Marine Fisheries Scenario

INDIA-EEZ Map

Contribution to marine fish landings (%) by region (2022)
- SW Region 41.1%
- SE Region 28.3%
- NW Region 21.4%
- NE Region 9.2%

Operational fishing fleet structure of India (Source: ReALCRaft)

	Registered	Operational
MECHANIZED	66442	55330
MOTORIZED	136061	112567
NON-MOTORIZED	41690	23560

[1] In India, the mechanized fleet pertains to fishing vessels fitted with inboard engines that are used for both propulsion and hauling the gear. The mechanized boats have a wheelhouse, and the entire fleet is below 24-meter length overall (LoA).

[2] The Indian motorized fleet comprises undecked boats using outboard motors for propulsion only. The entire fleet is below 24-meter LoA.

- 1,547 marine fish landing centres
- 9 maritime states and 2 UTs & 2 Islands
- Coastline: 8118 km
- EEZ : 2.02 million sq. Km
- PY: 5.31 million tonnes (2018)
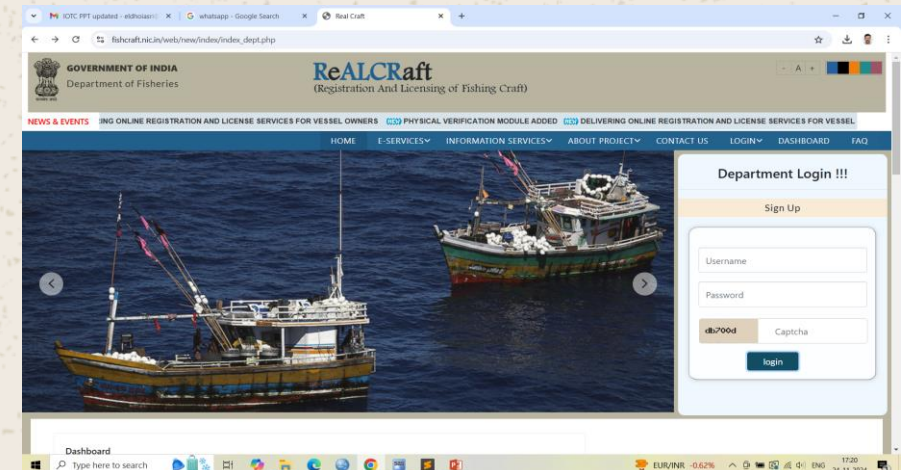
## Fisheries scenario

- India – second largest fish-producing country

- Contributes 8.92 per cent to the global fish production

- Ranks second in aquaculture production

- The fish production in 2022-23 (April-March) is 17.54 Million Tonnes comprising of marine fish production of 4.43 Million Tonnes and 13.11 Million Tonnes from Aquaculture.

- Fisheries contribute 1.1% to India's economy
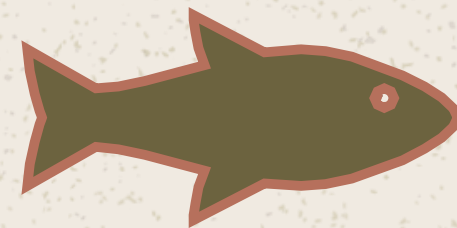
Marine fisheries scenario

- Marine fisheries – mainly artisanal/small-scale

- All vessels are <24 m LoA

- Deploys both mechanized and motorized boats, using a variety of gear

- The Lakshadweep group of Islands located in the Arabian Sea (FAO Area 51) use artisanal pole and line targeting the surface swimming oceanic species, primarily the skipjack tunas.
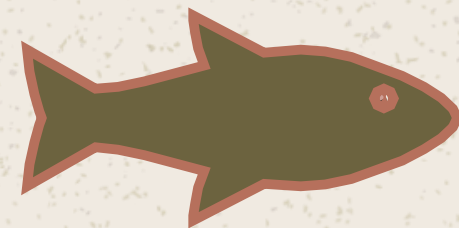
Monitoring and Assessment of Indian Marine Fishery Resources

Accomplished by two approaches;

- Sampling done at Landing Centres (by Central Marine Fisheries Research Institute (CMFRI) & Fisheries Departments of State Governments/Union Territories (UT)):- Marine Fish Landings Estimation in India

- Exploratory surveys at Sea (by Fishery Survey of India, FSI)

Monitoring and Assessment of Indian Marine Fishery Resources

Information on

- ❖ **landings**

- ❖ **effort**

- ❖ **biological aspects**

- ❖ **socio-economic aspects**

Essential requirements for assessing the exploited stock
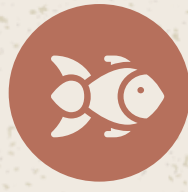
Marine Fisheries Data Collection

India is one among few countries where a system based on sampling theory is used to collect marine fish catch statistics.

HISTORY

Initiated the process of collection of data on marine fish catch, effort, biological parameters etc.

1947

Pilot surveys along the Malabar coast by IASRI based on a three stage stratified sampling

1949

Initiated marine fish landings data collection along the west coast through stratified multistage sampling design

1959

The stratified multistage random sampling design for the entire coast became operational

1961

Sampling scheme evaluated by independent statistical experts (NIO)

1972

Marine Fisheries Data Collection

Scientific Basis of the Sampling Scheme

SAMPLING TECHNIQUE FOR ESTIMATING THE CATCH OF SEA FISH IN INDIA

P. V. SUKHATME
F.A.O. Rome, Italy

V. G. PANSE AND K. V. R. SASTRY
I.C.A.R., New Delhi, India

Marine Fisheries Data Collection

Why Sampling?

In 2022, there were 55,05,971 boat trips in the landing centres to be enumerated for arriving at the exact landings figure

We require 30,588 man months/year for complete enumeration

B

C

A scientifically valid sampling scheme is the only feasible way for estimating fish landings and fishing effort

Fish landings take place all along the coast line in 1,547 landing centres including fisheries harbours during day and night through out the year

D

A
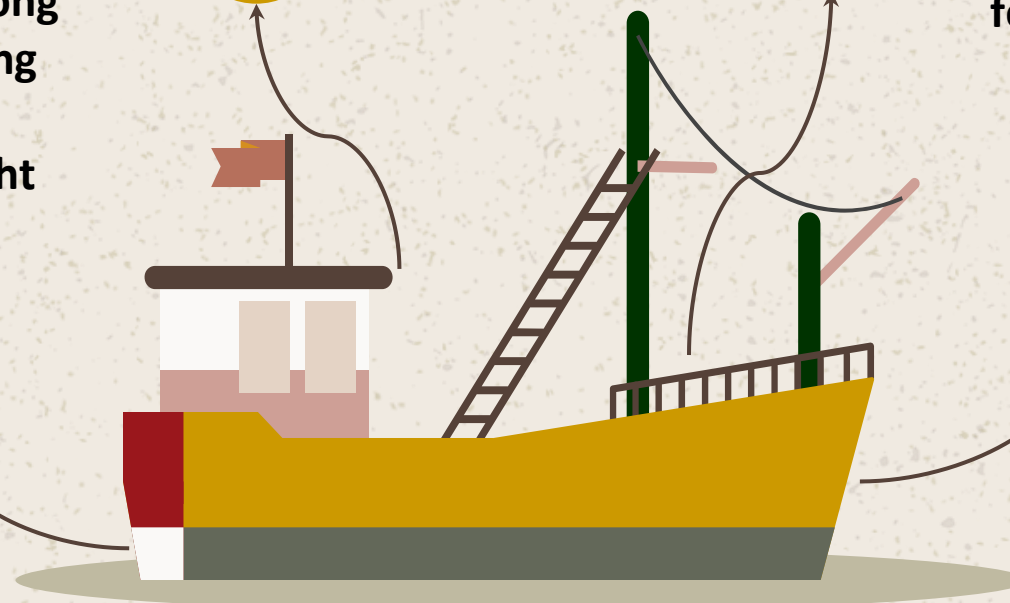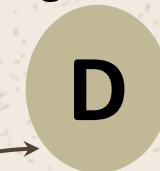
1,547 Landing Centres…..(Handbook of Fishery Statistics, 2023)

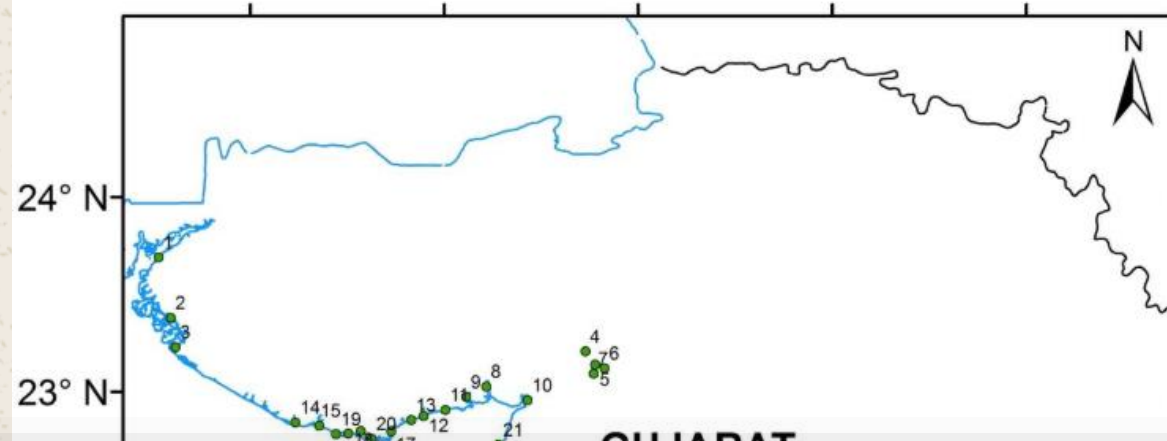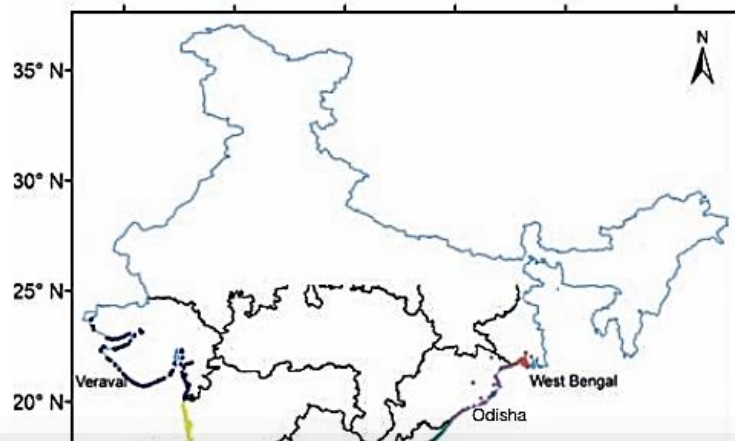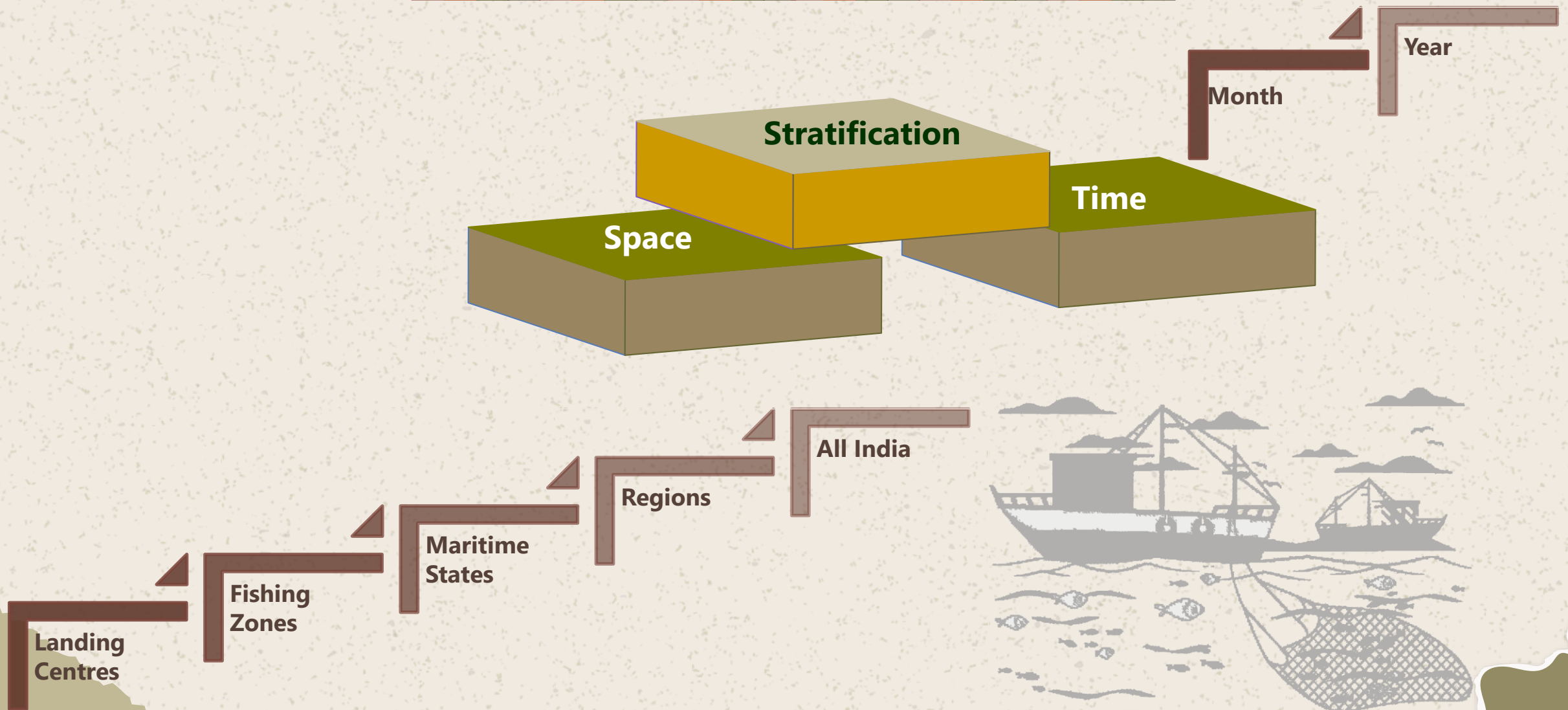| S.No	Name of landing centre	District	Latitude	Longitude	Gears Operated	Period of Operation	Distance covered for fishing
1	Narayan sarovar	Kutch	23.6894	68.5257	Mechanised gillnet, Motorised gillnet	Throughout year except monsoon	upto 15 km
2	Gunau	Kutch	23.3785	68.5888	Mechanised gillnet, Motorised gillnet	Throughout year except monsoon	upto 20 km
3	Jakhau	Kutch	23.2284	68.6136	Trawl, Mechanised gillnet, Motorised gillnet, Indigenous gillnet	Throughout year except monsoon	upto 60 km
4	Surajbari	Kutch	23.2062	70.7271	Stake nets, Indigenous gillnet	Throughout year	upto 7 km
5	Hanjisar	Rajkot	23.1390	70.7766	Indigenous gillnet, Stake nets	Throughout year except monsoon	upto 4 km
6	Kajarada	Rajkot	23.1196	70.8255	Indigenous gillnet, Stake nets	Throughout year	upto 4 km
7	Maliya	Rajkot	23.0918	70.7695	Indigenous gillnet, Stake nets	Throughout year	upto 4 km

iotc ctoi

Marine Fisheries Data Collection

Stratification

Space

Time

Month

Year

All India

Regions

Maritime States

Fishing Zones

Landing Centres

Marine Fisheries Data Collection

Stratified Multistage Random Sampling Design

Number of landing centres

Single Centre

Major Centres – Stratum I

Minor Centres – Stratum II
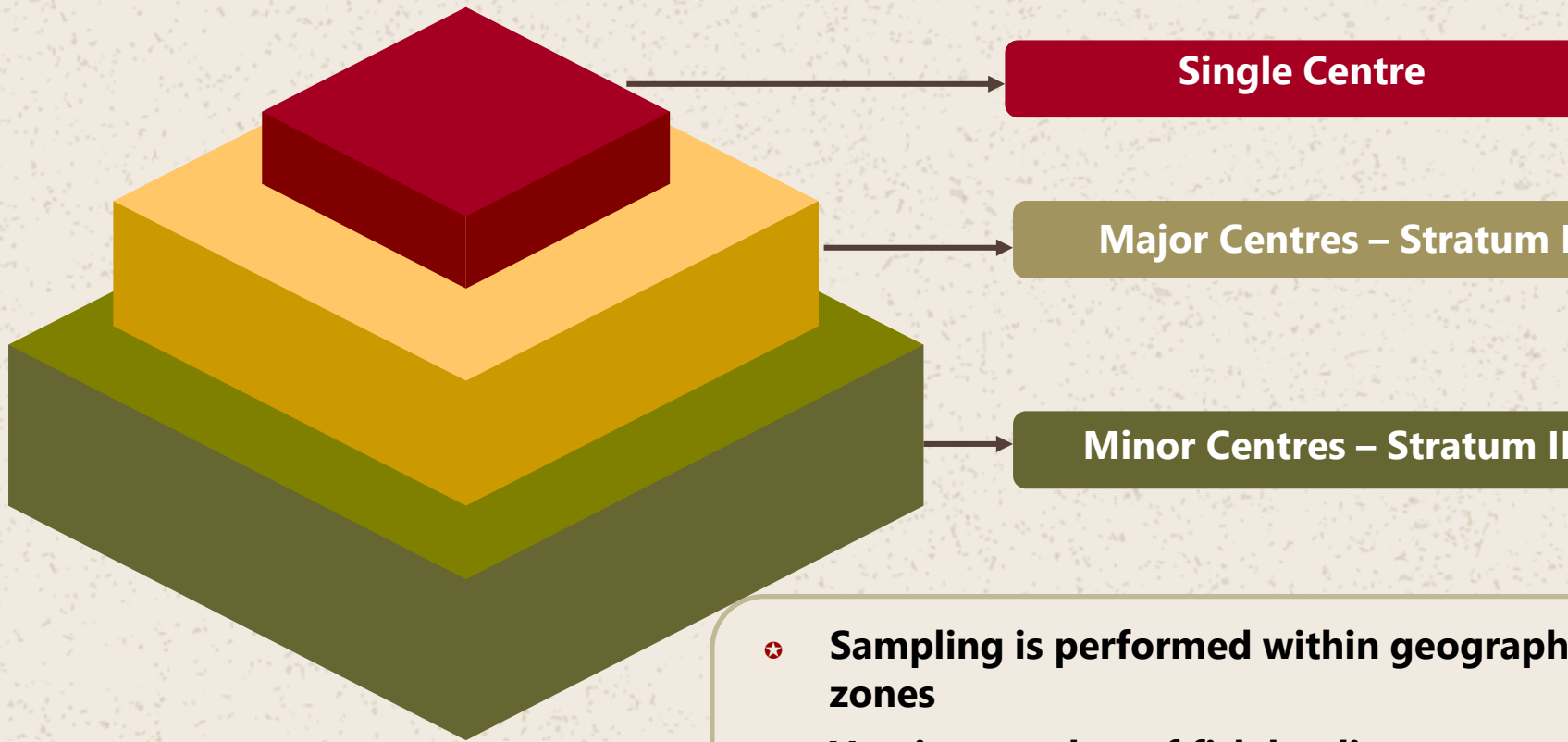
Criteria for stratification within fishing zones

- ✪ **Variation in fishing intensity**
- ✪ **Type of fishing craft and fishing method**
- ✪ **Number of fishing crafts**

- ✪ **Sampling is performed within geographical areas referred as fishing zones**
- ✪ **Varying number of fish landing centres fall under fishing zones**
- ✪ **Single centre zones - Landing centres with relatively high intensity of fishing activity**

Marine Fisheries Data Collection

Stratified Multistage Random Sampling Design

Primary Stage Unit
Landing centre day

Second Stage Unit
Fishing boats

Selection of Second Stage Units

- ○ **Not practical to record the catches of all fishing units (boats) landed**

- ○ **Sampling of the units becomes essential**

Marine Fisheries Data Collection

Selection of Primary Stage Units

- ✪ A month is divided into 3 groups, each of 10 days

- ✪ From the first five days of a month, a day is selected at random

- ✪ Then, the next 5 consecutive days are automatically selected

Time strata	Days in a month									
1	1	2	3	4	5	6	7	8	9	10
2	11	12	13	14	15	16	17	18	19	20
3	21	22	23	24	25	26	27	28	29	30
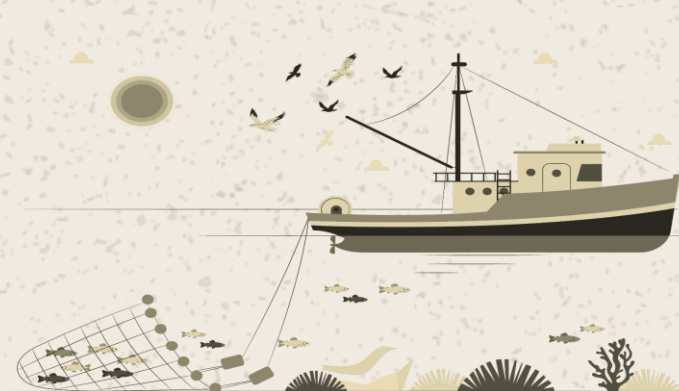
Marine Fisheries Data Collection

Selection of Primary Stage Units

- ✪ From this, three clusters of two consecutive days are formed.
- ✪ In the remaining ten day groups, the clusters are systematically selected with an interval of 10 days.

Time strata	Days in a month									
1	1	2	3	4	5	6	7	8	9	10
2	11	12	13	14	15	16	17	18	19	20
3	21	22	23	24	25	26	27	28	29	30

Marine Fisheries Data Collection

Fishing unit - Secondary stage unit

Period	Duration
Period 1	1200 to 1800 hours on 1st day
Period 2	1800 hours to next morning 0600 hour
Period 3	0600 to 1200 hours on 2nd day

Marine Fisheries Data Collection

Period of Observation

Number of Boats landed	Fraction to be observed
Less than or equal to 15	100%
Between 16 and 19	First 10 and the balance 50 %
Between 20 and 29	1 in 2
Between 30 and 39	1 in 3
Between 40 and 49	1 in 4
Between 50 and 59	1 in 5 and so on

Marine Fisheries Data Collection

Recording of Fish Landings

Fishing Effort

Gears operated

Other details

1st

2nd

3rd

4th

5th

6th

Species wise catch

Type of Crafts

Hauls

iotc ctoi

Marine Fisheries Data Collection

Fish Catch
Survey & Analysis

Fisheries Research
Volume 267, November 2023, 106821

Fish Catch Survey and Analysis – An online application for deriving measures and indicators for fish stock assessment

Mini K.G. , Sathianandan T.V., Somy Kuriakose, Sindhu K. Augustine, Manu V.K., Manjeesh R., Sijo Paul, Jayasankar J., Eldho Varghese, Gopalakrishnan A.

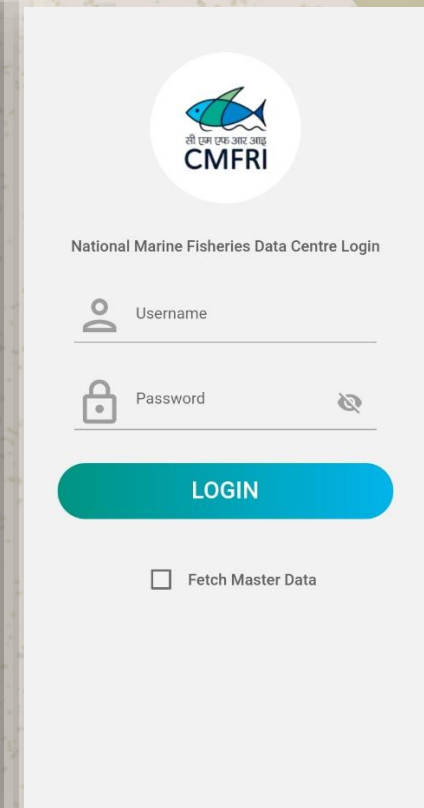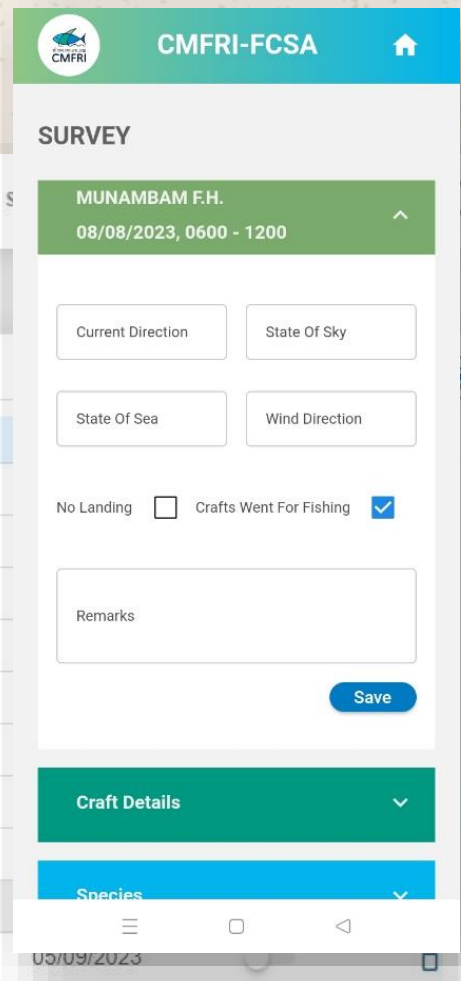# Marine Fisheries Data Collection

FCSA Mobile App

Marine Fisheries Data Collection

FCSA Mobile App

Marine Fish Landings in India (main land)-2023

3.53
3.49 million tonnes

Gujarat
8.23 / 5.03

Daman & Diu
0.91 / 0.74

Maharashtra
2.11 / 1.70

Goa
0.61 / 0.52

Karnataka
6.04 / 6.95

Kerala
6.33 / 6.87

West Bengal
1.73 / 1.90

Odisha
1.30 / 1.33

Andhra Pradesh
1.90 / 2.16

Puducherry
0.51 / 0.50

Andaman and Nicobar Islands
0.18

Tamil Nadu
5.65 / 7.22

■ 2023   ■ 2022

Landings in lakh tonnes

1.2%

3.53 million tonnes

Region-wise

NE 8%
SE 23%
SW 37%
NW 32%
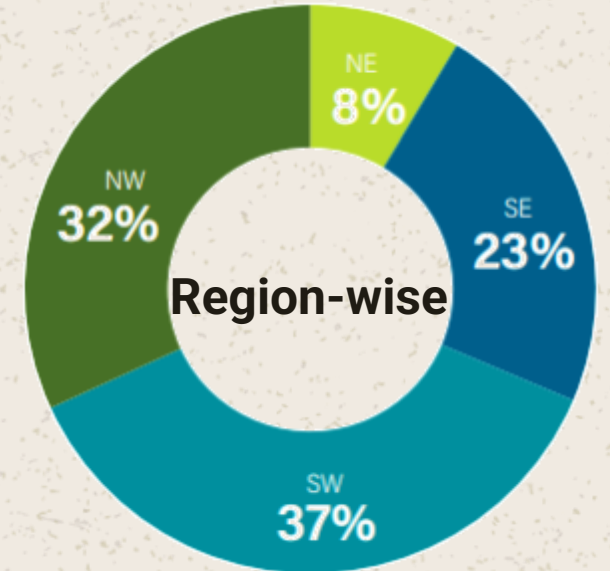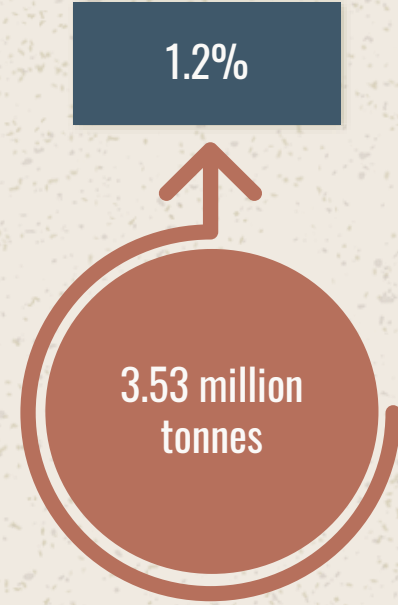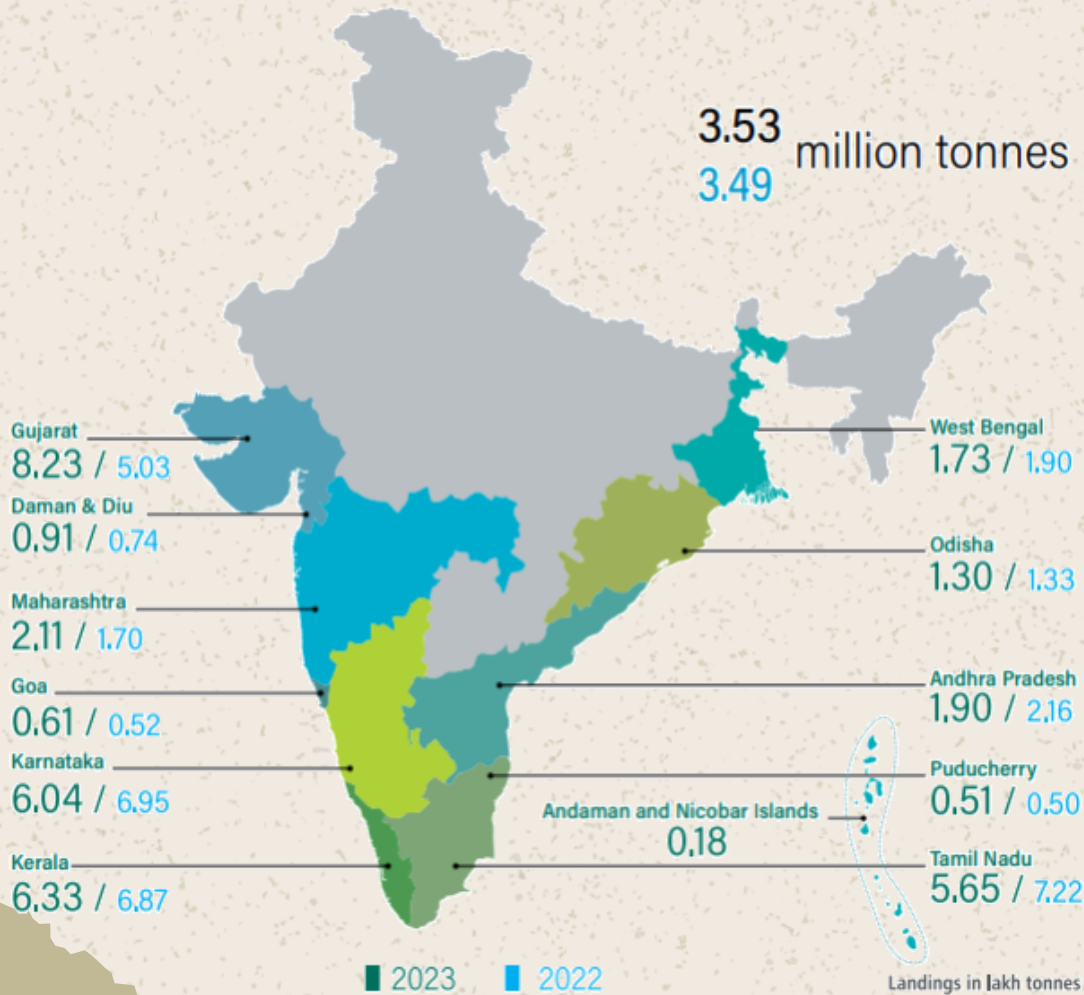
Total estimate including ANI, Seaweed, Mussels, Oysters and Clams

3.74 million tonnes
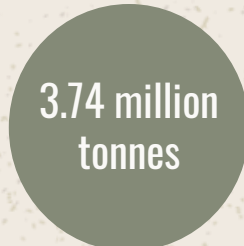
Number of Species in Landings 2022-2023

National Marine Fishery Resources Data Centre (NMFDC)

State	Mon	83Code	Group	SpecID	Species/Gear->	MDTN	MGN	MHL	MOTHS	MPS	MTN	NM	OBGN	OBHL	OBOTHS	OBPS	OBRS	OBSS	OBTN
Karnataka	01	2	Sharks	0003	*Chiloscyllium griseum*						347								
							206												
Karnataka	01	2	Sharks	0040	*Carcharhinus spp.*	45606	3				1156		1909						
Karnataka	01	2	Sharks	0048	*Carcharhinus limbatus*	1092							298						
Karnataka	01	2	Sharks	0120	*Sphyrna spp.*	15929													
Karnataka	01	4	Rays	0190	*Himantura spp.*	22832					3558	389							
Karnataka	01	4	Rays	0192	*Maculabatis gerrardi*	2749													
Karnataka	01	4	Rays	0196	*Himantura uarnak*	4258													
Karnataka	01	5	Eels	0606	*Muraenesox cinereus*	76293													
Karnataka	01	6	Catfishes	0545	*Arius spp.*	35708						51							
Karnataka	01	8	Wolf herring	0430	*Chirocentrus spp.*	31				310									
Karnataka	01	8	Wolf herring	0431	*Chirocentrus dorab*	21000				558									
Karnataka	01	9	Oil sardine	0362	*Sardinella longiceps*												2025		
Karnataka	01	10	Lesser sardines	0355	*Sardinella spp.*							2083							
										219									
										256							5062		
Karnataka	01	10	Lesser sardines	0361	*Sardinella gibbosa*	258019				2	3330	310	6269				5		
Karnataka	01	16	Stolephorus	0385	*Stolephorus spp.*	133806					3137								
Karnataka	01	16	Stolephorus	0389	*Encrasicholina devisi*	177375													
													1730						
Karnataka	01	18	Thryssa	0400	*Thryssa spp.*	165496					8618	4898	6				1125		
Karnataka	01	18	Thryssa	0401	*Thryssa baelama*							579							
Karnataka	01	18	Thryssa	0410	*Thryssa mystax*	76318					1742		1068				6413		
Karnataka	01	19	Other clupeids	0276	*Megalops cyprinoides*	1786													

Exploratory surveys at Sea (FSI)

11 survey vessels operated from bases distributed all along Indian coasts

Exploratory surveys at Sea (FSI)

Fishery Survey of India (FSI) operational Bases and survey vessels					
Name of FSI Base office	Name of vessel	Vessel type	LoA (m)	GRT	BHP
Mumbai	Matsya Vrushti	Longliner	37.5	465	1215
	Matsya Nireekshani	Stern trawler	40.5	329.3	2030
Mormugao	Yellow Fin	Longliner	35.7	310	800
	Sagarika	Stern trawler	28.8	189	650
Kochi	Matsya Varshini	Trawler-cum-purse seiner	36.5	268.8	1160
	Lavanika	Stern trawler	24	151	500
Chennai	Matsya Drushti	Longliner	37.5	465	1215
	Samudrika	Stern trawler	28.8	189	650
Visakhapatnam	Matsya Shikari	Stern trawler	39.8	352.4	1740
	Matsya Darshini	Trawler-cum-purse seiner	36.5	268.8	1160
Port Blair	Blue Marlin	Longliner	35.7	310	800

Survey Components

- Demersal resources survey and research programme along the coasts of India

- Survey of oceanic tuna and allied resources in the Indian EEZ

- Pelagic resources surveys in the continental shelf areas using pelagic trawls and drift gillnets and

- Experimental fishing with traps, hand line, purse seining, squid jigging, bottom set longlining, trawling and bottom set vertical long lining.

Objectives

- ✪ **Spatio-temporal estimation of abundance indices**

- ✪ **Estimation of biomass of selected species**

- ✪ **Collection of length, weight and other biological data for studying diet, reproduction etc. and estimation of growth and mortality parameters**

- ✪ **Collection of environmental data**

Biomass estimation

- Stratified random sampling design – stratification based on geographic location, bathymetry and month.

- The survey activities, except the oceanic fishery survey are limited to the 500m depth contour

- Stratification in terms of bathymetry is 20-30m, 30-50m, 50-100m, 100-200m and 200-500m.

- The sampling units are demarcated on the basis of one-degree latitude and one-degree longitude, which is further divided into sub-areas at the level of 6 minutes latitude and 6 minutes longitude.

Biomass estimation

- ❂ **The unit sampling area will thus measure 36 sq. nautical miles (123.47 sq. Km).**

- ❂ **The sampling stations are usually selected so as to ensure that the sampling unit is sampled at least once in three months**
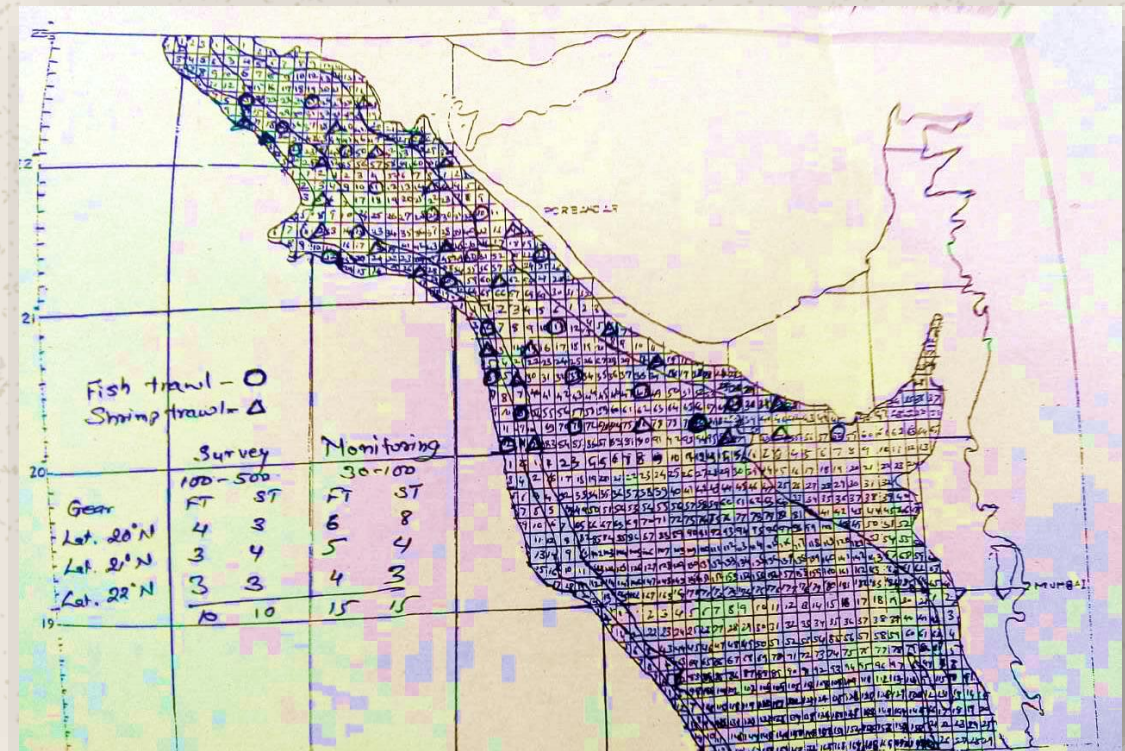
Oceanic Survey

- ✪ For the oceanic fishery survey, Systematic Sampling is employed in a given area by exploring each 1-degree latitude X 1-degree longitude square at least once in three months. The shore-ward limit for exploration in squares selected was a 500m depth contour.
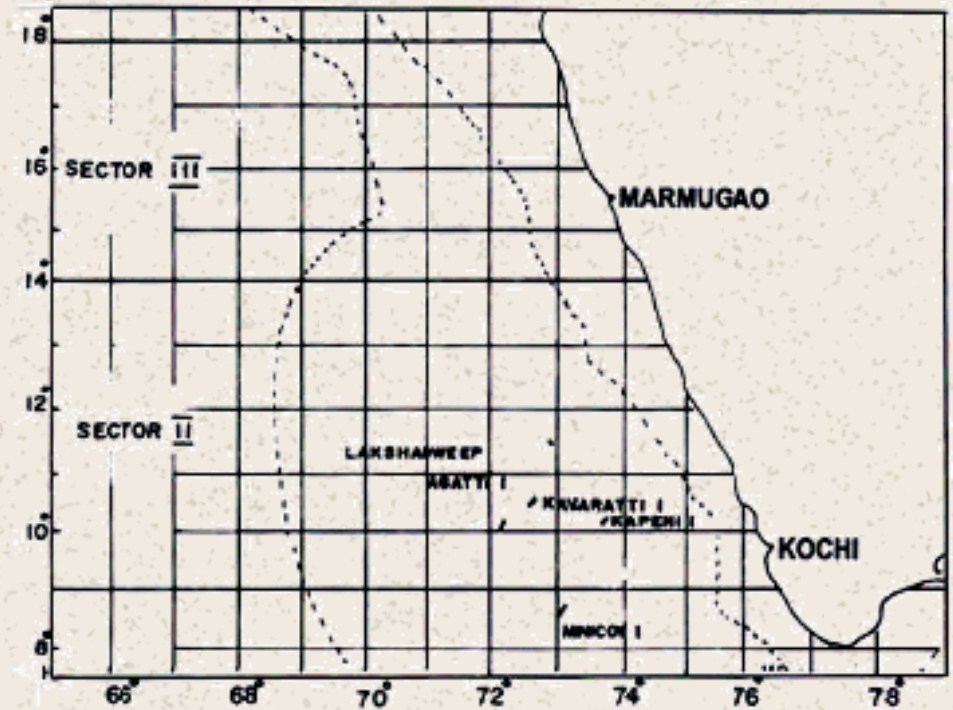

Every month, the survey vessels are deployed for fishing voyages lasting 20 days. At least one Scientist from FSI invariably participates in each voyage, who collects the crucial species-wise data on the catch and effort, length, biology and oceanographic data as per the log sheets designed for this purpose.

Biological/Growth Studies

Length-weight, morphometry, food and feeding and reproduction of yellowfin tuna, sharks, sailfish, swordfish, marlins, dolphinfishes, lancetfish etc.

- Growth parameters studied mainly using length based models

- Yellowfin tuna, swordfish, sailfish, sharks etc.
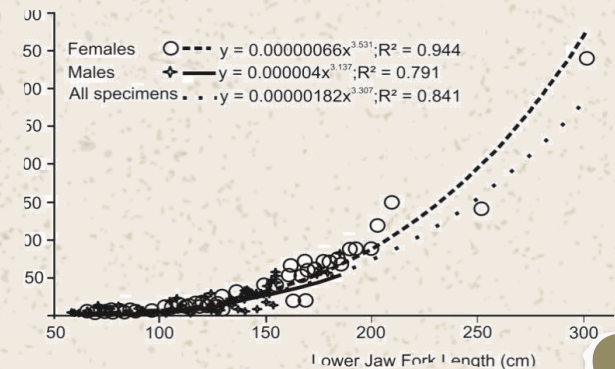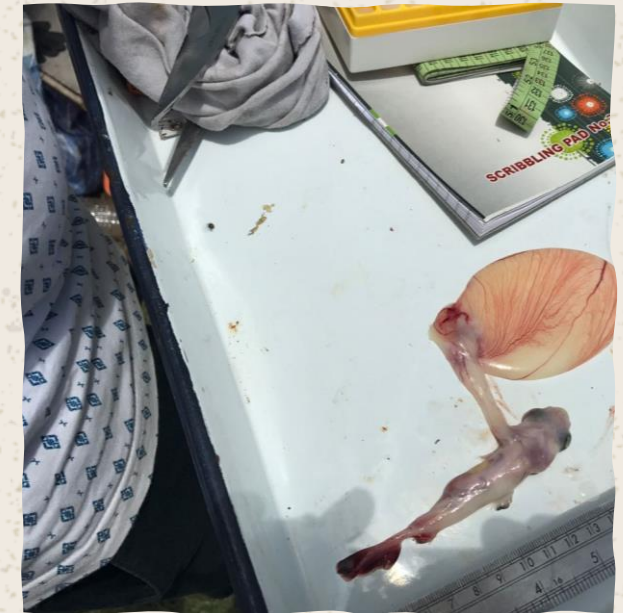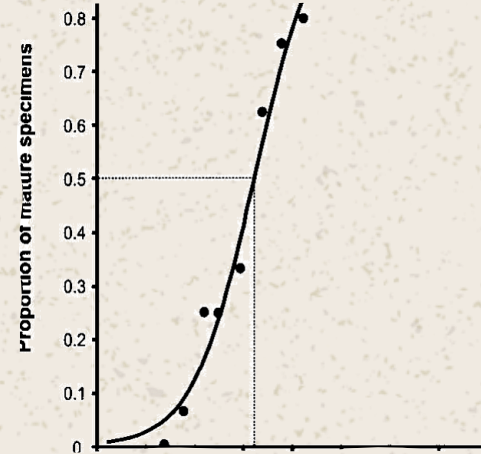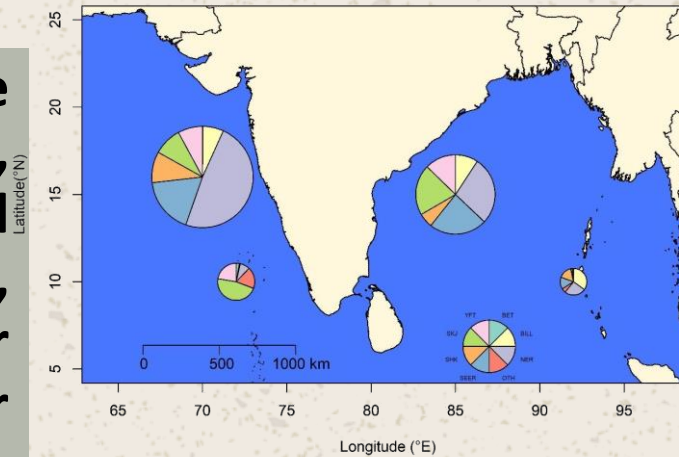
IOTC species-2023

- Oceanic tunas—Yellowfin (YFT), Skipjack (SKJ), and Bigeye (BET)—accounted for 26% of the total tuna and tuna like species landings in 2023, while neritic tunas (five species) contributed 38%.

- Spanish mackerels significantly impacted the landings, with a reported contribution of 18%. Billfishes (8.2%), pelagic sharks (8.1%), and other species (2%) formed the remainder of the catch.

- The tropical tuna catch totaled 53,526.83 tonnes in 2023, comprising 21,247.45 tonnes of Yellowfin, 31,710.67 tonnes of Skipjack, and 568.7 tonnes of Bigeye tuna.
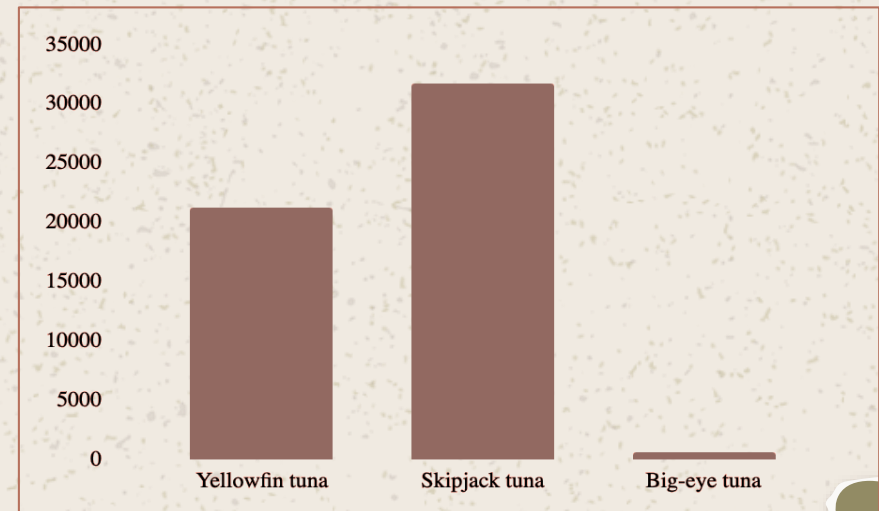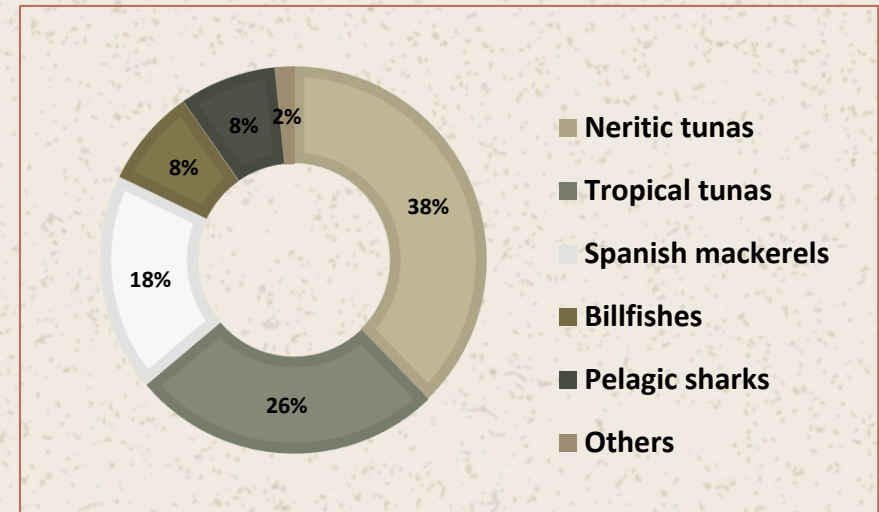

Nominal catch of tropical tunas (yellowfin, skipjack and big-eye tunas), 2023

IOTC species-2023

- The west coast, including the Lakshadweep Islands (FAO Area 51), contributed 62.46% of the total landings, while the east coast, including the Andaman and Nicobar Islands (FAO Area 57), accounted for 37.54%.

- On the east coast, landings included 41.97% of Yellowfin, 45.68% of Skipjack, and 2.81% of Bigeye tuna. The west coast accounted for 58.03%, 54.32%, and 97.19% of these species, respectively.
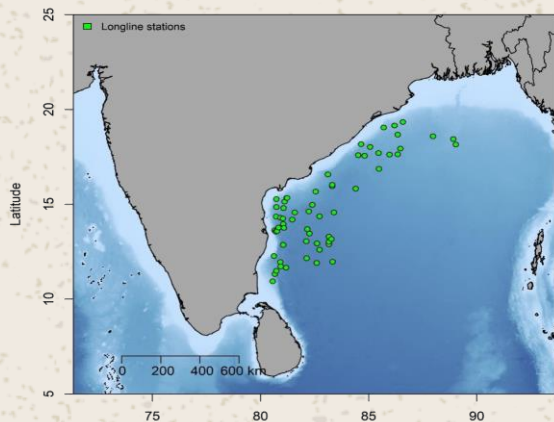

Map showing group-wise catch composition of tunas and tuna-like fishes (2023)
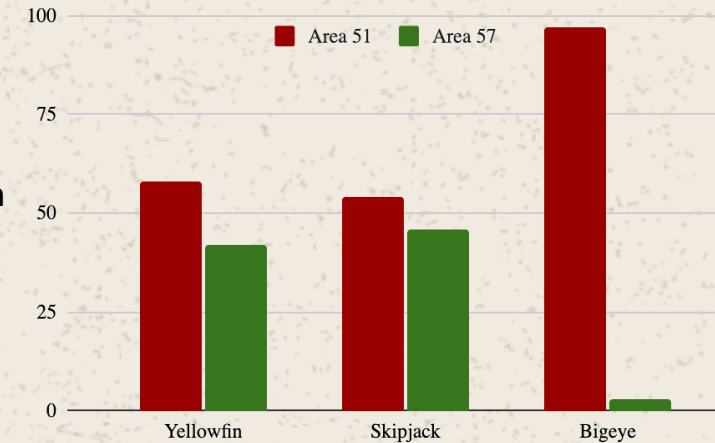
The pattern of tropical tuna catches in the west and east coasts of India (2023)

IOTC species-2023

Map showing
sampling locations
by exploratory
longline surveys
by the FSI vessels
(2023)

Name	Matsya Vrushti	Yellow Fin	Matsya Drushti	Blue Marlin
LoA (Meter)	37.5	36	37.5	36
GRT (Tonnage)	465	290	465	290
BHP	1100	800	1100	800
Base of operation	Mumbai	Mormugao	Chennai	Port Blair
IOTC Registration Number	IOTC 003604	IOTC 003602	IOTC 003605	IOTC 003603

Dedicated longline fishery practiced by various vessels of the
Fishery Survey of India

- Four longline fishing vessels—Matsya Vrushti, Yellow Fin, Matsya Drushti, and Blue Marlin—are operated by the Fishery Survey of India.

- The vessels operate from different ports across India: Matsya Vrushti and Yellow Fin from Mumbai and Mormugao, and Matsya Drushti and Blue Marlin from Chennai and Port Blair, respectively.

- These vessels are engaged in India's dedicated longline fishery, conducting exploratory surveys within the Indian Exclusive Economic Zone (EEZ) targeting tuna and tuna-like species.

- Survey activities by these vessels were restricted during the reporting year due to various operational challenges.

National Research Programmes

- ❖ India's research programme on tuna fishery involves **ICAR-CMFRI** and coastal States/UTs conducting regular sampling and estimation of tuna fishery resources at designated landing points, along with studies on biological and socio-economic aspects of the fisheries.

- ❖ The **Fishery Survey of India (FSI)** operates four dedicated modern longliners, two on the East Coast and two on the West Coast, conducting exploratory surveys within the Indian EEZ to assess tuna resource distribution, fishing effort, bycatch, and environmental parameters.

- ❖ The **FSI**, in collaboration with **ICAR-CMFRI**, **ICAR-CIFT**, and **MPEDA**, is engaged in a marine mammal stock assessment programme to monitor species status, study fishing-related interactions, and identify mitigation measures for their conservation.

- ❖ A research project titled **"Stock Structure of Yellowfin Tuna in the Indian EEZ"**, implemented by **FSI** and **ICAR-CMFRI**, focuses on delineating the stock structure of Yellowfin tuna in the Indian EEZ and adjacent high seas.

- ❖ Institutions such as **CMLRE (MoES)**, **DST (MS&T)**, **INCOIS**, **NIOT**, and the **Wildlife Institute of India (MoEF&CC)** actively contribute to exploratory surveys and research activities, including monitoring marine mammals and developing conservation strategies.

Sagar Mitras and MSS

3477 *Sagar Mitras* **(Friends of Sea) deployed, one each at every coastal fishing village to collect data on fish landing, welfare etc.**

(Pradhan Mantri Matsya Sampada Yojana - A scheme to bring about Blue Revolution through sustainable and responsible development of fisheries sector in India **)**

Vessel tracking and communication system: transponders being installed onboard all mechanised fishing boats/vessels (mobile satellite services – MSS) to establish vessel communication and support system – two-way communication
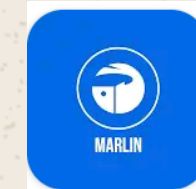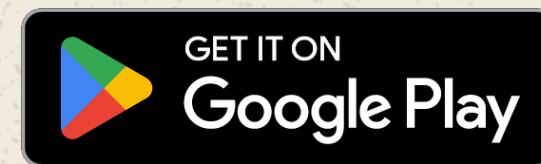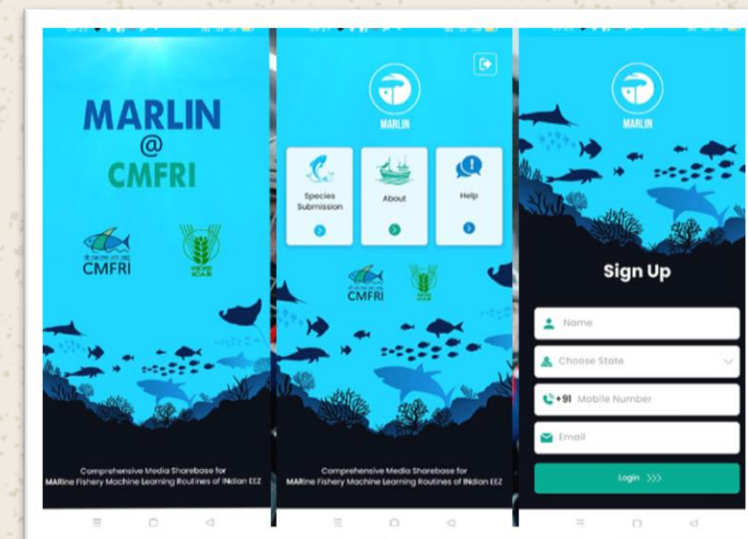
Artificial reef deployment

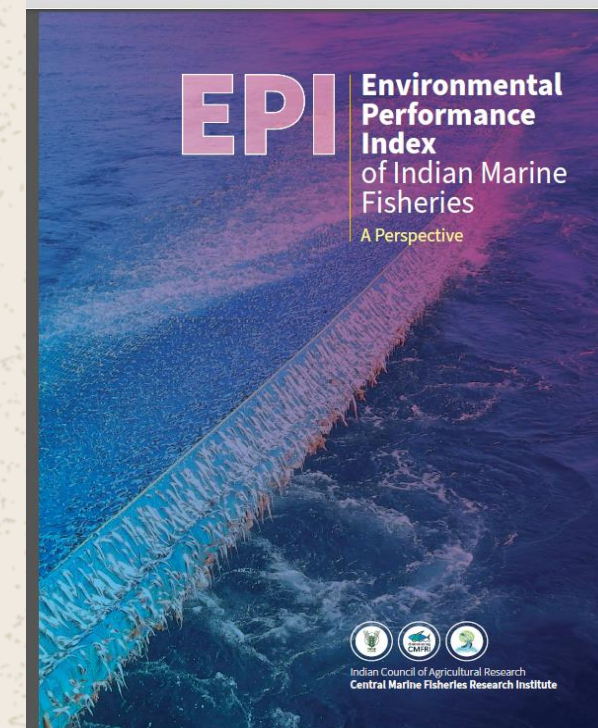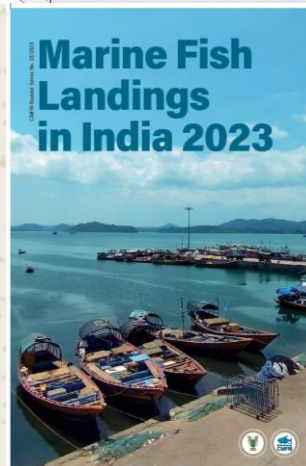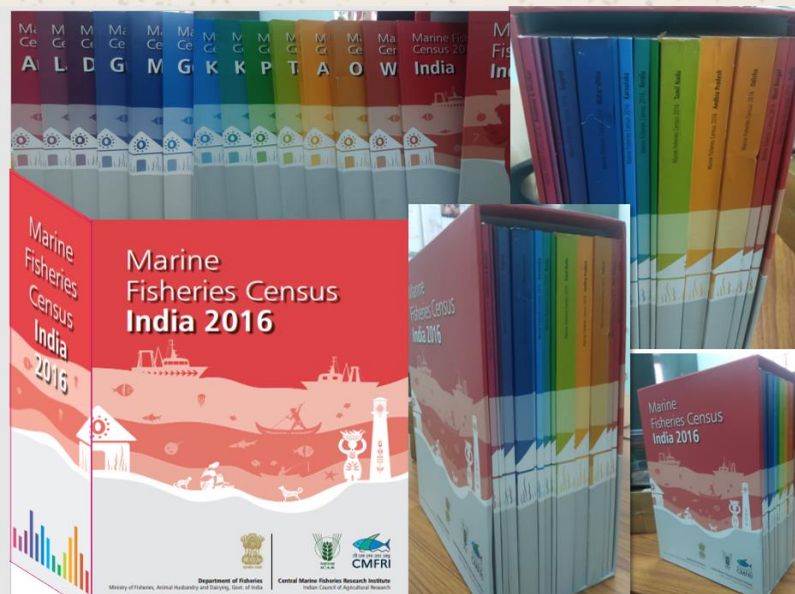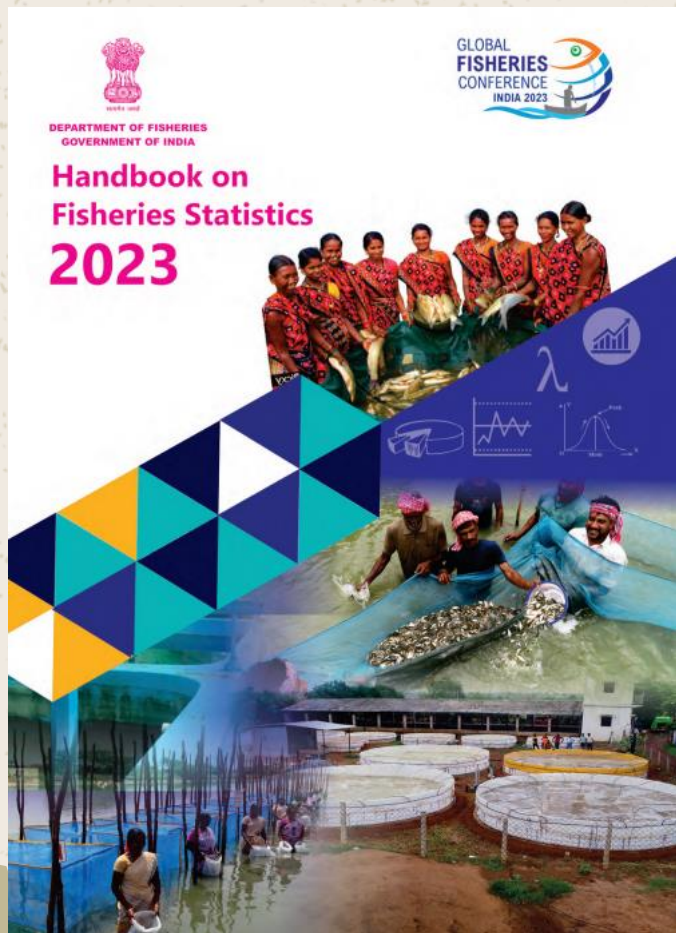**Artificial reefs (1500 AR deployed-----target is 3500)**

Management measures

- ❖ Regulating fishing and related activities in the sea up to a distance of 12 nm (22 km) from the shore (territorial waters) for provincial states.

- ❖ The 12-200 nautical miles zone of the Indian EEZ is within the control of the Government of India

- ❖ Area demarcation for traditional and mechanised crafts

- ❖ Closed season (Jun-July)----61 days

- ❖ Mesh size regulation for finfish and shellfish

- ❖ Minimum legal size (50+species for MH, KA, Goa and KL)

- ❖ Maximum allowable engine horsepower ratio----(250Hp in some states and 350 in some states)

- ❖ Restriction on certain fishing gear types (pair trawling…..)

- ❖ Registration of fishing vessels, boat building yards, fishing net production units

- ❖ Licensing of fishing vessel

- ❖ Restriction on destructive fishing practices (FAD, explosives, poisons)

- ❖ MPAs and use of Turtle Excluder Devices (TEDs) in trawlnets

Passive Georeferencing (Landings >>>>>>>>>>>>Catch)

The landings records have information about bearing and the distance covered by the craft surveyed.

Haversine formula for finding the destination coordinates given distance and bearing from start point coordinates:

$$\phi_2 = asin(\, \sin \phi_1 \cdot \cos \delta + \cos \phi_1 \cdot \sin \delta \cdot \cos \theta\,)$$

$$\lambda_2 = \lambda_1 + atan2\,(\sin \theta \cdot \sin \delta \cdot \cos \phi_1,\ \cos \delta - \sin \phi_1 \cdot \sin \phi_2)$$

where ϕ is latitude, λ is longitude, θ is the bearing (clockwise from north), δ is the angular distance d/R; d being the distance to destination, R the earth's radius (mean radius = 6,371km), 'asin' is arcsine (i.e. the inverse sine) of a given number and 'atan2' is the arctangent (or inverse tangent) of the specified x- and y-coordinates.

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Landing Estimates /Stock Assessment/ Census

Marine Fisheries Stock Status of India (MFSS) 2023: Assessed 135 marine fish stocks nationwide, with 91.1% found healthy.

Thank you

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