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CELEBRATING 25 Years Silver Jubilee Publication

A Manual on The Use of Potential Fishing Zone (PFZ) Forecast

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Narendra Pratap Singh
Janhavi Kolwalkar
Tejaswini Patil
Pastta M. Fernandes

भाकृअनुप ICAR

गोवा के लिए भा.कृ.अनु.प. का अनुसंधान परिसर
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ICAR RESEARCH COMPLEX FOR GOA
(Indian Council of Agricultural Research)
Old Goa - 403 402, Goa, India

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A Manual on The Use of Potential Fishing Zone (PFZ) Forecast

PFZ MISSION PROGRAMME
Indian National Centre for Ocean Information Services
Hyderabad
Ministry of Earth Sciences
Govt. of India

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FOREWORD

GOA is the state in south west coast of India is blessed with a coast line of 104 km (1.28% of Indian coast line of 8117 km) with numerous bays and headlands. The continental shelf area of Goa extends to about 10,000 km2 with a total area of about 100 fathoms depths. Goa has an estimated marine fisheries potential of 1.14 lakh tonnes/ annum. The pelagic fisheries potential of EEZ (Exclusive Economic Zone) of Goa is about 69000 tonnes for the inshore area and 8000 tonnes for the oceanic area (Parulekar, 1989). The sustainable pelagic yield is projected as 46,560 tons per annum. Similarly, the potential demersal resources of EEZ are estimated to be 1, 12, 600 tonnes with a sustainable yield of 67,500 tonnes per year (Subramanian, 2002). Therefore, the total sustainable yield for both pelagic and demersal fisheries of Goa is projected to be 1, 14, 060 tonnes annually. The Goa fisheries has faced several up and downs in the marine fish catch.

The duration of fishing operations along the Goan Coast Ranges from 2 hours to 20 days with a major portion of time being spent on scouting the fish shoals of fishing grounds. The quick sight of fishing locations or fishing grounds will significantly reduce the searching time, usage of fuel and human effort which in turn will be reflected in the CPUE and the income of fishermen. The satellite based remote sensing techniques have advanced to predict the fish shoal availability and their movements. A reliable and timely short-term forecast on the fish aggregation zones helps them to identify the fishing grounds. Indian National Centre for Ocean Information Services (INCOIS) provides short term fish forecasts using Remote Sensing (RS) and Geographic Information System (GIS) Techniques. Satellite derived Chlorophyll and Sea Surface Temperature (SST) information are the basic inputs for generating this information. the advisories on the PFZ over Arabian Sea and Bay of Bengal from the thermal infrared channels of NOAA- AVHRR and optical bands in IRS-P4 OCM.MODIS Aqua data. The multilingual PFZ advisories are generated on every Monday, Wednesday and Friday to about 500 fish

landing centres/ fishing villages covering the entire coast line of India. Features such as oceanic fronts, meandering patterns, eddies, rings and up-welling areas are identified from the satellite images, transferred to navigational charts and provided as PFZ advisories. These forecasts are disseminated with an idea to exploit the fishery resources of Goa in a sustainable manner and to bridge the gap between estimated and harvested potential. The increase in catch, CPUE and net profit for fishermen from Goa underlines the importance of satellite based fish forecasts and their efficiency.

The present publication is a frontrunner and a guide to the future satellite based fish forecasting methods and sustainable fishery management. The ICAR Research Complex for Goa has really made a shift in the fishery management and forecasting scenario in Goa by adopting and disseminating the PFZ advisories based satellite based tools. I congratulate the authors Dr. S. Subramanian, Mr. Sreekanth G. B., Ms. Manju Lekshmi, N., Janhavi Kolwalkar, Tejaswini Patil and Passta M. Fernandes for the excellent work carried out and for consolidating the information in to a bulletin form. I am sure that this will enlighten the fishery researchers in India to begin rigorous research initiatives on satellite based fish predictions.

(Narendra Pratap Singh)

CONTENTS

Introduction

India has a long coastline of 8,129 km and an EEZ of 2.5 million sq. km, having a high potential for exploration of natural resources. Thus marine fisheries play an important role in increasing the economy of the country. The annual marine fisheries production in India is about 2.94 mt, against the harvestable potential of 3.93 mt (Anon, 2008). Development of Fisheries industry has to be intensified and aimed to increase fish production, to promote exports, to improve the welfare of fishing community and to provide food security.

Because of the increasing demand for fishery products and the need to exploit marine resources in a cost effective manner, the introduction and application of modern techniques have become important considerations.

Adoption of modern technology technique is needed for economizing the on going marine fishing operations and reducing the valuable human efforts.

In this context, the application of remote sensing technique in marine fisheries will not only be useful in achieving exactly the above mentioned objective of reducing the cost of fishing and mitigating the human drudgery.

Indian National Centre for Ocean Information Services (INCOIS) has taken up the task to provide information/ forecast about fish congregation in the sea using Remote Sensing (RS) and Geographic Information System (GIS) Techniques. These forecasts are referred to as the Potential Fishing Zones (PFZ) advisories which would indicate the places where possible fish shoals may be present. Features like oceanic fronts, meandering patterns, eddies, rings and up-welling areas indicate the presence of fish. Presence of Chlorophyll and difference in Sea Surface Temperature (SST) are also factors which indicate the fish congregation in the sea. Satellite derived realtime information on the above two factors are used for generating PFZ forecasts. These identified potential fishing zones derived from the satellite images and transferred to navigational charts are provided as PFZ advisories.

Marine Fisheries Scenario of Goa

The state of Goa, located along the central West Coast of 1ndia, is blessed with 105 km of coastline. With a continental shelf of about 10 mha, the state has a vast potential for marine fisheries. Nearly 90% the Goan population consume fish as their main protein source. Out of 11 talukas of the state, people from 8 talukas are involved in fishing activities and fishermen from 42 villages are engaged in marine fishing. There are over 30,000 fishermen in the state, with the population of active fishermen standing at 12,000. Besides strengthening the economy, fishing industry provides employment to a large number of people in Goa. The estimated annual pelagic and demersal potential yields of EEZ from Goa are 77,660 t and 1,12,600t, respectively. Marine catches of Goa comprise of about 41 varieties of fishes including mackerel, sardines, seer fish, cephalopods, pomfret, ribbon fish, catfish, croakers, shrimps, threadfins, silver bellies, soles, Elasmobranches, etc., the bulk of the catch being mackerels and sardines. The annual marine fish landings of Goa have been varying between ` 60,000 to 1.0 lakh tons per year during the last two decades.

The marine resources of the state are presently exploited by 1183 mechanized vessels, 950 motorized wooden country crafts and 886 non motorized country crafts. Though the fishing operation extends upto 200 m depth zone, the intensive fishing zone is between 30 -120 m depth.

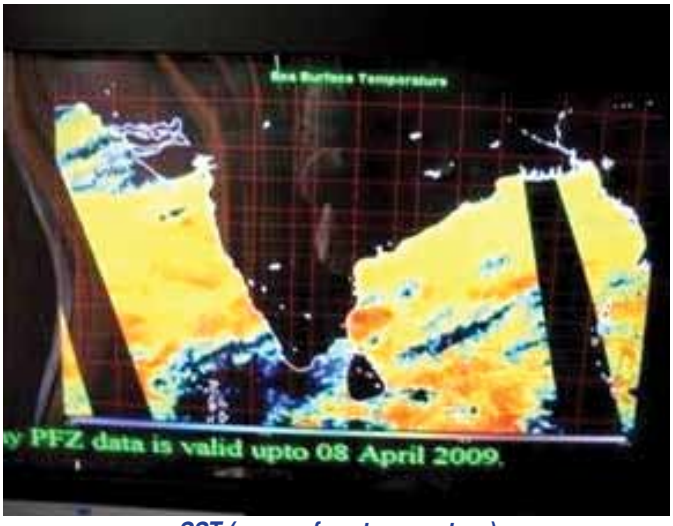
The major fish species caught off Goa are pelagic and demersal species of which Indian mackerel and oil sardine constitute nearly 40 per cent of the commercially important varieties. The Potential Fishing Zone map can help in locating the fish shoals in the open sea with the help of GPS (global positioning system). Being surface parameter based forecast, the PFZ advisories will be particularly useful for pelagic gears like purse seine, gill net and long line and it may also be useful to some extend for mid water trawls and trawlers in the shallow waters.

What is Potential Fishing Zone (PFZ) and How it is developed?

Potential Fishing Zone (PFZ) is a reliable and short-term forecast on the fish aggregation zones in the open sea. PFZ advisory are brought out by Indian National Centre for Ocean Information Services (INCOIS), Hyderabad, during the cloud free days on thrice a week basis earlier and daily recently and are disseminated through FAX/telephone to different fish landing centers and boat owners along the Indian coast. Satellite derived Chlorophyll and Sea Surface

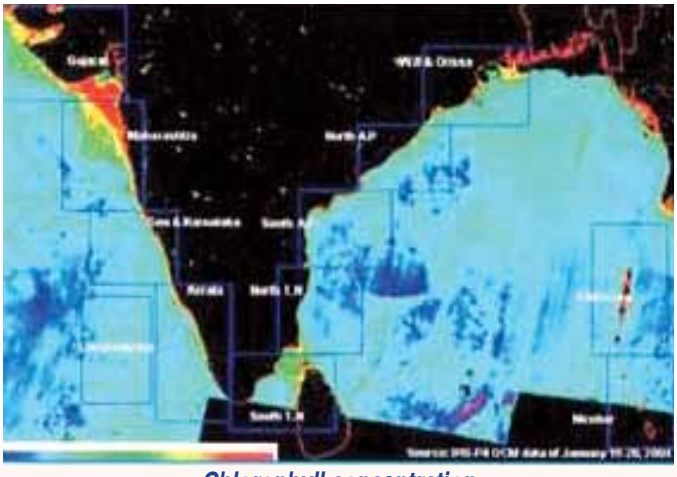
Temperature (SST) information over the Arabian Sea and Bay of Bengal are the basic inputs for generating this information. It is retrieved from Thermal infrared channels of NOAA-AVHRR and optical bands in IRS-P4 OCM / MODIS Aqua data and is used for identifying Potential Fishing Zones along the Indian coastline

Proficiency in the generation of the Integrated Potential Fishing Zone advisories using both Sea Surface Temperature (SST) and Chlorophyll, developed under the Satellite Coastal and Oceanographic Research (SATCORE) project has been acquired from Space Applications Centre (SAC), Ahmedabad. Software for generation &(i) SST from NOAH-AVI-IRR and (ii) Chlorophyll from Ocean Color Monitor (OCM) of OCEANSAT-1 (IRS-P4) developed by Regional Remote Sensing Service Centre (RRSSC), Nagpur was installed on IBM AIX Platform at INCOIS, Hyderabad for operational use in PFZ forecasting.

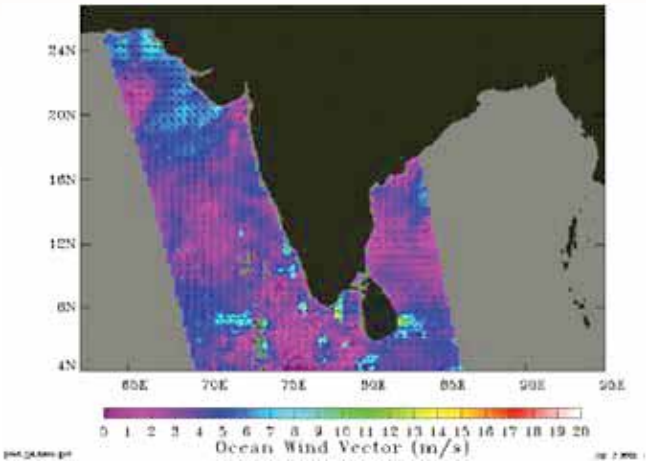


SST (sea surface temperature)

Geographical Information System (GIS) database has been developed for bathymetry, landing points and light houses. Map Compositions have been worked out for the entire Indian Coastline and identification of the PFZ lines has been done on screen and thereby, improving the planimetric accuracy of the forecasts.


Chlorophyll concentration

Furthermore, an ISDN connectivity of 256 kbps is established between National



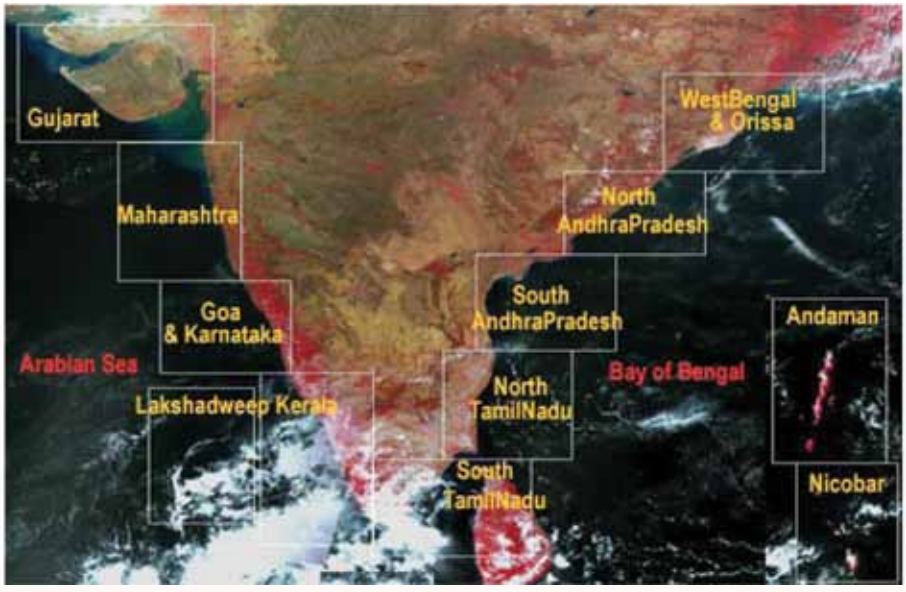
Wind factor

Remote Sensing Agency (NRSA) and INCOIS for timely reception of the Satellite data from NRSA.

The PFZ forecast are disseminated in different languages to twelve identified centers along the coast of India, who disseminate the information to the end users, collect feedback and conduct experiments on various aspects of usefulness of the PFZ advisories.

How PFZ is received at the fish landing centers?

PFZ advisories are being generated and disseminated during the fishing ban and non-monsoon period to the entire fishermen community situated along entire coast of India through various modes viz. telephone, fax, e-mail. To improve the coverage and penetration advances in Information and Communication Technology has been adapted and Electronic display board (**EDB**) has been developed and installed at various fish landing centers along the coast.



PFZ dissemination along coastal states of India.

In Goa, three EDBs are installed at the three landing centers viz., Malim, Mormugao and Cutbona jetty. PFZ forecasts are transmitted to the board directly from INCOIS using telephone, modem and dedicated software. The fishermen can know about the PFZ advisories directly from the board just before venturing into the sea for fish harvest, without waiting for the fax message.

What is Electronic display board (EDB)?

Electronic display board facilitates dissemination of satellite images, animations, short-films, and ocean state information, in addition to disaster information and disaster warning such as Tsunami.

EDB consists of two parts:

1. It contains a 32" LCD display panel :
   It displays the PFZ map and the table. It also gives information like wind direction wind speed and wave height.
2. Secured siren system with audibility up to 1 km:
   It is a Tsunami warning alarm which warns the fisher in the sea to return back to the shore and also warn them against venturing in the sea.

EDB underwent drastic changes from old version to improving its technology and updating to new version of 1.9.1.

Old version of EDB with warning unit

Latest EDB version with new siren unit

Components of PFZ forecast

PFZ advisory consists of two components viz., a table and a map

1. TABLE:
Table consists of title relating to which state or zone to which it is related namely Karnataka and Goa state. The title also consists up to which date the forecast is valid or likely availability of the fish shoal.

I) TABLE

(KARNATAKA and GOA) ಕರ್ನಾಟಕ ಮತ್ತು ಗೋವ

कार्नाटाका ऐन्ड गोआ

Satellite Data shows likely availability of Fish Stock Till the Date January 14, 2011

ಉಪಗ್ರಹ ಮಾಹಿತಿಯಿಂದ January 14, 2011 ದಿನಾಂಕದ ವರೆಗೆ ಮೀನು ದೊರಕುವ ಸಾಧ್ಯತೆಯ ಬಗ್ಗೆ

उपग्रह आकडों से January 14, 2011 तक की संभावित मत्स्य भंडार की उपलब्धि।

From the Coast of तीरदिंद कि समुद्र तट से		Direction दिक्कु दिशा मे	Angle in Degrees कोनद कोण (डिग्री मे)	Distance in Km दूर कीलो मीटरुगळु दूरी (किलो मीटर मे)		Depth in Metres आळ मीटरुगळु गहराई (मीटर मे)		Latitude / Longitude रेखांश / अक्षांश
				From इंद कहाँ से	To वरेगे कहाँ तक	From इंद कहाँ से	To वरेगे कहाँ तक	
Chapora चापोरा	चापुर	SW	248	25	30	45	50	15 29 55.16 N 73 29 46.26 E
Panaji पणजि जि	पणजी	SW	251	15	20	35	40	15 24 42.88 N 73 34 57.70 E
Aguada अगुअडा	आगुंडा	SW	253	15	20	30	35	15 27 03.91 N 73 37 08.30 E
Marmagoa मार्मागोआ	ಮರ್ಮಾಗೋವ	SW	261	18	23	40	45	15 19 20.52 N 73 35 07.74 E
Betul बितुल	ಬಿಟುಲ್	SW	246	15	20	25	30	15 04 23.98 N 73 47 41.21 E
Karwar कार्वार	ಕಾರವಾರ	SW	254	22	27	40	45	14 43 34.85 N 73 53 22.78 E
Tadri तादरि	ತಡ್ರಿ	SW	207	40	45	40	45	14 10 30.37 N 74 09 27.23 E
Dhareshvar धारेश्वर	ದಾರೀಶ್ವರ	SW	221	38	43	45	50	14 05 38.23 N 74 09 07.13 E
Honnavar होन्नावार	ಹೊನ್ನಾವರ	SW	226	34	39	45	50	14 02 36.91 N 74 11 57.92 E
Bhatkal भात्काल	ಭಟಕಲ್	NW	272	52	57	50	55	13 59 25.51 N 74 00 54.87 E
Gangolli गान्गोलि	ಗಂಗೊಳ್ಳಿ	NW	278	60	65	55	60	13 45 39.48 N 73 54 53.20 E
Kota कोटा	ಕೋಟಾ	NW	276	93	98	60	65	13 36 05.29 N 73 49 51.81 E

Director, Indian National Centre for Ocean Information Services (INCOIS), Govt. of India,
"Ocean Valley", Post Bag No. 21, IDA Jeedimetla P.O.,Ranga Reddy Dist.-500 055., India.
Phone: +91-40-23895013 ; Fax:+91-40-23895014.
E-mail: pfz@incois.gov.in; www.incois.gov.in

संभाव्य मत्स्य क्षेत्र का परामर्श
इंकोइस INCOIS
Potential Fishing Zone Advisories

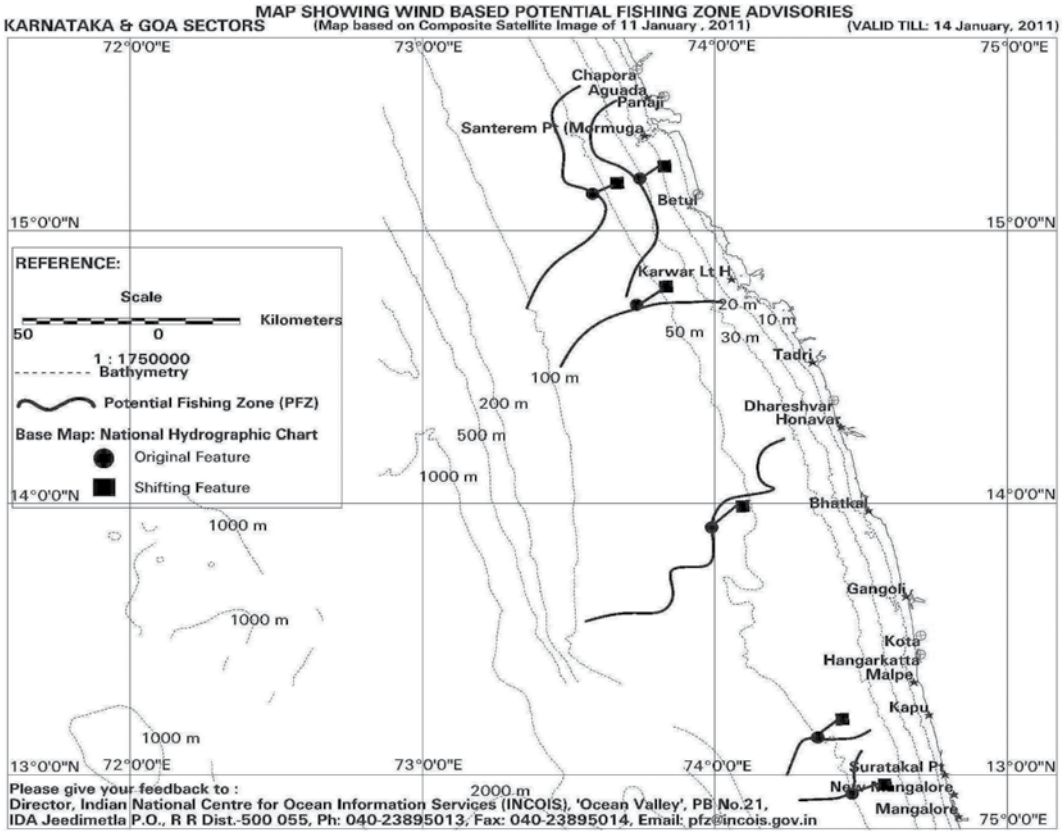
निदेशक, भारतीय राष्ट्रिय महासागर सूचना सेवा केंद्र (इंकोइस), भारत सरकार
"ओशियन वैली", पोस्ट बाक्स नं २१, आई डी ए जीडीमेटला (पो.ओ.)हैदराबाद - ५०० ०५५, भारत.
फोन: +91-40-23895013 ; फैक्स:+91-40-23895014.
ई-मेल: pfz@incois.gov.in; www.incois.gov.in

The table provides information like

1. Name of the landing center as the referral point from where the relevant logistic information is provided.
2. Direction of the fish shoal
3. Direction in terms of angle in degree
4. How big the fish shoal is (in terms of kms)
5. At what depth the shoal is swimming
6. Location of the shoal in terms of Latitude and longitude

It also gives the validity of the map (that is if fishing is carried out on the first day after the receiving of the map, the probability of getting fish is higher than the remaining days).

II) MAP



The map contains title showing on which parameter the PFZ advisory is based, to which sector it is referred to (Karnataka and Goa), the date on which the PFZ imagery is made and the date till PFZ is valid. The map has vertical and horizontal lines indicating the longitude and latitude.

The map contains the following details as indicated in the reference:

1. Scale in kilometers (1: 50 km)
2. Bathymetry shown by the dotted lines indicating the depth at which the bottom is found (10 m, 20 m, 30 m, 50 m,100 m…… .1000 m)
3. The dark line indicates the Potential fishing zone where the possible fish congregation is available.
4. Referral point on the shore at which the fish landing center is located (Chapora, Panaji, Vasco)

5. The map also shows the source with address from which the PFZ is received (Director INCOIS)
6. In wind based map the shifting feature is shown by a dark round and square indicating the possible during the second and subsequent days of presence of fish.

Points to note in the map are:

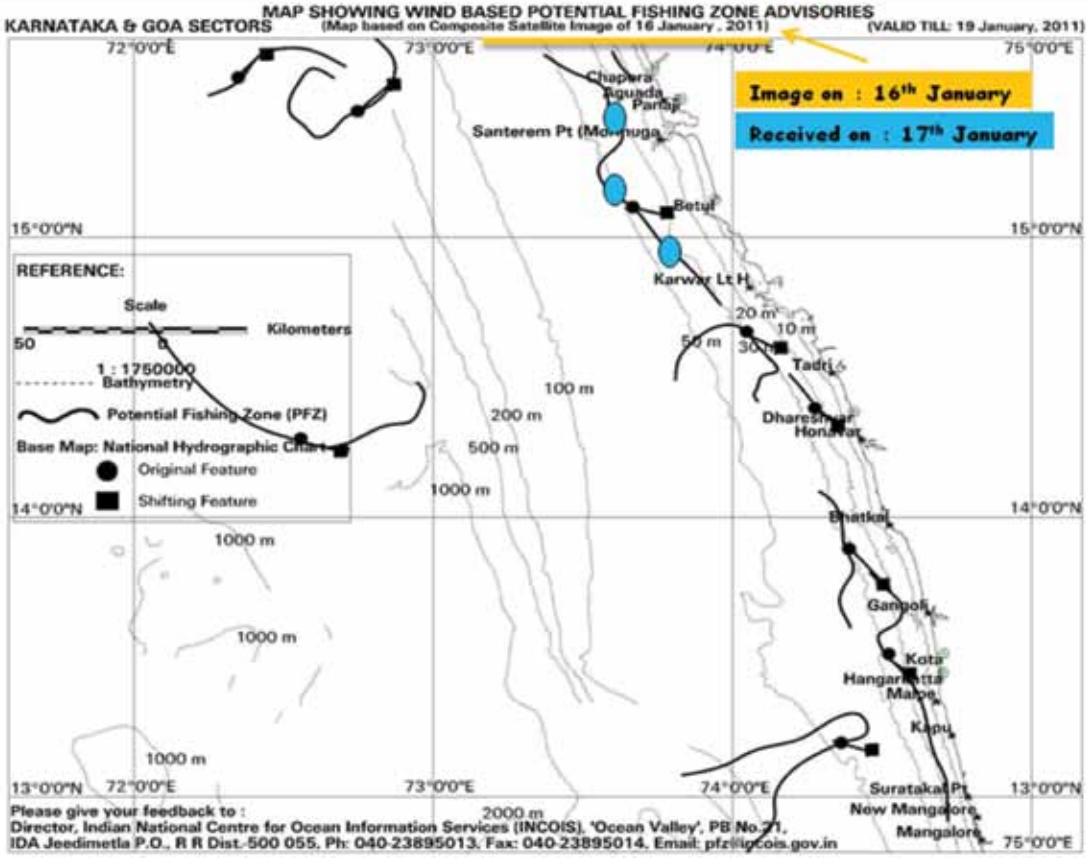
1. Image provided belongs to which date
2. Validity of the image (up to which date one can use the image)
3. The dark lines on the map which show the approximate location of the fish shoal
4. The faint line on the map that shows the depth of the bottom of the sea.
5. The square point is the shifting feature. This gives one the direction in which the fish shoal is likely to move from the day of forecast. Thus helps the fishermen to locate fish even on the second and third day of the forecast.

How to use PFZ?

It is very important to know how and when to use the PFZ advisory to get maximum benefit out of the forecast.

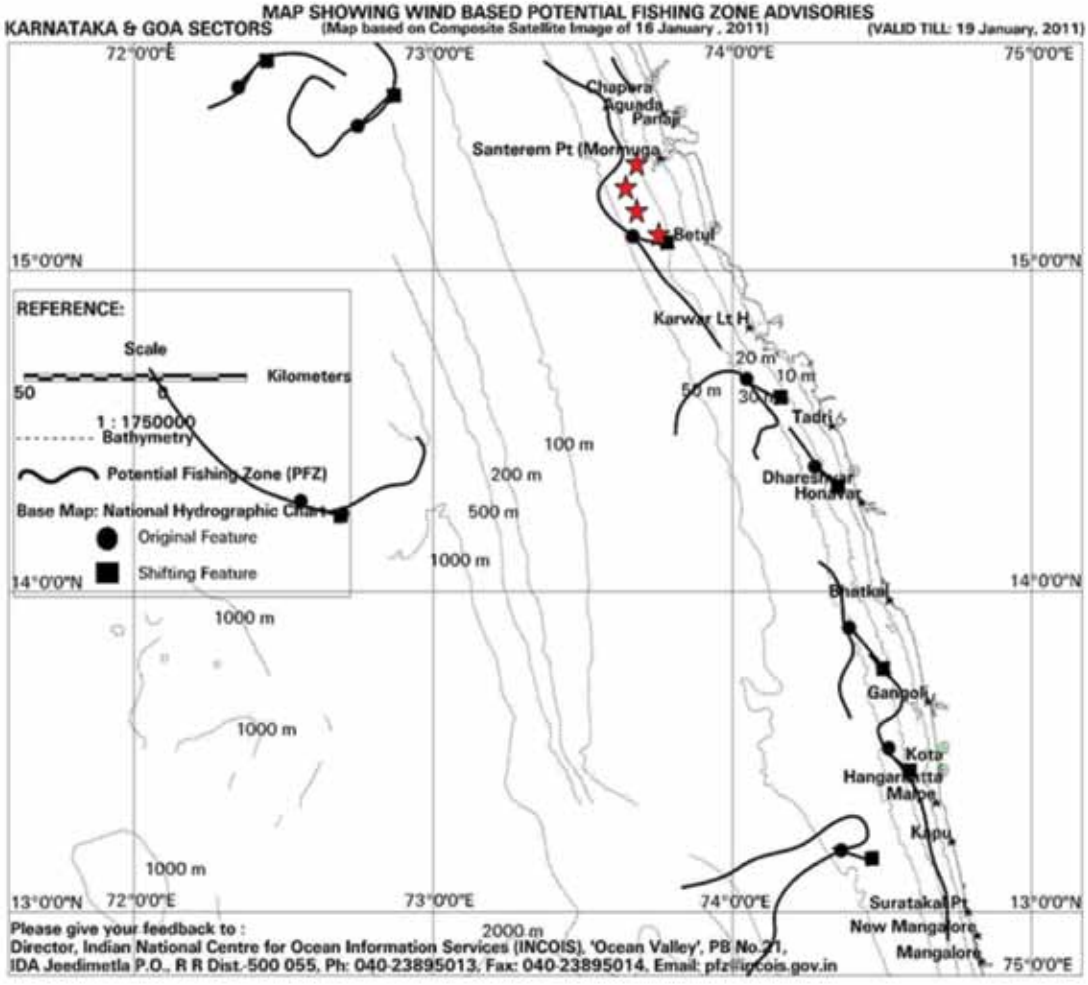
Some of the important aspects of the forecast are:

1. It is better to catch fish on the advisory on the same day after receiving it, as the chances of dispersion of fish due to migration is less on the first day. For example, in the map below, the PFZ image was formed on 16th January by the composite satellite and received at the landing center on 17th January. If the boat owner goes for fishing on the same day i.e. 17th January on the PFZ line indicated, the chances of getting a reasonably good catch is more than fishing on the same PFZ on subsequent days (like 18th or 19th)



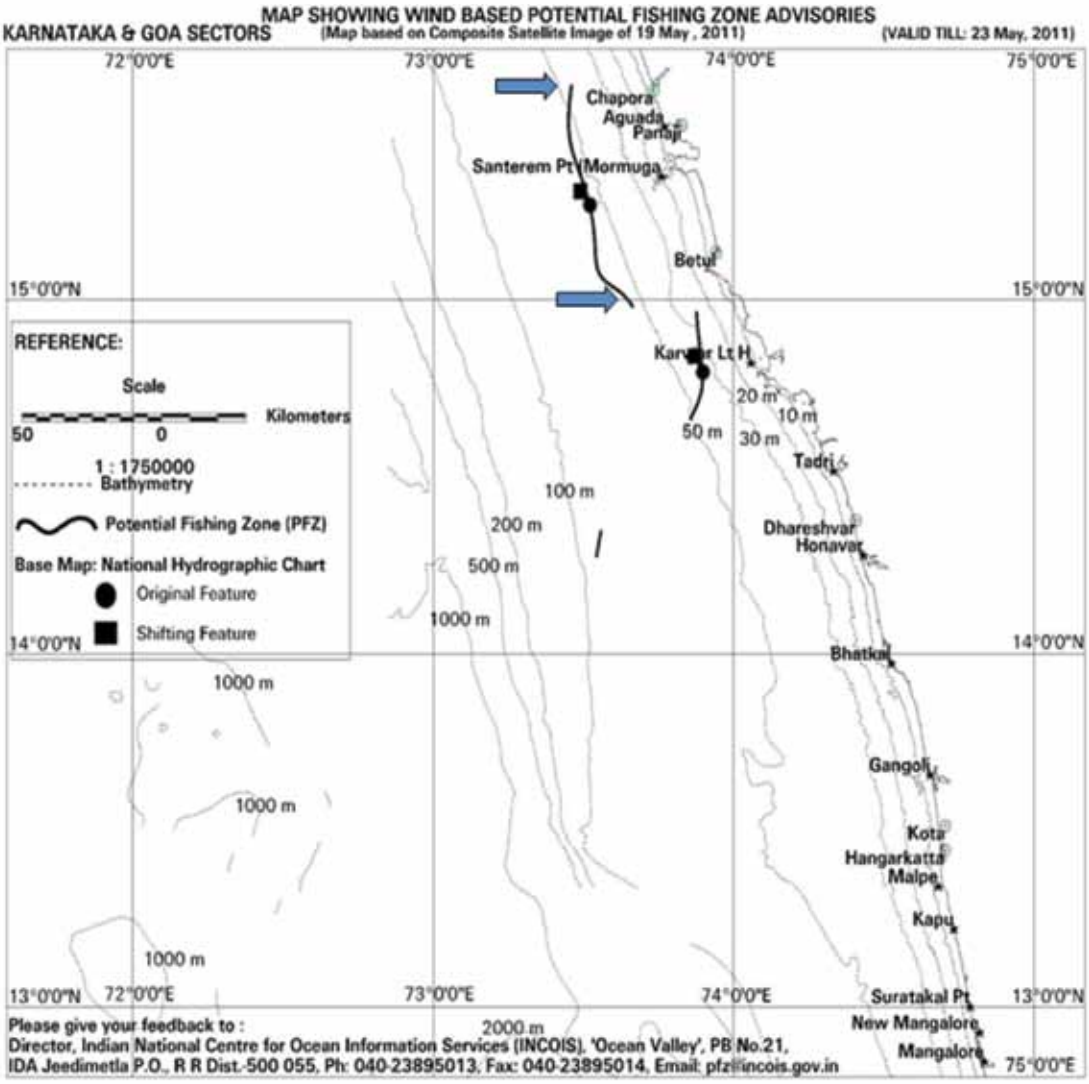
Shifting feature and PFZ.

2. When PFZ is in form of a line, than fishing at the center of the line will give the maximum catch.

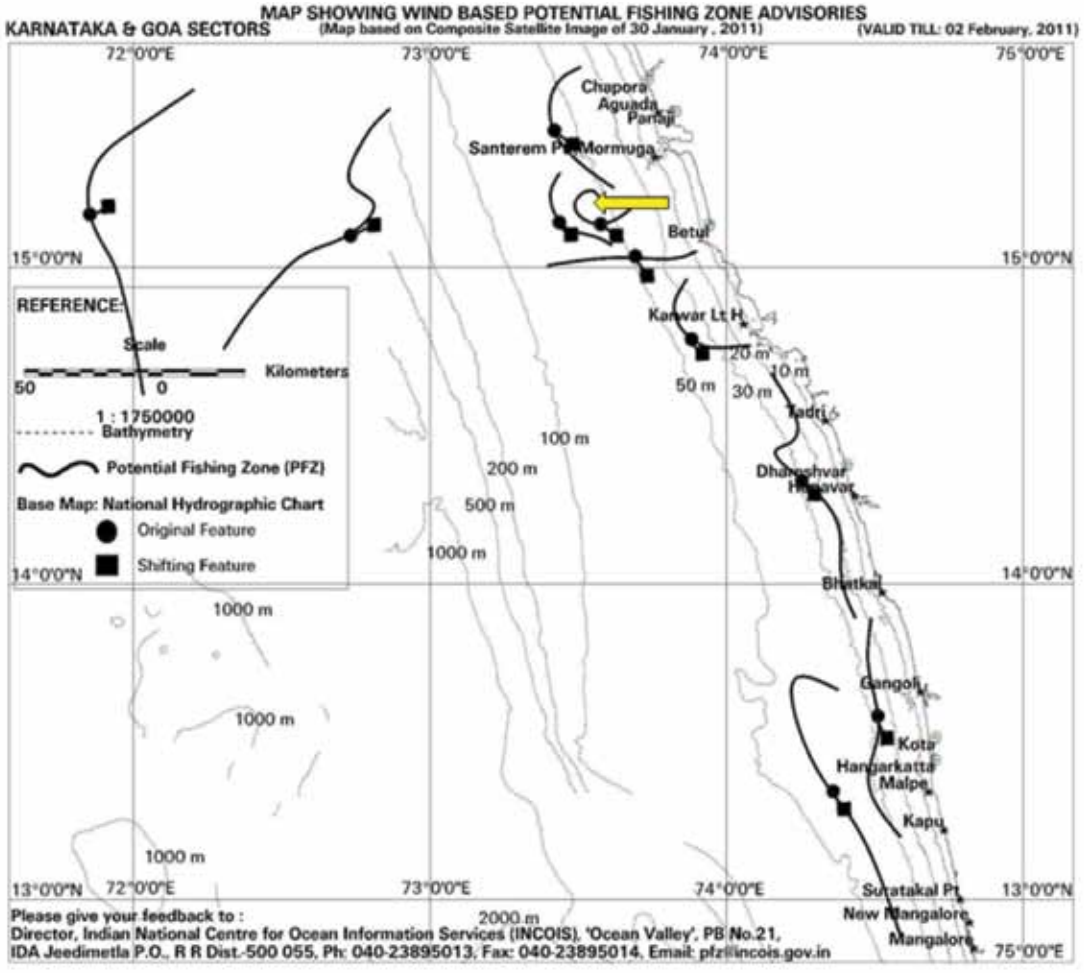


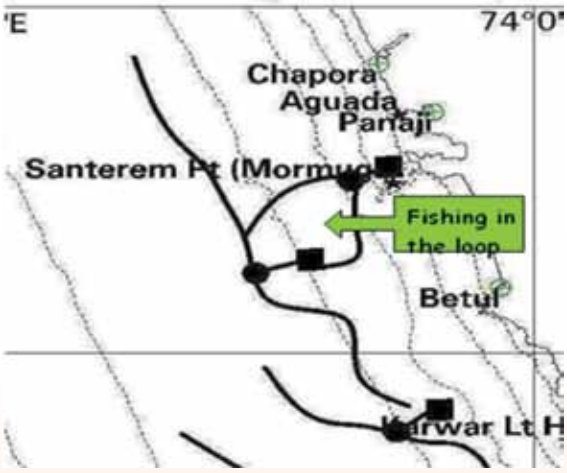
Fishing in the middle of the PFZ advisory (indicated in above figure by red stars) is much profitable than on other places on the line. This is mainly because

3. Fishing at the end of the PFZ advisory will give a smaller catch

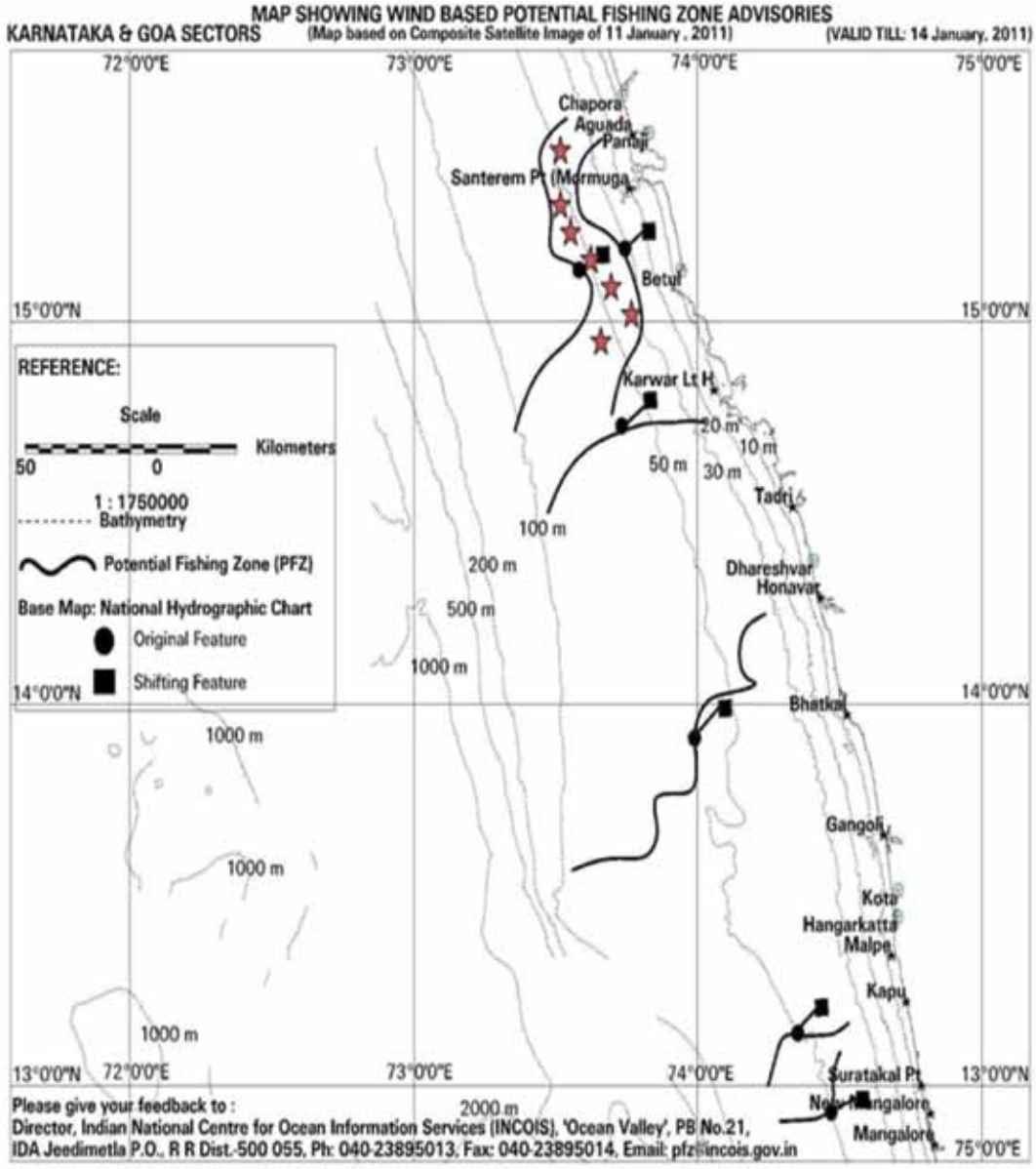


4. If the PFZ is shown as a curve than fishing inside the curved area will yield maximum catch.

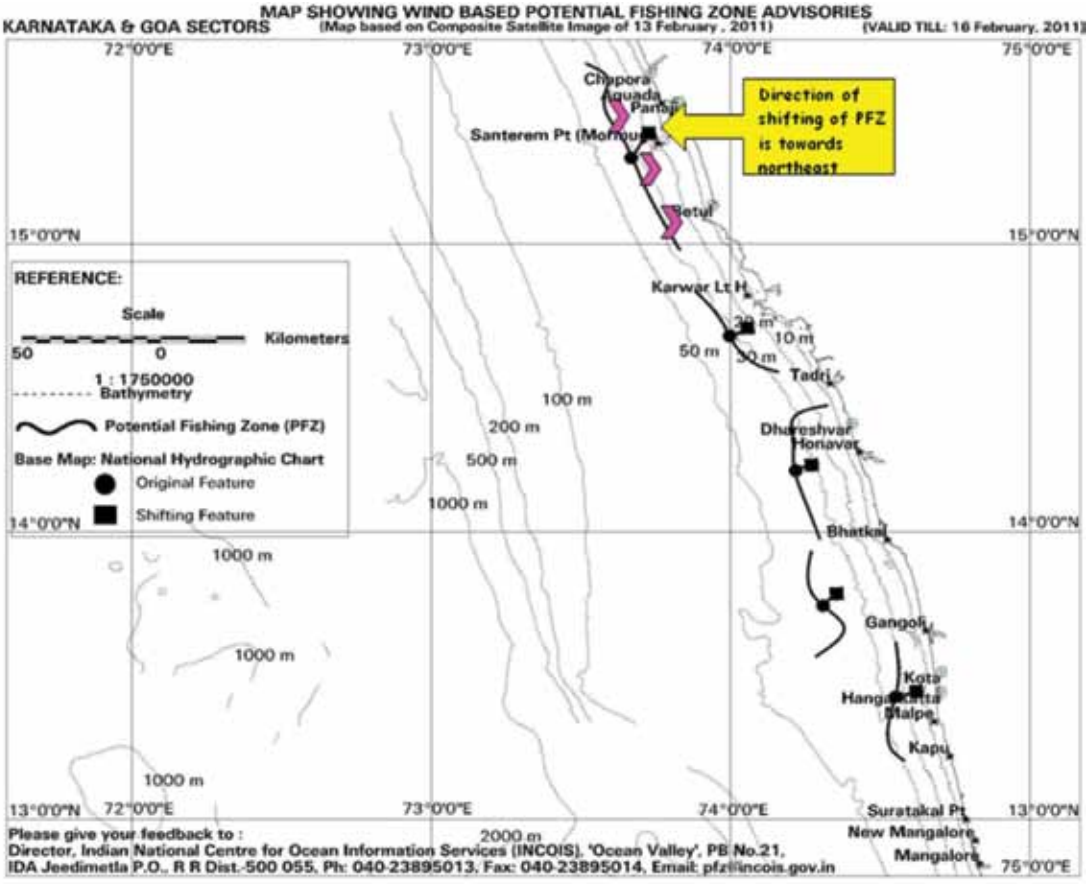




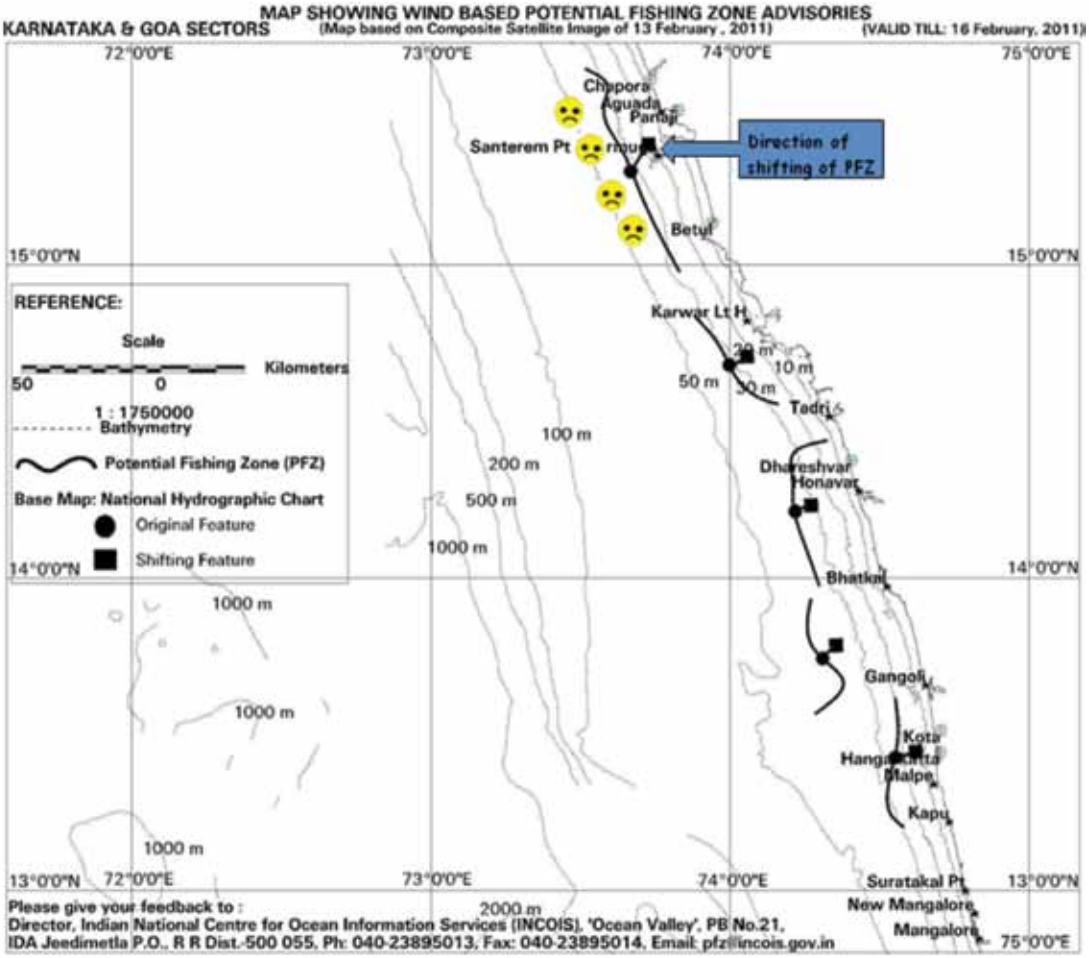
5. When there are two or more PFZ close to each other, than fishing in-between those gives a better catch.



6. Keep a close eye on the shifting feature as it gives the direction in which the fish shoal will move for the next two days. This can help you get a good substantial catch even after the second and third day after receiving the PFZ.



7. Fishing on the opposite direction of the shift is likely to give a much lesser catch or no catch at all.



The month-wise availability of major fish species caught off Goa in response to PFZ advisories received during 2004 to 2012 is furnished below in Table below:

The month-wise availability of major fish species caught off Goa using PFZ forecast

Month	Major fish species caught in the catches using PFZ forecast
April	Indian mackerel, Oil sardine, Skip jack Tuna, Horse mackerel, Lesser sardines, Breams, Threadfin breams
May	Indian mackerel, Oil sardine, Skip jack tuna and Coastal tuna, Horse mackerel, white fish
June	Indian mackerel, Oil sardine, Horse mackerel
July	Indian mackerel, Oil sardine
August	Indian mackerel, Seer fish, Skip jack Tuna, Solar shrimps, Red snapper, Cat fish, moon fish
September	Indian mackerel, Oil sardine, Seer fish, White pomfret,
October	Indian mackerel, Oil sardine, Seer fish, Skip jack Tuna, Moon fish, Scad, Ribbon fish
November	Indian mackerel, Oil sardine, Seer fish, horse mackerel, Ribbon fish
December	Indian mackerel, Oil sardine, Seer fish, Horse mackerel, Silver pomfret, White fish, Skip jack Tuna, Ribbon fish
January	Indian mackerel, Oil sardine, Seer fish, Horse mackerel, Skip jack tuna and Coastal tuna
February	Indian mackerel, Oil sardine, Seer fish, Horse mackerel Lesser sardines Skip jack tuna
March	Indian mackerel, Oil sardine, Seer fish, Horse mackerel Lesser sardines Skip jack tuna

Things to avoid:

1. Avoid fishing at the end point of the PFZ advisory, it will yield a lower catch.
2. Avoid fishing on the opposite direction of the shifting feature as the fish moves in the direction of the shift.

3. Fishing should not be done on the PFZ "line" after second and third day after receiving the PFZ. This is because the fishes are not stationary but are fast moving resulting in lower catch. It should be done on the direction of the shift.
4. Fishing is to be avoided during day time as the fishes dive to deeper areas during day time because of the sunlight. Ideal time is to fish during late evening or early morning.
5. Fishing during fish ban period for allowing the fishes to breed and propagate their species.
6. Indiscriminate fishing of small sizes of fishes. This can be achieved by using permitted and appropriate mesh size and net for different species.

Advantages of PFZ:

1. Helps to locate the fish in the areas were fish congregate.
2. Saving on valuable fuel and human drudgery.
3. Reduction in search time by 30 to 70 %.
4. Fishing period reduced from 3-5 days to 1-2 days.
5. The PFZ forecast is more useful to pelagic gears like Purse seine, gill nets and long line, because the PFZ is derived from surface parameters like chlorophyll and sea surface temperature.
6. It may also be useful to mid water trawls and near shore and shore operated gears irrespective of depth.
7. Traditional fishermen can benefit by the use of PFZ forecast when available near shore.

Conclusion

The Potential fishing Zone mission programme is an important one under the common minimum programme of Government of India, in which the latest and modern scientific technology is brought to the use of common men in the fisheries sector. The experience gained in the course of implementing the PFZ forecast programme during the last five years (XI Plan period) had been helpful in gaining knowledge both on the various aspects of the PFZ and the resultant fisheries off Goa coast, as the programme was well received by Goan fishermen with particular reference to pelagic fishers who had benefited in saving fish search time and thereby reducing the use of fuel and human effort to an extent of 30 to 70%.

The PFZ forecast will be continued to be transmitted directly to the Electronic Display Board (EDB) installed at Malim, Vasco and Cutbona fish landing centers and fishermen can get benefit by getting the information from the EDB for which it is hoped that this manual will be of use. The interested fishermen can directly contact the Director, Indian National Center for Ocean Information services (INCOIS), Ministry of Earth Sciences, Government of India ''Ocean Valley'', Pragathi Nagar BO, Nizampet SO, Hyderabad 500 090, India for getting the PFZ information directly to their FAX or e- mail. It is sincerely felt that this manual will be of immense use to fishermen of different crafts and gears in using the latest scientific technology for the effective, economical and sustained marine fisheries off Goa coast.

Acknowledgement

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Appendix - I

Major species observed in catch from PFZ regions.

Oil sardine (*Sardinella longiceps*)

Indian mackerel (*Rastrelliger kanagurta*)

King Seer fish (*Scomberomorus commerson*)

Seer fish (*Scomberomorus guttatus*)

Skipjack tuna (*Katsuwonus pelamis*)

White fish (*Lactarius lactarius*)

Ribbon fish (*Trichiurus lepturus*)

Moon fish (*Mene maculata*)

Silver pomfret (*Pampus argenteus*)

Black pomfret (*Formio niger*)

Breams

Carangids

Red snapper

Lesser sardines

Coastal tuna

Shrimps

Threadfin breams

Cat fish

Appendix - II

Feedback forms

Feedback No: _____

Indian National Centre for Ocean Information Services (INCOIS)

Potential Fishing Zone Advisories - Feedback Form

FISHING PERIOD: With in PFZ ☐ Outside PFZ ☐

Name of the Landing Station/ Fishing Base	Date of Fishing	Time of Departure	Time of Arrival

VESSEL/BOAT & NET DETAILS:

Name of the Vessel	Type of Boat.(Mech /Non.Mech)	Length of Boat	Type of Net

PFZ FORECAST DETAILS:

Location as per PFZ Forecast		Validity Date	Forecast Received on
Latitude/Longitude	Angle, Degrees, Distance and Depth		

ACTUAL LOCATION OF FISHING:

Latitude	Longitude	Distance from the Landing Centre (Km.)	Direction from the landing centre	Depth at the Location (meters)

FISHING OPERATION DETAILS:

Number of fishing Hours (Indicate Start & End time of the fishing operations)	Number of Hauls	Engaged Number of Fishermen	Number of Fishing Boats

CATCH DETAILS:

	TOTAL (Kg.)	Name of Major Species					
		a)	b)	c)	d)	e)	f)
Haul I Duration Hr							
Haul II Duration Hr							
Haul III Duration Hr							
Total Catch							
CPUE							

Indian National Centre for Ocean Information Services (INCOIS)

Potential Fishing Zone Advisories - Feedback Form

STATUS OF THE CATCH: (Give √ Mark)

Bumper	Normal	Below Normal

EXPENDITURE:

Total Expenditure in Fishing Operation (Rs.)	Fuel (Rs.)	Wages (Rs.)	Other Expenses (If Any) (Rs.)	Approximate cost of total Catch

WEATHER CONDITION:

State of Sea	State of Sky	Wind Direction

Oceanographic Parameters:

	Hauling Site		
	HAUL I	HAUL II	HAUL III
• Sea Surface Temperature (deg C) **(Mandatory)**			
• Secchi disk depth (m) **(Mandatory)**			
• Ocean Color (visual) **(Mandatory)**			
• Plankton Volume			
• Chlorophyll concentration (ug/litre)			
• Dissolved nutrients (ug-atm/lit.)			
o Nitrate			
o Nitrite			
o Ammonia			
o Silicate			
o Phosphate			

DETAILS OF LENGTH FREQUENCY ANALYSIS OF MAJOR SPECIES:

DETAILS OF GUT CONTENT ANALYSIS OF MAJOR SPECIES:

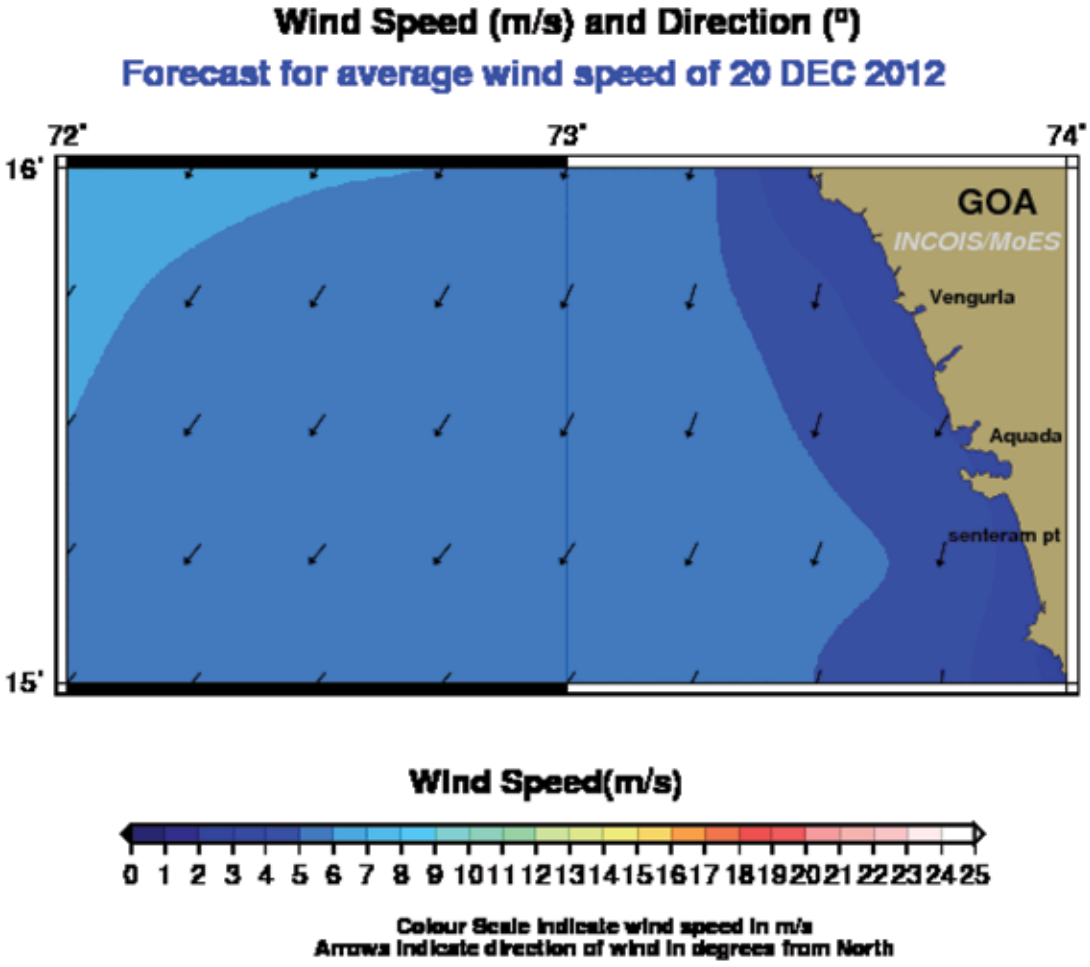
Signature of Analyst with Date

Signature of the Scientist-In-Charge with Date

Note: This form should be sent to INCOIS within a week after each forecast through email to pfz@incois.gov.in or to Fax: 040-2389 5014.

Appendix - III

Wind pattern information



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