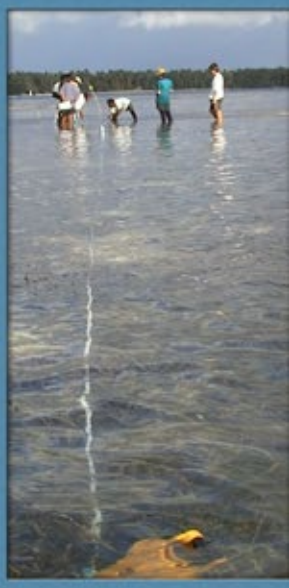
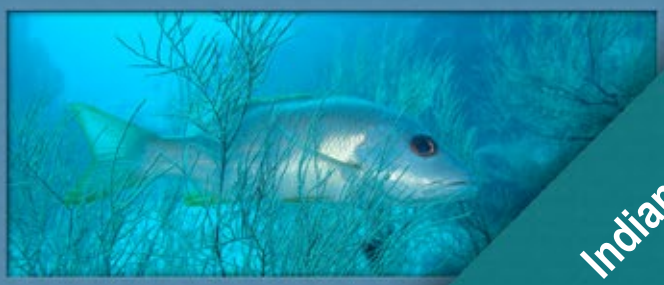
Bay of Bengal Large Marine Ecosystem Project





Report of the

Indian Mackerel Working Group Meeting

1-2 December 2011 • Kochi India

BOBLME-2011-Ecology-19

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1. OPENING OF THE MEETING AND ADOPTION OF THE AGENDA

1 A Workshop on assessing the data and assessment potential on Indian Mackerel (*Rastrelliger kanagurta*) was held on 1st and 2nd of December, 2011 at Kochi, India. The BOBLME Stock Assessment Coordinator, Dr Rishi Sharma welcomed the participants and wished them well in their work

2 Dr Sharma reminded the meeting that BOBLME Project is mandated to develop regional fishery assessments for Indian Mackerel, and this meeting was the second one to that end. The focus of the meeting was to understand the current assessment approaches used, pursue alternative approaches and develop some research and M&E initiatives for the region that will further the understanding of Indian Mackerel in the BOBLME Region.

3 The meeting was opened by Dr Vijaykumaran (NC for India). In his address Dr Vijayakumaran highlighted the lack of information on the species and stocks which contribute to the fishery in different parts of the bay. The need for a common management strategy would be required only when stocks are unambiguously established as transboundary. The rest of the meeting was chaired by Dr Rishi Sharma.

4 The participants of the meeting are listed in Appendix I and the agenda for the Meeting was adopted as presented in Appendix II.

5 Dr Sharma informed the meeting about the scope of the project, and how far the work has proceeded. The agenda was adopted (Appendix II); and the participants were introduced.

6 The list of documents presented to the meeting is given in Appendix III.

2. INTRODUCTION TO SELECTED STOCK ASSESSMENT TOPICS AND TECHNIQUES OF INDIAN MACKEREL ASSESSMENT IN BOBLME REGION

2.1. Information Needs for a Defensible Stock Assessment – Dr Rishi Sharma

7 Dr Rishi Sharma gave a overview on the BOBLME Project and mandate. Crucial to this are the stock assessment components which are essential to the entire project success. This is why the meeting and Indian Mackerel assessment is extremely important in the region. Essential elements of a stock assessment are CPUE and effort at the resolution that mimics the stock and the life-history of the species. A basic stock assessment was presented using a Surplus Production (SP) Model and how B_{MSY} would be estimated as well as elements of a age-structured assessment were presented. Methods that use different sources of data from different countries and gear-types could be integrated into the overall fitting procedure using Maximum Likelihood Estimation (MLE) techniques. Essential in this would be to stratify catch and effort by gear, sector and country. In this manner fleet catchability could be assessed as well so we could compare effort controls, and a desired outcome in fishery yield.

8 The working group discussed the adequacy (quality) of the data in the various countries. Alternative assessment options should be pursued, rather than a single approach taking into account data from uncertain sources. Life history based modeling approaches like Leslie Matrix models, age-structured integrated assessments, FISAT based assessments, Surplus Production based assessments and PSA approaches should be developed.

2.2. Indian Mackerel Fisheries Assessment in Bay of Bengal (Thailand):

9 Thailand presented their information on catch and CPUE trends off the Andaman coast from 1997 onwards. Between 1997-2007, there were between 192-337 purse seiners registered in the western coast of Thailand. The annual production and CPUE of Indian mackerel, estimated only from purse seine fisheries, fluctuated and showed the highest peak, 21,654 tons in 1998, while the highest peak CPUE was 243.04 kg/day in 2001. However, overall

trend of both catch and CPUE have declined in this period. Monthly variation is quite large in these catch trends with the largest catch occurring in October and November. The sampling is based primarily on landing sites across the Andaman coast, and includes at a minimum 1200 fishing trips across the year. 15% of the Purse Seine catch is from Indian Mackerel. Length and weight relationships were developed for *R. kanagurta* from Andaman Sea of Thailand, with values of K=0.9555/year, L∞= 31.75cms and t0= -0.0066 year. Elefan was used to develop the assessment. The total mortality coefficient (Z) was 8.1783 per year, the natural mortality coefficient (M) was 1.3944 per year and the fishing mortality coefficient was 6.7839 per resulting in a value of E that is 0.83/ year. This rate appears to be fairly high and maybe be due to biased samples. In addition if this rate is this high, there may be a stock that migrates into this area and keeps the fishery performing at such rates. Such hypothesis will need to be further explored over time and assess the performance of these resources. Thompson and Bell analysis assessed that in 2007 the fishery was over-exploited (F=0.7, yield of 12999 tons) and optimal economic yield rare at F=0.4 with a yield of 12,805 tons. Current yield rates are at. Current estimates of F are over the sustainable rates (0.83) indicating that the resource is being over-exploited with a yield in 2007 of near 17000 tons.

2.3. Indian Mackerel Fisheries Assessment in Bay of Bengal (Malaysia):

10 In 2009, Department of Fisheries Malaysia Annual Fisheries Statistic shows that the total fish landings from the marine capture fisheries subsector which include coastal and deep sea resources was 1,393,226 tonnes (Anon., 2009). The landings of *R. kanagurta* contributed a substantial quantity to the total landings i.e. about 4.1% (56,520 tonnes) while *R. brachysoma* is higher at 9.2% (128,970 tonnes) (Anon., 2009) as shown in Table 1.

Table 1: Landings of *R. brachysoma* and *R. kanagurta* by region (2009) for Malaysia.

Species/Region	West coast	East Coast	Sarawak	Sabah	Labuan	Total
R. brachysoma	127,735	861	101	7	267	128,970
	9.2%	< 1%	< 1%	< 1%	< 1%	9.3%
R. kanagurta	29,715	17206	2,555	6,546	498	56,520
	2.1%	1.2%	< 1%	< 1%	< 1%	4.1%
Grand total of marine capture	1,393,226					

11 The West coast (within BOBLME region) registered the majority of mackerel catches among the region in Malaysia in 2009 i.e. about 11.3% (157,450) out of 13.4%. Perlis State contributed the highest catch of both *R. brachysoma* and *R. kanagurta* at 43,368 tonnes and 10,225 tonnes respectively.

12 Various gears are used in catching Indian Mackerel. There are 4 most important fishing gears i.e. trawl nets, fish purse seines, gill/drift nets and hooks and lines used to harvest *R. kanagurta* and *R. brachysoma* in Malaysia (Table 3). Purse seine net registered the highest catch of *R. kanagurta* (49% of the total *R. kanagurta* landing in Malaysia) as compared to *R. brachysoma* (42.8%) in 2009. Trawl net also catch substantial amount pelagic fish like mackerel (*R. kanagurta*, 29.0% and *R. brachysoma*, 15.4%) because it had high mouth opening. Landings of *R. kanagurta* by gill and drift net is registered at 18%.

13 There was a large variation in catch by month with the largest catch occurring in October and November similar to the coast of Thailand.

14 Data indicates increased landings over time for *R. kanagurta* in Malaysia. Current landings (29,215 t) are 2.3% of overall landings in Malaysia (approx 4.3% if we include all areas of Malaysia).

15 Stock assessment using Elefan indciates the following for stocks in Malaysia (Table 2). This shows that some areas in Malaysia may be overfished, though estimates of optimal rates and Biomass are not estimated for this stock currently.

Table 2: Population parameters of *R. kanagurta* in Malaysia (west coast BOBLME area).

Area	**Parameters**					
	K (Growth)	**L∞ (Maximum length)**	**Z (Total mortality)**	**M (Natural mortality)**	**F (Fishing mortality)**	**E (Exploitation ratio)**
Perlis (WC)	1.19	29.7	6.9	1.97	4.93	0.71
Penang (WC)	1.21	29	2.01	2.01	6.13	0.76

16 Malaysia has a very comprehensive Fishery Management Plan that would address Indian Mackerel Management and fishery within the entire country with the Bay of bengal playing a large component in this plan. The elements of the plan are very comprehensive and include areas pertaining to the biology of the species, the management and enforcement of the fishery as well socio-economic aspects to the resource.

2.4. Indian Mackerel Fisheries Assessment in Bay of Bengal (Indonesia):

17 Indonesia gave a comprehensive overview of the subject and fishery within the Bay Of Bengal Region. There is a large component of small pelagics in the Purse Seine fleet. Purse Seiners have increased in magnitude from 1982-1998, and approximately 43% of the small pelagic catch is from Mackerel (both *R. kanagurta* & *R. brachysoma*).

18 Areas 571 in Indonesia Management Areas north and west of Banda Aceh are primarily the fishing areas that are targeting Indian Mackerel. Other areas are west Sumatra and North Sumatra. The primary catch techniques used are Purse Seine. Variations in catch rates are similar to Malaysia and Indonesia and occur mostly in the second monsoon. Bimodal spawning peaks indicate tow seasons, namely in January/February and then again in July/August.

19 Elefan based assessment were conducted on samples collected in different periods (Table 3 below) indicate the resource is being exploited at a rate between 0.61 and 0.68 between 1984 to 2009. This may be too high for the resource and is thus being overexploited. Of note is that the Purse seiner fleet has increased its efficiency in catch rates over time.

Table 3: Elefan based estimates of Indian Mackerel Assessment in Indonesia

Years	**Method**	**Loo**	**K**	**Z**	**M**	**F**	**E**	**Reference**
1984-1986	**Elefan 1**	**28.2**	**0.80**	**3.89**	**1.53**	**2.26**	**0.61**	**Tampubolon, 1988.**
1995-1997	**MPA**	**36.4**	**0.75**	**3.07**	**1.12**	**1.95**	**0.64**	**Hariati *et al*, 2001b.**
2009	**Elefan 1**	**26.3**	**1.0**	**4.76**	**1.52**	**3.24**	**0.68**	**2009**

2.5. Indian Mackerel Fisheries Assessment in Bay of Bengal (Myanmar):

20 Myanmar gave an overview of where the resource is utilized, namely on the Rakhine and Tainintharyi coasts. Estimates of overall Biomass and production are show below (Table 4), and are based on methods developed in 1981. The estimates thus are out of date and no current assessment programs are being developed to assess these estimates and yield estimates across groups.

Table 4: Species Biomass and optimal yield levels across all demerssal and pelagic groups on different areas in Myanmar

Area	Biomass			MSY		
	Demersal	Pelagic	Total	Demersal	Pelagic	Total
Rakhine	0.194	0.175	0.369	0.160	0.087	0.247
Delta (Yangon, Ayeyarwady, Mon)	0.334	0.505	0.839	0.220	0.252	0.472
Thanintharyi	0.256	0.295	0.551	0.17	0.147	0.317
Total	0.784	0.975	1.759	0.550	0.486	1.036

21 There are both inshore and offshore fisheries that occur on these species in these areas. Both drift gillnet and purse seine techniques are also used on the species fished in these areas. Catches are mostly prevalent between November and February (Rakhine) and November to April (Tanintharyi). Catches have varied between 14206 (09-10), 19357 (10-11) to 11852 (preliminary in 2011 currently. No data from Jan-April included here for 2012).

22 There are large constraints in the management of fisheries in Myanmar stemming from the capacity to collect useful scientific data and analyzing the data to assess the resource potential correctly. There is limited funding as well. Nonetheless, Myanmar has implanted both time (June through August) and area closures (near-shore 5 miles on Rakhine and 10 miles off Ayerwaddy and TaninThary coasts) to select trawl gear.

23 Tagging studies have also been conducted on Indian Mackerel by SEAFDEC in 2008, 2009 and 2010, with limited success as most tags are found immediately after release. Not much information on migration has thus been understood off the Myanmar coast.

2.6. Indian Mackerel Fisheries Assessment in Bay of Bengal (India):

24 India has a very comprehensive database on assessment and studies performed on Indian Mackerel from the 1950's. There is a large area covered in the fisheries (8129 kms of coastline), with 243,939 boats (59,743 mechanized and 76,372 motorized). 1331 landing centers are present on the coast that sample the catch for overall landings. There has been a 6 fold increase in amrine capture production in India from the 1950's to the present day.

25 The Indian mackerel lives in the pelagic-neritic, oceanodromous, marine, depth range of 150 - m environment. The Indian mackerel is generally found in shallow, coastal waters, where the surface water temperature is at least 17 °C (63 °F). Adults of this species are found in coastal bays, harbours and deep lagoons. They are commonly found in turbid waters rich in plankton.Adult Indian mackerel feed on macroplankton including the larvae of shrimp and fish. The spawning season around India, which is in the northern hemisphere, is between March and September. Around Seychelles in the southern hemisphere, it is between September and the following March. Spawning occurs in batches. The eggs are laid in the water and are externally fertilized. The Indian mackerel do not guard their eggs, which are

left to develop on their own. Juveniles feed on phytoplankton like diatoms and small zooplankton including cladocerans and ostracods. As they mature, their intestines shorten, and their diet changes to primarily includemacroplankton such as the larvae of shrimp and fish.

26 As far as the fishery is concerned, the bulk of the catch comes from West Coast of India between Cape Comorin and Ratnagiri. The contribution from the East Coast (From Tamil Nadu, Andhra and Orissa Coast) is relatively of lesser magnitude However, isolated very heavy catches during certain years has been taken on the east coast as well. During the past twenty years, the catch data has shown that the annual mackerel catch in the total marine landings in India is of the order of 8%. But, this is based on the catches varying on 2-19% of total marine landings. The fishery is supported by the species *R. kanagurta* (Cuvier) mainly. Besides *R. Kanagurta*, there is one more species, namely, *R. brachysoma* (Bleeker) also known as short-bodied Indian mackerel. This has so far been reported from Andaman Islands, where it forms a very small local fishery. The third species *R. faughni* is reported to occur sporadically along the east coast of India. The fishery originally was small scale muscle and subsistence (sail) boats. In the 1980's there was a shift towards motorized and by the 2000's the fleet had a large number of mechanized boast.

27 Landing data is reported from 2000-2009, and is shown in Table % below.

Table 5: Landing data from India for *Rastrelliger kanagurta* (Cuvier)

Year	All India	East coast	West coast	% contribution of east coast
2000	134020	22638	111382	16.9
2001	88576	24108	64468	27.2
2002	94014	41520	52494	44.2
2003	111880	41379	70501	37.0
2004	141774	46014	95760	32.5
2005	125424	41190	84234	32.8
2006	141918	43050	98868	30.3
2007	180117	30666	149451	17.0
2008	158913	42457	116456	26.7
2009	186128	58293	127835	31.3

28 While the east coast landings are minor compared to the west coast they still contribute a large number of catch and this trend is increasing over time. Overall production has averaged about 30% between 200 and 2009 though in some years has been as high as 44%. While the states of Tamil Nadu and Andhra Pradesh have the larger catch contributions, West Bengal and Orissa also catch substantial amounts of Indian Mackerel. Most catch comes from the mechanized and motorized sector on the east coast (95%) whereas the Non-mechanized sector catches only 5% of the overall catch. Of the gears catching these, trawl (52%), gillnet (28%) and seiners (14%) account for 94% of the catch. The commercial fishery begins to exploit mackerel from about a size of 18 cm., which they attain within six months. Fish below this size are also caught in good numbers in some places. About 80-90% of fish in the commercial catch comes from size below 22 cm., which they attain in the first year of its life. The size groups above 22 cm., contribute a small portion in the commercial catch. The major contribution to the commercial catch comes from the 0 – year class. The 1-year and 2

year classes contribute progressively less. There is large variation in catch by age across different gear types.

29 Important size based reference points are the following:

- Size at first maturity (Lm) =175 mm
- Length at recruitment (Lr) = 80 mm
- Size at first capture (Lc) = 140 mm (0.5yrs)
- Lopt = 195 mm (0.86 yrs)

30 Numerous studies by CMFRI have understood life history traits such as their appearances to shoal in some areas as well as migrate to certain areas for spawning and rearing. Mackerel recede from coastal waters during the south west monsoon period for the purpose of spawning. It is believed that the fish after spawning do not permanently retire to deep sea, but come back to coastal waters and their spawning ground are not very far from the coast. The region between Vizhinjam and Cape Comorin off the south west coast of India appears to be spawning ground, as spawners, young mackerel and post larvae have been obtained in this region.

31 Mackerel behavior is governed by where the thermocline occurs in the coastal waters. Mackerel generally prefers to stay immediately above the thermocline. They come to the surface with upwelling (August to October) and sinks to deeper waters with the sinking of thermocline (February to May). Post-monsoon catches are mainly by surface gears like purseseines and ring seines, and Pre-monsoon catches from deeper waters are mainly by trawls. In addition there is diurnal migration that occurs. Indian Mackerel occupy deeper waters during the day and are found nearer the surface at night.

32 K and l-infinity values vary substantially on the stock in Indian waters. They are shown below:

Table 6: K and L-Infinity Values for different areas in Indian waters observed for Indian Mackerel.

Place	K	L-infinity (cms)
Cochin (West)	0.43	21.77
Calicut (West)	0.26	23.26
Karwar(West)	0.36	22.84
Tuticorin (East)	1.634	33.28
Kakinada (East)	1.89	28.63

33 Even though no information was presented on stock assessments numerous papers where referred to that have done this analysis. These papers are available upon request from CMFRI and are mostly based on the Elefan technique for assessment. East coast assessments estimate MSY- at 2 different locations, Kakinada and Tuticorin to be 3550 and 1857 tons respectively. No information was presented relative to these reference points to understand if these stocks were being over or under exploited in the fishery.

34 On an average, the annual total stock available along the Indian coast is estimated as 400000 tons of which 190000 tons are exploited. Exploitation beyond this level may not be economical under the present fishing Efficiency. Status of Exploited Marine Fishery Resources of India from year to year due to variations in stock density, which is related to fishery independent, and fishery dependent factors. Under the present age at capture, the maximum sustainable yield from the resource is 220,000 tons. There is a large market of

mackerel as both fresh and dry products, fish-meal for cattle and poultry as well as fertilizers for coconut, coffee and tea plantations.

35 Recent trends indicate higher catches from the east coast due to changes in fishing technologies such as pair trawling and ring-seines. These are extremely destructive fishing methods and have been banned though the ban is not being enforced in a systematic manner. Climate change effects may change the distribution of these fish, and some changes have been detected after 1989. Finally, the future of the Indian Mackerel fishery is a probable expansion to a fully developed fishery due to global demands.

2.7. Indian Mackerel Fisheries Assessment in Bay of Bengal (Maldives):

36 Maldives does not have a targeted fishery for Indian mackerel. Rather it is caught occasionally in the scad fishery. A reason for the absence of either an Indian mackerel fishery or large quantities of Indian mackerel in the scad fishery might be the mismatch of gear to the species where scads are caught from the surface using miniature pole-and-line and lift nets.

37 As the primary fishery in the Maldives is that of tuna, little emphasis has been placed on other species especially Indian mackerel. To this end, the current system of catch and effort data collection does not segregate Indian mackerel nor has there been any biological studies done on the species. Hence, the scale of the fishery and other aspects of the species remain unknown.

2.8. Indian Mackerel Fisheries Assessment in Bay of Bengal (Other countries not present):

38 Both Sri Lanka and Bangladesh have the occurrence of Indian Mackerel stocks. Current fishing techniques do not harvest these stocks at sufficiently high levels in Bangladesh though there may be a substantial catch in Sri Lanka. Studies to expand the sampling in Sri Lanka are currently being proposed. There is no separate fishery for Indian mackerel (*R. kanagurta*) in Bangladesh. In Bangladesh mackerel is primarily seen as bycatch.

3. INDIAN MACKEREL (*Rastrelliger kanagurta*) STOCK ASSESSMENT RECOMMENDATIONS AND WORKPLAN

3.1.1. Capacity Building

39 There is a strong need for capacity building to support the implementation of a Fisheries Management Plan for the region. While the status and current knowledge may be sufficient for India, other countries will need help to develop their plan. The countries were all supportive of an Integrated Fisheries Stock Assessment Tool for the region that is developed to address the life-history and peculiarities of Indian Mackerel in the region. This will work in conjunction with the existing FISAT and ELEFAN tools that the countries are already using in the region.

Recommend

- ***Establish a Regional Body of experts (i.e. The Indian Mackerel Assessment Working Group, (IMAWG*)) that will share knowledge across the region, and provide some continuity on this project.***
- ***Encouraging exchange of regional transnational knowledge and sharing in management planning processes through the IMAWG for transboundary fisheries, and/or fisheries with similar characteristics***
- ***Provide workshops and trainings on sample design, standardization of effort, and newer stock assessment approaches for the region.***
- ***Create a regional and national pool of experts that would facilitate development of plans***
- ***Strengthen the knowledge of decision makers***
- ***Build more effective fisher organisations within the sector***
- ***Governments to initiate capacity building, but with responsibilities and capacity development carried out at a decentralized level, and inclusive of many stakeholder groups***

40 To this effect the IMAWG Working group members were identified form each country and are the following:

India CMFRI: **Dr Pratibha Rohit**, Dr Sathianandan, T.V., Dr E.M. Abdussamad, J. Jayasankar, Dr U. Ganga.

India FSI: Dr A. Das, Mr. Tiburtius, Mr. Tamilarasam, Mr. K. Govinda Raj

Malaysia: **Mr. Richard Rumpet**, Mr. Sallehudin Jamon, Mr. Abd. Haris Hilmi Ahmad Arshad

Myanmar: **Mr. Myo Aung**, Mr. Soe Myint, Mr. Tun Than, Mr. Aye Thwin, Mr. Soe Win, Mr. Muang Hla, Mr. Hla Win

Thailand: **Ms. Praulai Nootmorn**, Mr.Wudtichai Wungkahart, Mr.Amnuay Kongprom, Mr.Sonthaya Boonsuk, Mr.Montri Sumontha, Ms.Thumawadee Jaiyen.

Indonesia**: Mr. Suwarso**, Mrs. Tuti Hariati, Mrs. Neneng Pebruanti, Mr. Akhmad Zamroni, Mr. Muhammad Taufik, Mr. Andika Prima, Mrs. Ayi Yustiah

Sri Lanka: **Dr Sisira Haputhathri**, Prabath Jayasinghe, Dinali, Deishni Herath

Bangladesh: **Dr Md. Shahidul Islam**, Ms. Ayesha Siddique, Ms. Shamim Ara Begum

Maldives: **Mohamed Ahusan**, Fahmeeda Islam

3.1.2. Develop a fishery management plan for the region in Indian Mackerel

41 All countries expressed concerns of unilateral implementation of management recommendations that were not standardized in other areas if this were a common shared

stock for the region. Using a standardized time area closure mechanism as well as standardized gear regulations will be better for the stock if it is a common stock. Enforcement must be an integral part of this approach if it is to succeed. In addition standardized regulations as well as standardized data assessment programs need to be developed for this region. CMFRI will take the lead on data assessment programs as they collect standardized data by gear/ fisheries sector, and by marine and inshore areas (Sathianandan, T.V. and Jayasankar, J. after approval from Dir. and NC). These programs will be standardized across the region.

Recommend

- ***BOBLME to start developing elements of a FMP (or FIP) for Indian Mackerel Assessment in the BOB Region***
- ***CMFRI to circulate the systematic Stratified Random Sampling design to estimate effort and catch by sector and gear in the marine areas employed in India, and develop the approach to use in the BOBLME region. By April/May of 2012 we will review this design and have a report. Sathianandan, T.V. and Jayasankar, J. will follow up on this.***
- ***Trainings held by BOBLME and CMFRI to train people in the region to collect the right sort of information by sector.***
- ***Standardized regulation package developed by an advisory body and implemented in the region***

3.1.3. Develop a Standardized Model Framework for Stock Assessment

42 The integrated type approach presented by BOBLME that uses all sources of data in all sectors estimating catchability, and vulnerability by sector, gear and area and fitting to indices of CPUE and Survey based indices is the approach that could be pursued in parallel with the exiting FISAT, and ELEFAN based approaches.

Recommend

- ***BOBLME in collaboration with all countries to start developing the framework for the model, and then provide guidelines on what data to collect for the region.***
- ***Train people on the understanding of the model and the dynamics.***

3.1.4. Develop a Dossier on Indian Mackerel

43 Base literature reference for all studies of Indian Mackerel in the region needs to be established. Once this is conducted, we will have a better information base for management and further studies in the region.

Recommend

- ***Assemble all the annotated literature on the species and studies performed in the region***
- ***Public access domain for all IMAWG and others to access for future work.***

3.1.5. Develop a Standardized Short and Long Term Program for Ecosystem Health and Resource evaluation for the different sub-areas of mackerel that occupy the BOBLME Region

44 A long discussion occurred on the range and existence of Indian Mackerel in this region, and how dynamic the BOBLME ecosystem and varied the ecosystem is from one year to the next. The 7 systems being studied have a wide range of activities that have impacted them and the group proposed to develop a joint study on the health of these sub-systems over the duration of the project. The sub-systems studied will have a cross-section time series analysis are the following:

1. India-Gulf of Mannar, Palk Bay, Coromandel Coast, Andaman Islands, and Orissa
2. Sri-Lanka-Jaffna Peninsula
3. Bangladesh-Lower Sundarbans
4. Myanmar-Rakhine Coast (Thantwe District) and Tanintharyi Coast (Kawthaung District).
5. Thailand- Mergui Archipelago, and Andaman Sea.
6. Malaysia-West coast (Langkawi Island to Port Klang)
7. Indonesia- Banda Aceh coast (Aceh Province), North Sumatra and West Sumatra

Recommend

- ***BOBLME fund a longer more comprehensive study on health of the 7 sub-ecosystems that Indian Mackerel occupy to understand the following:***
  1. ***Water Quality across these systems***
  2. ***Habitat Quality and quantity in these systems.***
  3. ***Species Biotic index in the systems, along with Juvenile Mackerel measurements.***
  4. ***Surveys on economic livelihoods of locals in these areas.***
- ***Standardize methods and data to be collected on these attributes by the region.***
- ***Long term study that will capture ecological connections and functions in the estuary and ocean sections of this region that tie in with Indian Mackerel Recruitment and resiliency over time.***
- ***What is a properly functioning marine ecosystem and how can we improve habitat to keep populations resilient. This will be the focus of the longer term study.***

3.1.6. Other Priority Items for consideration

45 Other itesm were divided into two kinds shown below:

Short term objectives (next 2-5 years):

i) Reanalyze Biological Data on the sub-areas and note biological differences if they exist.
ii) Integrated study across region using Genetics, Otolith Microchemistry and Morphometrics.
iii) Identify spawning and juvenile nursery areas.
iv) Develop a common data repository of Catch and effort data for the region.
v) Conduct country level assessment models using CPUE, and SP and length structured assessments.
vi) Develop an M&E strategy and training for catch, effort and CPUE data for the region.
vii) Develop the framework for an integrated assessment for the region. BOBLME region.
viii) Start survey of spawning biomass targeted towards Mackerel.

Long term objectives:

i) Develop an integrated model for the region.
ii) Incorporate physical forcing variable that may determine recruitment dynamics, i.e. ecosystem interactions that may effect sardine mackerel fluctuations in BOB region.
iii) Long-term study on indicators (i.e. temperature, salinity UPI, and circulation measurements, oceanography) effecting recruitment
iv) Establish FMP, and management body to provide advice for the region.

3.2. Proposals for Research and M&E Work in 2011-2013

46 Proposals were presented by each country, but due to insufficient detail in the workplan and the budgets were requested to be resubmitted again by the end of December, 2011. However, due to having all countries present at the location an integrated design where similar work would be conducted across all regions was discussed and presented. The common elements suggested were:

i. Collection of a systematic genetic study to undertand stock structure along with otolith micro-chemistry and morphometrics within the region.
ii. Collection of length frequency data both from commercial landings and experimental fishing.
iii. Collection of time series data on catch, effort and recruitment.
iv. Assessment of age, growth, mortality and stock with the help of length based models, or other newer techniques.

3.3. Stock status advice for Indian Mackerel in BOBLME Region

47 The workshop conducted in India considered the range of information available, and adopted the following stock status advice for the regional Indian Mackerel fish-stock in the Bay of Bengal.

The stock status of Indian mackerel (*Rastrelliger kanagurta*) is unknown.

All countries except Maldives catch Indian mackerel (even Maldives do in certain time and areas), but it is uncertain whether this species is one large stock or whether two or more sub-stocks exist. For example, it is possible that Indonesia, Malaysia and Thailand may be fishing one stock and India/Bangladesh/Myanmar or India and Sri Lanka may be fishing another.

In the western areas of the Bay of Bengal it may be confused with the short mackerel (*Rastrelliger brachysoma*). The minimum current catch estimate is around 174,570 t in 2009 (India 58097 t, Myanmar14207 t, Thailand 23337 Mt (Average of 2005-2007 landings), Indonesia 20000 t (based on equal split of data shown in Hariati and Nugroho, 2010 study of 40000 t), Sri Lanka 400 t, Malaysia 56520 t, and unknown number from Bangladesh). FAO data estimates the average landings across India, Thailand and Indonesia in the BOB region to land 47887 Mt on average between 2004-2009.

No conclusive stock assessments are currently available, though FISAT/Elefan based methods suggest a huge amount of variation in both the length at age methods and exploitation rates observed in the fisheries (F= 6.78 in Thailand, 4.93<F<6.13 in Malaysia, 3.24 in Indonesia in 2009). The huge amount of disparity is primarily a function of length at first capture, and while F of 3.24 maybe sustainable, F of 6.78 with M between 1.1 and 1.5 maybe difficult to sustain.

While the current catch trends show fairly stable catches over the region, this rate may not be sustainable if small changes occur in temperature in the region. Indian Mackerel is a r-selected species with a high fecundity and short life-span (high growth rate) and could possibly sustain these rates currently, but it is not known if this is sustainable in the long run.

ADOPTION OF THE REPORT

The Report of the First meeting of the BOBLME Indian Mackerel Fisheries Assessment Working Group in Kochi was adopted by email January 18th, 2012.

Appendix I LIST OF PARTICIPANTS

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Appendix II Agenda

BOBLME INDIAN MACKEREL FISHERIES ASSESSMENT WORKING GROUP

Kochi, India December 1st & 2nd, 2011

Programme- Day 1 December 1st

9.00	Registration
9.05	Ice breaking/Self introduction
9.10	· Welcome Address & Introduction to Assessment Workshop on Indian Mackerel Fisheries from BOBLME- Dr Rishi Sharma · Address by NC India (Dr Vijaykumaran) to the meeting
9.30	Country Assessment Techniques paper on Indian Mackerel fisheries and its stock assessment in Indonesia **Lead:**
10:00	Country Assessment Techniques paper on Indian Mackerel fisheries and its stock assessment in Thailand **Lead:**
10.30	Tea break
10.45	Country Assessment Techniques paper on Indian Mackerel fisheries and its stock assessment in Malaysia **Lead:**
11.30	Country Assessment Techniques paper on Indian Mackerel fisheries and its stock assessment in India **Lead:**
12.00	Country Assessment Techniques paper on Bait fish fisheries and its stock assessment in Maldives **Lead:**
12:30	Lunch
13:30	Integrated Assessment for the Region: Dr Sharma
14:00	Group Discussion on the Improvement of current models and an alternative approach
14:30	Tea Break
15:00	Alternative Models to be used- Use of Computers and how to develop an integrated model- Dr Sharma
15:30	Unknowns about Indian Mackerel in BOBLME Region: Data Gaps
16:00	Wrap up for the day

Programme- Day 2 December 2nd, 2011

9.00	Day 1 Discussion/Draft Recommendations- Dr Sharma
10.00	Data Needs and Sampling Coverage for the Region for supporting current assessments or alternative models (Genetic study on stock structure in region)
11.00	Tea Break
11.15	Improving current sampling for integrated models- Getting good measures of effort and standardization: Group Discussion
12:00	Independent Surveys of Biomass- Who, what and How?
13.00	Lunch
14.00	Next steps- Proposals on Indian Mackerel- Each country will present their proposals for BOBLME (a draft of this based using the attached proposal format will need to be submitted before the meeting be each country in BOBLME format)
15.00	Timeline to finalize these proposals and work-plans
15.30	Short and Long term strategies-Finalize Recommendations/ Establish Working Group
16.00	Tea Break
16:15	Wrap Up- Concluding Remarks
16.30	End

Appendix III LIST OF DOCUMENTS PRESENTED TO THE MEETING

Presenter	Title
Dr Vijaykumaran	Introduction and welcome to Indian Mackerel Workshop in Kochi
Dr Rishi Sharma	Indian Mackerel Working Group: Data Needs and Alternative Approaches to Assessment
Mr. Richard Rumpet & Abd. Haris Hilmi Ahmad Arshad	Status of the Indian Mackerel (*Rastrelliger kanagurta*) resources, socio-economic aspects and their possible management in Malaysia
Md. Ahusan & Famida Islam	Indian Mackerel Fishery in Maldives
DOF Myanmar	*Assessment and Evaluation of Indian Mackerel Fisheries in Myanmar*
Dr Suwarso, N,P., and A. Yustiati	Indonesian Indian mackerel in Sothern part of Andaman sea : fisheries and stock assessment
M. Sumontha, S. Boonsuk & T. Jaiyen	*Stock Assessment of Indian Mackerel* **(***Rastrelliger kanagurta (Cuvier, 1816)) along Andaman Sea Coast of Thailand*
DrH.Mohamad Kasim* & E.M.Abdussamad	*Rastrelliger kanagurta:* the Indian mackerel – status in India

Bangladesh, India, Indonesia, Malaysia, Maldives, Myanmar, Sri Lanka and Thailand are working together through the Bay of Bengal Large Marine Ecosystem (BOBLME) Project and to lay the foundations for a coordinated programme of action designed to improve the lives of the coastal populations through improved regional management of the Bay of Bengal environment and its fisheries.

The Food and Agriculture Organization (FAO) is the implementing agency for the BOBLME Project.

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For more information, please visit www.boblme.org