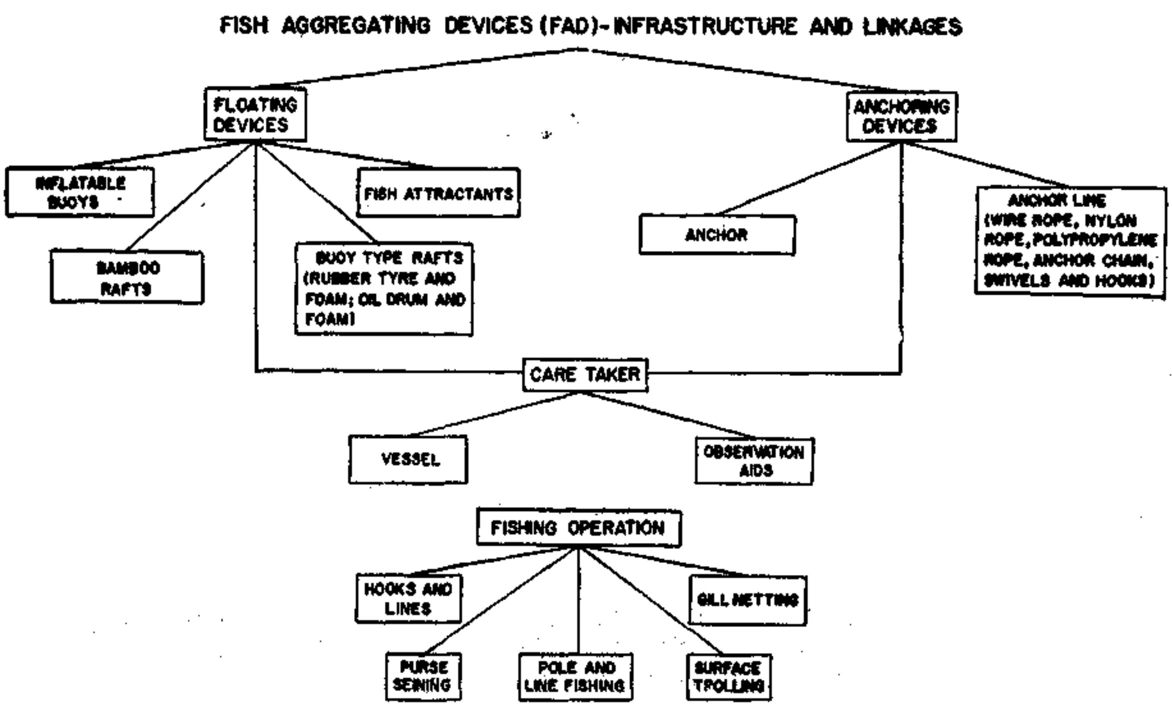

DRIFT GILLNET FISHERY–INFRASTRUCTURE AND LINKAGES FOR OPERATION IN SMALL SCALE FISHERIES
GEAR
NET UNITS
SINKERS
FLOATS AND BUOYS
AUXILLARY FLOATS
VESSEL
FUEL AND LUBRICANTS
FISH HOLD AND CRUSHED ICE
SAILS
MAST
NET HAULER
CREW
Labour, wages and contracts expertise in the operation
FISHING GROUND AND OPERATION
HYDROGRAPHIC PARAMETERS
Temperature, direction and speed of winds and currents
OPERATION
Net setting and hauling
ONBOARD PRESERVATION
Crushed ice and hold
BASE FACILITIES
VESSEL SERVICING
Slipways, fuel, fresh water, gear, maintenance, spare parts
FISH LANDING PLACES
Jetties and harbour, navigational aids
UNLOADING AND HANDLING
Manual, transportation, market halls, ice plants
POST-HARVEST UTILISATION
TRANSPORTATION AND MARKETING
Fresh / frozen-internal markets
PROCESSING
Canneries, salted, dried and smoked-internal markets

Fig. 5


FISH AGGREGATING DEVICES (FAD)- INFRASTRUCTURE AND LINKAGES
FLOATING DEVICES
ANCHORING DEVICES
INFLATABLE BUOYS
FISH ATTRACTANTS
BAMBOO RAFTS
BUOY TYPE RAFTS (RUBBER TYRE AND FOAM; OIL DRUM AND FOAM)
ANCHOR
ANCHOR LINE (WIRE ROPE, NYLON ROPE, POLYPROPYLENE ROPE, ANCHOR CHAIN, SWIVELS AND HOOKS)
CARE TAKER
VESSEL
OBSERVATION AIDS
FISHING OPERATION
HOOKS AND LINES
GILL NETTING
PURSE SEINING
POLE AND LINE FISHING
SURFACE TROLLING

PROFORMA

ESTIMATED FISHING EFFORT AND CATCH

Year :

Centre :

Resource :

Month	Name of the fishing gear/craft									Total		
	E	C	C/E	E	C	C/E	E	C	C/E	SE	C	C/SE
Jan.												
Feb.												
Mar.												
Apr.												
May												
Jun.												
Jul.												
Aug.												
Sept.												
Oct.												
Nov.												
Dec.												
Total :												

E—Number of units/Trawling hours : *C*—Catch (kg) : *C/B*—Catch per boat/Trawling hour* : *SE*—Standardised effort (specify) and *C/SE*—Catch per standardised effort.

(* Indicate trawling speed and width (m) of Bottom trawl)

PROFORMA 11

ESTIMATE SPECIES COMPOSITION OF CATCH
(By Wt.)

Year : **Centre :**
Fishing gear : **Resource :**

Month	Catch composition of species (Specify)	Monthly Total (kg)
Jan.		
Feb.		
Mar.		
Apr.		
May		
Jun.		
Jul.		
Aug.		
Sep.		
Oct.		
Nov.		
Dec.		
Annual Total (Wt)		
%		

PROFORMA III

MONTH-WISE ESTIMATED SIZE-DISTRIBUTION OF DOMINANT SPECIES (NO. OF FISH PER UNIT EFFORT) IN THE CATCH

Year : Centre :

Gear : Species :

Length groups mm/cm*	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
0—													
5—													
10—													
15—													
20—													
25—													
30—													
35—													
40—													
"													
"													
"													
"													
100—													
105—													
110—													
115—													
120—													
125—etc.													
Sample Size (No. measured)													

* UNIT of measure in (mm) for smaller species and (cm) for larger species.
Groups : O = (0 - 4), 5 = (5-9) and 10 = (10-14) units of measure.

PROFORMA IV

GONADAL CONDITION OF ADULTS*

Year : Centre :

Species :

Sex-ratio/ Maturity etc. :	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total	
													No.	%
Male														
Female														
Resting (II)														
Developing (II-IV)														
Gravid (V-VI)														
Spent (VII)														
Sample size (in number)														

* All fish above the size at first maturity *only need* be included.

PROFORMA V

FEEDING CONDITION

Year :

Centre :

Species :

Month	Day (0600-1800 hrs)				Night (1800-0600 hrs)				Sample size	Name dominant food items
	0	0.5	1	1+	0	0.5 (Nos.)	1	1+		
Jan.										
Feb.										
Mar.										
Apr.										
May										
Jun.										
Jul.										
Aug.										
Sep.										
Oct.										
Nov.										
Dec.										
Total No.										
Per cent										

Scale : 0 = Empty, 0.5 = Half full, 1 = Full and 1 + = Gorged.

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