



Bay of Bengal Large Marine Ecosystem Project



Report of the
BOBLME Fisheries Assessment Working Group meetings
Bangkok Thailand • 13-14 September 2010 & Chennai India • 25 November 2010

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*Eight countries, connected by one ecosystem,
working together to secure its future.*



Report of the BOBLME Fisheries Assessment Working Group meetings

Bangkok, Thailand, 13-14 September, 2010

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1. TWO MEETINGS OF THE BOBLME FISHERIES ASSESSMENT WORKING GROUP WERE HELD IN 2010

1.1 Bangkok

1. The meeting of the BOBLME Fisheries Assessment Working Group was held 13-14 September 2010 in Bangkok. The BOBLME Regional Coordinator, Dr Chris O'Brien welcomed the participants to Bangkok and wished them well in their work. He noted that for reasons beyond their control, scientists from India were not able to attend the meeting but hoped they still will be able to contribute to the outcomes of the meeting and the report.
2. The Regional Coordinator reminded the meeting that BOBLME Project is mandated to develop regional fishery assessments for hilsa and Indian mackerel and this meeting was the first step to assessing what data are available and begin the assessment process.
3. The meeting was chaired by Mr Hussain Sinanan (Maldives) and the agenda for the Meeting was adopted as presented in Appendix I. The list of participants is provided in Appendix II and a list of the documents presented to the meeting is given in Appendix III.

1.2 Chennai

1. The meeting of the Indian Fishery Assessment Working Group of the Bay of Bengal Large Marine Ecosystems (BOBLME) Project was held at Hotel Savera, Chennai on 25 November 2010.
2. The outputs from this meeting were have been combined with those of the Bangkok meeting in order to produce one compendium of information. The entire report from the Chennai meeting is provided in Appendix ZZ. Selected excerpts of information and data from the report and presentations has been combined into the tables below.
3. The Indian scientists reviewed the stock status statements for hilsa and Indian mackerel that produced at the Bangkok meeting (in the absence of input from Indian scientists). Based on the expertise and information at its disposal, the Indian meeting generally concurred with the advice but recommended some factual amendments to each statement. The final stock status statements are given below.
4. At the opening of the meeting Dr K Vijayakumaran, National Coordinator in India welcomed Dr Chris O'Brien, Regional Coordinator BOBLME; Members of the Fishery Assessment Working Group and all other dignitaries present on the occasion. The list of participants is provided in Appendix ZZ. Dr K Vijayakumaran explained the circumstances under which formation of this Working Group has become necessary. Dr V V Sugunan, National Technical Advisor outlined the background of the meeting, its objectives, format and the expected outputs. Speaking on the occasion, Dr O'Brien explained how this process will add value to the outputs of the meeting of the Bangkok meeting. The Meeting consisted of four Technical Sessions and a Plenary Session.

2. INTRODUCTION TO SELECTED STOCK ASSESSMENT TOPICS

2.1 The state of world fisheries – Ray Hilborn

5. Ray Hilborn provided an overview of the status of the worlds fisheries covering a range of topics including trends in the catches of worlds fisheries stocks; commentary on the percentages of fish stocks that have been assessed; changes in the levels of exploitation of stocks over time and predictions for the future status of stocks. On a more technical level he covered an introduction to surplus production, the factors affecting fish productivity and what catch data tell us.

2.2 Stock assessments, the simple to the complex – Adam Langley

6. Adam Langley informed the meeting on aspects relating to the development of collaborative regional fishery assessments. He described a range of assessment approaches that might be applicable in the Bay of Bengal and their data requirements. This included surplus production models, virtual population analysis and statistical age structured models. He reviewed the current available data and assessments and made recommendations on possible future assessments for hilsa and Indian mackerel and the areas of work that would need to be undertaken to support them. This included: defining stock units; reviewing biological parameters (growth, M, maturity); define the principal fisheries; review of current and historical catch and

associated size (length) data; deriving an index of abundance – CPUE and the selectivity of fisheries. The possible assessment approaches included, estimating model free metrics (e.g. Z); Surplus Production models and integrated age-structured models (in the long term). And more 'Semi quantitative' assessments in the shorter term. A stochastic approach to stock reduction analysis was outlined.

2.3. Overview of the literature

7. Information available in the literature by species that were relevant to stock assessments was summarized. These tables were further updated (Table 1 and Table 2 in following sections) based on the presentations and discussions at the Workgroup meeting. In addition to the available information relative to stock assessment, a simplistic surplus production analysis with uncertainty was presented for demonstrating what approaches could be used once the data are available for future stock assessments (Appendix VI).

3. HILSA (*Tenulaosa ilisha*)



3.1 Review of available data and assessments from Bangladesh and Myanmar

Bangladesh

8. Hilsa is of major importance to Bangladesh. Recent national catches are estimated to be about 300,000 t representing 12% of total fish production in Bangladesh. The hilsa fishery supports a large number of fishermen and fishing communities. Over the last 30 years the fishery has expanded from river and coastal waters to encompass the wider area of the Bay of Bengal. Hilsa is principally caught using gill nets.

9. Hilsa was once widely distributed in the inland waters of Bangladesh; however, the distribution has contracted and hilsa is now concentrated only in the lower reaches of the main rivers in the southern region. Inland catches have remained relatively stable since the mid 1980s although total catches have increased from about 150,000 t to 300,000 t as the marine fishery has expanded.

10. Recent genetic studies revealed no genetic differences among areas (including areas in Myanmar and India) and on that basis it was concluded that hilsa should be considered to be a single stock. This suggests no natal affinity to the river spawning habitats.

11. Hilsa is an anadromous species. Adults spawn in the river and then return to the sea. Juveniles remain in the river habitat for the first 6-8 months before moving to the sea, returning to the river to spawn at about 1 year of age. Recent biological studies suggest that male fish may change sex (to females) as reported in other species of the same genus. The time series of biological studies (from late 1960s) indicates that the fecundity of the species has declined.

12. Length data from the fishery have been applied to estimate growth and mortality rates in most years from 1992 to 2000 (using FiSat).

13. There has been a substantial loss of river habitat in Bangladesh due to siltation from erosion, and the construction of dams and barrage. Some rivers are also heavily polluted. Overfishing (growth and recruitment) of the hilsa stock is occurring and there has been a significant decline in the size of first capture. The use of smaller meshed set nets in river areas is increasing as fishermen target juvenile hilsa (jatka). There are numerous reports available documenting the catch rates from the fishery in specific areas, although there is no consistent CPUE time series of data.

14. A range of conservation measures have been introduced to protect hilsa, including time/area closures to protect juvenile fish and the seasonal closure of important spawning areas. Trends in the CPUE of jatka indicate that these measures are resulting in improvements to the fishery. These measures have led to the development of a comprehensive management plan for hilsa in Bangladesh. There is also a proposed management arrangement between Bangladesh, India and Myanmar.

Myanmar

15. In Myanmar, hilsa is caught using purse-seine and encircling gill nets. Some vessel licensing statistics are available and hilsa export data are available for the last five years. Annual exports were approximately 16,000 t in recent years with a high proportion of the exported catch sent to Singapore. The relative proportion of the total catch that is exported is unknown.

India

16. Five species under the Genus *Tenulosa* has been recognized from the estuaries and coastal waters of tropical Asia. The Indian shad *T. ilisha* and to a certain extent *T. toli* are available in Indian waters. A vast literature on the species is available, however great disparity exist in the results obtained by the various workers, which is sometimes not only confusing but also contradictory

17. *T. ilisha* is found from north Sumatra in the east to Kuwait in the west, with important fisheries in Bangladesh, India, Myanmar, Pakistan and Kuwait. It is also recorded from the coastal waters of Sri Lanka. *T. ilisha* is most abundant in the Ganga-Brahmaputra drainage systems of Bangladesh and India i.e. along the east coast, hilsa occurs in Ganga, Hooghly, Mahanadi, Godavari, Daya, Chilika, Cauvery, Krishna, Padma, Brahmaputra and the Barak. Along the west coast, the hilsa ascend the Narmada, Tapi, Purna, Ulhas, Savitri, Kali and Vambanand backwaters. Overall, its marine distribution extends from Iran and Iraq in the Gulf to the west coast of India in the Arabian Sea and the Bay of Bengal. *T. toli* is now very rarely found in Indian waters.

18. Hilsa is a prime food fish in northern Bay of Bengal States. It supports lucrative fishery and the livelihoods of millions of people. The value of production in the area is over US \$110 million. Catches have reached a plateau and mean size at catch is declining. Fishing effort is increasing and CPUE is declining.

19. Availability of hilsa in most of the Indian rivers is largely diminished as their breeding run is severely hindered by construction of dams, anicuts, barrages etc. Lower stretches of many rivers are almost dried-up, turning it unsuitable for migration. Hilsa landing is now confined in estuarine part of majority of Indian rivers. In the Hooghly estuary, the freshwater inflow attracts higher number of hilsa for their breeding migration and form a commercial fishery.

20. Hilsa migrate into rivers during the main breeding season. Long range migration is not uncommon, and historical records indicate that hilsa may have migrated from the Indian Ocean as far as Delhi in the past. Two runs of hilsa migration have been reported in the main Ganga river system, one during the south-west monsoon and the other (of smaller magnitude) during late winter.

21. Availability of hilsa in most of the Indian rivers has diminished as their breeding run is severely hindered by construction of dams, anicuts, barrages etc. The lower stretches of many rivers are almost dried-up, turning it unsuitable for migration. Hilsa landing is now confined in estuarine part of majority of our rivers.

22. The fishing for hilsa takes place mainly during the monsoon season when adult fish migrate up the rivers for spawning and is centered in the estuaries and rivers. A less important fishery takes place during the later part of winter, when there is a minor run of mature fish up river for spawning

23. The fishing season generally lasts as long as the catches are satisfactory. The largest catch from the hilsa fishery comes from the deltaic region of the Gangetic system of India and Bangladesh, where it is reported to be more valuable than any other single species of fish

24. Catch statistics are difficult to collect due to the highly dispersed nature of the fisheries; difficulties to approach landing centers and the diverse fishing gear employed. The catch records have continuity only for a few places and for a few years and considerable fluctuations have been reported in the catches from different

areas. About 80-90% of the catch is during the monsoon months (July-October). The gear is mostly drift gill nets and set gill net in the lower estuary and upper estuary all type of netrs are used.

25. Presently more than 2000 small mechanized and 4000 non-mechanized boats mostly equipped with drift gill net containing 150 to 350 net pieces are actively engaged in the coastal areas of West Bengal.

26. Fishing activities are mainly confined within 30 to 40 Km of the shore and the inshore area up to 50 m depth is intensively exploited. Mean length at capture declined from 35.6 cm on the 1960s to 32.5 cm in 2007. Fishing effort, CPUE are not well documented. Serious stock assessment has not been carried out to assess catchable limits; available data do not support such estimations

Country	Catch (t)	Year
Bangladesh	298 458	2009
India	64 540	2010
Indonesia	-	-
Malaysia	-	-
Maldives	-	-
Myanmar	16 743	2009
Sri Lanka	-	-
Thailand	-	-
Middle BOB	200 100*	FAO Fishstats 2010
Total	379 741	

3.2 Identification of future assessment approaches and data needs

27. Based on the information presented on hilsa at the meeting and subsequent discussions (Table 2), the FAWG identified the following fundamental activities that should be undertaken to support the advancement of a regional stock assessment of hilsa. The WG noted that most recent assessment by Bangladesh is a length based assessment using FiSAT (see <http://www.fao.org/fishery/topic/16072/en>). However, it appears that sufficient data exists to undertake an assessment using use Stock Synthesis based approaches and/or Surplus Production Models:

- a. To evaluate the results of the existing length based Stock Assessment approaches using FiSAT. While FiSat is unlikely to yield a definitive assessment and reliable estimates of MSY, etc it should highlight the key areas of uncertainty and identify areas for direction of data collection in future. On the otherhand, it may enable more specific conclusions regarding exploitation pattern (estimation of selectivity and compare to maturity, etc) and has the potential to evaluate suitability of current management approaches such as mesh size restrictions.
- b. The sources of data were identified and a review of the data is proposed for future working group meetings.
- c. The use of Stock Synthesis and simplistic Surplus Production Model approaches are recommended. With respect to the Stock Synthesis analysis, a statistical catch at age model could be developed for Hilsa Shad where recruitment would be estimated as a function of the available Biomass and CPUE data. In this model, the components such as total catch by sector and the available length/age data would also be incorporated into the statistical likelihood that the model estimates would be fitted to.
- d. The assessment approaches developed will needs to consider stock structure issues, or at the very least management units that may consider geographical boundaries (India, Myanmar and Bangladesh stocks).

- e. The WG noted that there was an immediate need to increase stock assessment capacity in each country through future training on Fishery Statistics and Stock Assessment, including running some simplistic assessments such as surplus production models, length based models, etc with regional technical teams.

Table 2: Stock Assessment Data and Parameters available for Hilsa (*Tenualosa ilisha*). References are listed in Appendix IV.

Data/Parameters of interest for Stock Assessment	Availability/Notes	Source
Tonnage by sector and time for Bangladesh	Yes since ?? <i>Late 70's Sampling program RSS. Good information</i>	Siddique 2009 (AFS)
Tonnage by sector and time for India	Intermediate –Yes. <i>Can be gathered from WB State Agency as well as from JU.</i>	Could be eyeballed from Report BOBLME status report between 71-04
Tonnage by sector and time for Myanmar	No (2006, 2007 and 2008 some data). <i>Historic data may be available from processors.</i>	Aung Htay Oo and Saw Aung Ye Htut Lwin Report on status of Hilsa in Myanmar 2010.
Effort-Bangladesh	Yes in 1000's of boats/year though not dynamic- static 86-87, 88-98, 99-06. These values are by Boat type (motorized/non-motorized) and don't necessarily map to inland/ocean catches that their data are assembled on catch.	Mome and Arnason 2007. Appendix 2
Effort-India	<i>None available presently, but probably exists.</i>	
Effort Myanmar	Yes-Purse Seine (92-07)	Aung Htay Oo and Saw Aung Ye Htut Lwin Report on status of Hilsa in Myanmar
Length composition of the catch n age over time	Only 2003 in Bangladesh. <i>Dr Rahman says he could provided data from , 1996-1999, 2002, and 2003. Daily growth increments have been validated but it is not feasible to determine age composition of the catch – reliant on length data.</i>	Amin et. al. 2008
Maturation rate on species	Some information suggests Hilsa becomes fully mature at age 1, 200 mm length, though fecundity is low. Very few 3 or 4 year olds, though in 1963 this was primarily the age class	Blaber et. al. 2003
Nat Mortality estimates	From Elefan/FiSat Models M anywhere from 1.18,1.41, 1.28, 1.25.1.28,1.36,1.15	Amin et. al. 2008, Amin and Milton 2002
Fecundity estimates	Anywhere from 0.1 to 2 M eggs/spawner	Blaber et. al. 2003
F	Estimated in Elefan	Amin et. al. 2008, Amin and Milton 2002
Selectivity	<i>Could be estimated from length frequency data if it is made available</i>	Amin et. al. 2008

28. Recommendations were made that were country specific. They are summarized below by country:

Bangladesh

29. Based on the information presented at the meeting, the WG noted that considerable information exists as far as shad assessment is concerned in the Bay of Bengal. Some of this information could be used in a sophisticated age-structured assessment, if the data were collated adequately over time. At the least, an update of all available length frequency analysis from 1995-2009 is required. Representatives from Bangladesh were not entirely convinced that the data from catch sampling programs designed in the 1960's and 1970's were relevant today, and thus a review of sampling design to estimate catch was recommended. In order to get an index of effort over time, it was recommended that the fisheries be characterized through a census of the coastal fleet to estimate the total number of gears operated by location. Finally, a system that tracks vessel ownership would eventually lead to better estimates of effort. For assessment purposes it was important to tie CPUE to sector and catch, i.e. the same sampling strata as catch estimation.

30. For further improvements, it was recommended to pursue an index of spawning and juvenile abundance through research activities. Possible ways to estimate spawning abundance during the 10 day closure included Didson, other acoustic or mark-recapture based surveys. For an index of recruitment, the historical Jatka data time series should be analyzed, and maybe some experimental work further develop the index be pursued. Finally, regulatory measures such as alternative mesh sizes for management of fisheries (45 mm versus some other size for taking management measures) should be investigated. Some work on this regard has been done by Dr. Rahman, and these papers can be made available.

India

31. At the Bangkok meeting, which India was not present, the working group noted that little information on hilsa was available from India. The WG recommended that, if not already available, basic data elements that characterize the fishery and catch should be undertaken including assembling: i) catch data from the states of West Bengal and Orissa by sector over time; ii) CPUE data from West Bengal and Orissa by sector over time, and iii) length frequency data if available.

32. At the Chennai meeting the Indian scientists noted the following: There has to be an over arching body to monitor hilsa of Bay of Bengal. A rapid and comprehensive study following uniform strategy, methodology needs to be carried out simultaneously in all the hilsa countries in question (at rivers, inshore estuarine areas and also the oceanic areas together). This could include:

- Biological characterization (maturity, breeding season, growth)
- Migratory pattern, breeding grounds
- Catch and effort, biomass, MSY, population dynamics
- Stock identification (including marine and inshore areas and rivers) through morphological and genetic means
- Development of common data bank (Bay of Bengal)
- Delineation of management units (geographical) among countries
- Protection and improvement of hilsa habitat
- Impact of climate change on hilsa
- Data and information sharing mechanism within country and among countries
- Socio-economics and welfare of fishers; awareness building and training for the stake holders for alternate livelihoods if affected by regulations
- Formulate action plans and strategies based on the comprehensive study as well as the existing information

Myanmar

33. The WG made similar recommendations for Myanmar: i) assemble catch data over time (the domestic component); ii) assemble CPUE data over time (last conducted 30 years ago); iii) gather information on species surveys by SEAFDEC, iv) plan and undertake fishery-independent surveys in rivers and coastal areas; v) assemble length frequency data if available; and vi) ascertain the existence of, and obtain, to the extent possible, any historical data from processors operating on the Irrawaddy.

3.3 Stock status advice for hilsa

34. The FAWG considered the range of information available and adopted the following stock status advice for the regional hilsa fishstock in the Bay of Bengal.

The stock status of hilsa is uncertain.

Bangladesh produces the majority of the catch of hilsa (95%), followed by India (3%) and Myanmar. Catches continue to increase; however, the fishing pressure is also increasing; while gillnet net mesh sizes have decreased so the fishing mortality on juveniles is likely to have increased substantially. The catch statistics for Indian mackerel are highly uncertain. Current minimum catch is around 378 000 t and it not clear whether this level of catch is sustainable or whether long term yield has already been exceeded.

Hilsa is a highly productive species and this may protect it to some extent from overfishing. However pollution and loss and degradation of habitat are affecting the distribution and probably the productivity of the stock.

Time area closures in Bangladesh and India have been implemented to protect spawners and juveniles. Preliminary results are promising; however the effectiveness of these initiatives should be further monitored.

4. INDIAN MACKEREL (*Rastrelliger kanagurta*)

4.1 Review of available data and assessments from Bangladesh, India and Myanmar, Sri Lanka, Indonesia, Malaysia and Thailand

Indian mackerel

Bangladesh

35. No data were available for presentation at the meeting. It was noted that Indian mackerel represents a minor component of the total mixed catch from the marine fishery in Bangladesh. While the catch is not currently recorded by species, it is intended to improve the collection of catch data for Indian mackerel in the near future.

Sri Lanka

36. Total annual catches (all species) from the coastal fishery were about 175,000 t during the early 2000s and declined sharply in 2005 following the tsunami. Catches have recovered towards the previous levels in recent years. Since 2005, there has been a large increase in the number of boats participating in the artisanal coastal fishery. Fishing for Indian mackerel is principally conducted using small mesh gill nets in conjunction with fishing for herring. Indian mackerel is also caught using beach seines.

37. Total production of Indian mackerel from Sri Lankan waters was reported at 17,500 t in 2008. Catches from the northwestern coastal waters of Sri Lanka were estimated at about 200 t in the mid 1990s; this represents a small component of the total production of Indian mackerel from Sri Lankan waters, but is expected to increase as a result of the area being reopened.

38. Limited CPUE and length frequency data are available from the various coastal fisheries for 2005. Size data are also available from the northwestern coastal fishery in the mid 1990s. These data were applied to estimate

growth parameters and mortality rates using the FiSat software package. In recent years, a programme has been implemented to collect more detailed information from the Indian mackerel catch.

India

39. The Indian Mackerel *Rastrelliger kanagurta* is the most widely distributed along Indian coast and accounts for more than 98 % of the total mackerel catch. The short bodied mackerel *Rastrelliger brachysoma* is caught off Andamans and landed occasionally along the east coast of India. *R. faughni* is caught seasonally in small quantities along the east coast of India.

40. *Rastrelliger kanagurta* is found throughout the year, with the peak period of occurrence off the east coast of India from December-May. Mackerel generally prefers to stay immediately above the thermocline and come to the surface with upwelling (August to October) and lives in deeper waters with the sinking of thermocline (February to May).

41. Post-monsoon catches are mainly by surface gears like purse seines and ring seines. Premonsoon catches from deeper waters are mainly by trawls. Along the east coast exploitation is high during December-May with a peak in March. This corresponds with the increase in salinity with the entry of high saline equatorial waters into the Bay of Bengal, low temperatures due to winter cooling and increased temperature interfered by upwelling during April-May.

42. The major contributor to commercial fishery is the 0 year class (96 %) followed by the 1 yr and 2 yr. Indian mackerel attains a total length of 220 mm, 250 and 280 mm during the 1st, 2nd and 3rd year. It is predominantly a zooplankton feeder (copepods, cladocerans, Lucifera, amphipods). Size at first maturity (Lm) = 175 mm. Length at recruitment (Lr) = 80 mm, and Size at first capture (Lc) = 140 mm (0.5yrs).

43. Key issues for India, regarding Indian mackerel include:

- Availability of data – Fairly Good
- Species-wise data not very strong
- 90% catch in India is *R. kanagurta*, and hence we have to concentrate on this species
- Stock identification is necessary especially in Andamans
- Surplus production model can be applied for stock assessment with the available data
- Data availability on biology also fairly good
- Geo-referred data available with FSI could be used for stock assessment.

Indonesia

44. The Indonesian fishery for Indian mackerel operates in three areas: western Sumatra, Banda Aceh, and northern Sumatra. The fishery is conducted using purse-seine, mini purse seine and encircling gill nets and operates for a limited fishing season in each of the areas. Limited catch data are available – total annual catch estimates are available from 2003 although the catch is not recorded by species. Overall, there is a lack of a time series of catch and effort data from the fishery and very limited sampling of the species and size composition of the catch. The fishery reporting system has not recovered since the tsunami in 2004, and consequently there are few recent statistics available from the fishery.

Malaysia

45. In Malaysia, the fishing region is divided into five main fishing regions that is West coast of Peninsular Malaysia (WC), East coast of Peninsular Malaysia (EC), Sarawak, Sabah and Labuan. There are two species of mackerel: Indian mackerel (*Rastrelliger kanagurta*) and short mackerel (*Rastrelliger brachysoma*). Based on the Department of Fisheries Malaysia Annual Fisheries Statistic 2008, the total landings from the marine capture fisheries subsector was 1,394,531 t. Total landing of *R. kanagurta* was estimated at 3.5% (48,450 t) and *R. brachysoma* at 8.7% (121,871 t). Indian mackerel is principally caught by purse seine and trawl. Annual catch data are available for 1982 to 2008. Recent catch estimates for Indian mackerel are available by fishery area, fishing gear and vessel size. Length data are also available from each region and these data were used to estimate growth parameters and mortality rates (using FiSat).

Thailand

46. Indian mackerel is one of the major target species of marine fisheries along the Andaman Sea coast of Thailand. Most of the catch is taken by purse seine (74%) and trawl (25%). The fishery operates throughout the year although the peak fishing season occurs from October to March. During 1997-2007, based on the fisheries statistics, there were 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, with total catches fluctuating around 20,000 t per year. Length data were collected from the fishery in 2007 and indicate that a high proportion of the catch is comprised of immature fish (less than 19 cm). These data were applied to estimate growth parameters, mortality rates and yields (using FiSat).

Myanmar

47. In Myanmar, Indian mackerel are principally caught using purse seine and encircling gill nets. The main fishing season is September-April. No catch statistics are available for the species.

Country	Catch (t)	Year
Bangladesh	400	2003
India	58 293	2009
Indonesia	1,233	2003
Malaysia	48,450*	2008
Maldives	-	-
Myanmar	-	-
Sri Lanka	17,500*	2008
Thailand	20,000*	2007
Eastern BOB	176,410	FAO Fishstats 2010
Total	236 336 t	

4.2 Identification of future assessment approaches and data needs

48. Based on the information presented for Indian mackerel at the meeting and subsequent discussions (Table 4), the FAWG identified the following fundamental activities that should be undertaken to support the advancement of a regional stock assessment of Indian mackerel.

49. The WG noted that, in general, considerable of uncertainty exists as far as Indian Mackerel in the Bay of Bengal are concerned. While some countries have directed fisheries, the there are considerable quantities taken as incidental catches, and overall, catch and effort information is patchy.

50. Most countries have adopted FiSat's software to derive a simple Length at Age based assessment for their respective countries. Sustainable catch levels may be able to be derived, but it will be important to understand the stock structure.

- a. Review sampling methodologies for estimating total catch of Indian mackerel by each region.
- b. Review species stock structure and recommend appropriate stock management units
- c. Recommendations for potential stock assessment approaches will need to be determined following a review of the stock structure of Indian mackerel in the Bay of Bengal. Once a stock structure is defined for a particular region of the Bay of Bengal, assemble time series of catch and CPUE data for each region- namely India, Indonesia, Malaysia, Thailand and Sri Lanka (Myanmar and Bangladesh – if possible). In particular, trawl fishery data should be explored to derive estimates of CPUE over time.
- d. Estimate size selectivity by gear and location - depending on the data available.

- e. Identify the information available on Indian mackerel from the SEAFDEC surveys and to the extent possible, analyze these data with respect to distribution and behavior.
- f. Conduct a genetic analysis for sub-stock structure of Indian mackerel in the Bay of Bengal Region.
- g. Assemble basic life history parameters such as spawning biomass and fecundity estimates by area. At the very least one needs to map the statistical catch (possible effort) with biological data (length, fecundity, migration and natural mortality).
- h. As noted above, for hilsa, the WG once the data for Indian mackerel has been compiled, a work shop should be run to assist with the training of national scientists in analyzing the Fishery Statistics and running some simplistic assessments such a surplus production models, length based models etc.

Table 4: Stock Assessment Data and Parameters available for Indian mackerel (*Rastrelliger kanagurta*). References are listed in Appendix IV.

Data/Parameters of interest for Stock Assessment	Availability/Notes	Source
Tonnage by sector and time for Bangladesh	Data available and can be estimated based on all marine catch estimates.	
Tonnage by sector and time for India	1984-1988 on east and west coast. Focus presumably east coast BOB. There is another report on Status of Indian Marine Resources with a chapter on Mackerel but it is unclear (although it indicates that the data are available for 1950-2000 onwards).	Nobel et. al. 1992 Yohannan and Sivadas (2000+??)
Tonnage by sector and time for Myanmar	No	
Tonnage by sector, time and area for Indonesia	Yes available. No of years since early 1990's	Presentation at meeting
Tonnage by sector and time for Sri Lanka	Yes. Since the 2000's though lumped with other species	Presentation at meeting
Tonnage by sector and time for Malaysia	Yes by east and west and off Lankawi.(mid 90's onwards)	Presentation at meeting
Tonnage by sector and time for Thailand	Yes	
Effort-Bangladesh	No	
Effort-India	No	
Effort-Myanmar	No	
Effort-Indonesia	Yes since early 1990's	Presentation at meeting
Effort-Sri Lanka	Yes since mid 2000's	Presentation at meeting
Effort-Malaysia	Yes since mid 1990's	Presentation at meeting
Effort-Thailand	Yes since mid 1990's	Presentation at meeting
Length frequency data on catch over time	1987 and 1988 for India was available in Nobel et. al. 1992. Length frequency analysis. Thailand, and Sri Lanka have the data. Indonesia and Malaysia uncertain.	Nobel et. al. 1992
Maturation rate on species		Sekharan, K V (1974) <i>Estimates of the stocks of oil sardine and mackerel in the present fishing grounds off the West coast of India</i> . Indian Journal of Fisheries, 21 (1). pp. 177-182.

Nat Mortality estimates	0.65-1.10, though on standing stock on west India not Bay of Bengal. Haputhantri et. al. 2008. Estimate M to be 2.48. SRI LANKA: 2.37 based on Fernando 2004 (sent by BOBLME project)	Sekharan, K V (1974) <i>Estimates of the stocks of oil sardine and mackerel in the present fishing grounds off the West coast of India</i> . Indian Journal of Fisheries, 21 (1). pp. 177-182.
Fecundity estimates	Probably 3-5 age classes. Starts reproducing at age 1, Fecundity??	
F	Done in 1974. However, this is not current, and does not represent stocks in the Bay of Bengal.	Sekharan, K V (1974) <i>Estimates of the stocks of oil sardine and mackerel in the present fishing grounds off the West coast of India</i> . Indian Journal of Fisheries, 21 (1). pp. 177-182.
Selectivity	None	

4.3 Stock status advice for Indian mackerel

51. The FAWG considered the range of information available and adopted the following stock status advice for the regional Indian mackerel fishstock in the Bay of Bengal.

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

All countries except Maldives catch Indian mackerel, 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 Bangladesh, India and Sri Lanka may be fishing another.

Indian mackerel is rarely targeted, and in the eastern areas of the Bay of Bengal it may be confused with the short mackerel (*Rastrelliger brachysoma*).

The catch statistics for Indian mackerel are highly uncertain. The minimum current catch estimate is around 236,000 t with around 176,410 t being taken in the eastern Bay of Bengal. Catch records from eastern Bay of Bengal countries are inconsistent with this total, but may indicate the relative distribution of the catch with around 58,300 t from (eastern) Indian waters, around 17,500 t from Sri Lankan waters, and 400 t from Bangladesh.

Catches of Indian mackerel off the east coast of India have more than doubled since 2000 and are expected to increase further. Studies indicate this marked increase in production is due to the rise in average sea water temperature waters in the region. However, it is possible that if the climatic and environmental factors are not favourable, the Indian mackerel stocks, which are climate driven, may be reduced to low levels.

No regional stock assessment for Indian mackerel is currently available. A recent stock assessment for the Indian fishery indicates that the current level of catches of Indian mackerel taken in Indian waters is sustainable,

5. ADOPTION OF THE REPORT

52. The Report of the First meeting of the BOBLME Fisheries Assessment Working Group was adopted by email.

APPENDIX I

LIST OF PARTICIPANTS - BANGKOK

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APPENDIX I

LIST OF PARTICIPANTS - CHENNAI

MEMBERS PRESENT IN THE MEETING OF THE FISHERY ASSESMENT WORKING GROUP INDIA

25 November 2010,
Hotel Savera, Chennai

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APPENDIX II

AGENDA OF THE MEETING - BANGKOK

1. Welcome
 - 1.1 Welcome, Chris O'Brien, Regional Coordinator
 - 1.2 Brief, self-introductions by the participants
2. Meeting formalities
 - 2.1 Election of the meeting Chair
 - 2.2 Adoption of the agenda
 - 2.3 Introduction to BOBLME
 - 2.4 Group photograph
3. Introduction to selected stock assessment topics
 - 3.1 The state of world fisheries – Ray Hilborn
 - 3.2 Stock assessments, the simple to the complex – Adam Langley
 - 3.3. Overview of the literature – Rishi Sharma

4. Hilsa (*Tenulaosa ilisha*)

- 4.1 Review of available data and assessments from Bangladesh, India and Myanmar
- 4.2 Identification of future assessment approaches and data needs
- 4.2 Stock status advice

The overall objective is to produce advice on stock status based on a regional stock assessment for hilsa. Currently, only national and some state assessments exist and the immediate aim is to determine how a regional assessment might be attempted and what data required.

Bangladesh, India and Myanmar are the major hilsa fisheries so this agenda item will focus on these countries.

Each presentation should be 30 minutes max. The basis for each country presentation should be the data summary sheet provided below. This will also include a presentation of your latest assessment – if one is available. The information from each presentation will enable the working group to make an appraisal of the available data and identify key data gaps, and the basis of decisions/recommendations regarding possible future assessment (or monitoring) approaches.

National Coordinators; please provide a copy of the completed table prior to the start of the meeting

5. Indian mackerel (*Rastrelliger kanagurta*)

- 5.1 Review of available data and assessments from Bangladesh, India, Indonesia, Malaysia, Myanmar, Sri Lanka and Thailand
- 5.2 Identification of future assessment approaches and data needs
- 5.3 Stock status advice

The overall objective is to produce advice on stock status based on a regional stock assessment for Indian mackerel. Currently, only national and some state assessments exist and the immediate aim is to determine how a regional assessment might be attempted and what data required.

Bangladesh, India, Indonesia, Malaysia, Myanmar, Sri Lanka and Thailand are the major Indian mackerel fisheries so this agenda item will focus on these countries.

Each presentation should be 30 minutes max. The basis for each country presentation should be the data summary sheet provided below. This will also include a presentation of your latest assessment – if one is available. The information from each presentation will enable the working group to make an appraisal of the available data and identify key data gaps, and the basis of decisions/recommendations regarding possible future assessment (or monitoring) approaches.

National Coordinators; please provide a copy of the completed table prior to the start of the meeting

6. BOBLME Fisheries Assessment Work plan

- 6.1 Overview of existing work plan -
- 6.2 Future research/work and priorities

7. Any other business

APPENDIX II

AGENDA OF THE MEETING – CHENNAI

Programme Arrival of guests: 24 November 2010 afternoon to 25 November 2010 morning

Inaugural Session Thursday, 25 November 2010 09:30 – 10:30

Introduction of participants

- All participants

Welcome and Introductory Remarks

- K Vijayakumaran, National Coordinator

Background, Context & Format of the Meeting

- V V Sugunan, NTA-BOBLME India

Presidential Address by Regional Coordinator

- Chris O'Brien, BOBLME-RCU

Technical Session I Thursday, 25 November 2010 10:30 – 11:30

Chair: B Vishnu Bhat

Assessment of multi-species, multi-gear fisheries – the Issues and challenges

- P U Zachariah

Mackerel fisheries in India, with special reference to Bay Of Bengal

- Prathibha Rohit

Hilsa fisheries in the Bay of Bengal Region - Challenges in assessment and management

– M K Mukhopadhyaya

Technical Session II Thursday, 25 November 2010 11:30 – 13:00

Moderator: V V Sugunan

Brainstorming on management of hilsa fisheries

- All Participants.

13:00 – 14:00 h Lunch Break

Technical Session III Thursday, 25 November 2010 14:00 – 15:30

Moderator: E Vivekanandan

Brainstorming on management of mackerel fisheries

-All Participants.

Technical Session IV Thursday, 25 November 2010 15:30 – 17:00

Chair: Chris O' Brien, Co-Chairs: K Vijayakumaran and V V Sugunan

Consolidation of results/output – All participants

Plenary Session Thursday, 25 November 2010 17:00 – 17:15

Presentation of recommendations - Prathibha Rohit

Adoption of recommendations - All participants

Vote of thanks - K Vijayakumaran

Departure of guests: 25 November 2010 evening to 26 November 2010 morning

APPENDIX III

LIST OF DOCUMENTS AND PRESENTATIONS PRESENTED TO THE MEETING - BANGKOK

Document	Title
BOBLME-2010-FAWG-01	Agenda
BOBLME-2010-FAWG-02	BOBLME Project – an introduction (power point). Chris O'Brien
BOBLME-2010-FAWG-03	State of the worlds fisheries (power point). Ray Hilborn
BOBLME-2010-FAWG-04	BOB LME: Development of collaborative regional fishery assessments (power point). Adam Langley
BOBLME-2010-FAWG-05	Fisheries Stock Assessment with Special Reference to Hilsa Fishery in Bangladesh (power point and paper). Dr. M. Anisur Rahman, Dr. S. Ali Azher, Azizul Haque.
BOBLME-2010-FAWG-06	Review available data and assessment, Indonesia (power point), Suwarso, Ayi Yustiati, N. Pebruwanti.
BOBLME-2010-FAWG-07	Assessment of Indian Mackerel (<i>Rastrelliger kanagurta</i>) Fisheries of Malaysia. Mahyam Mohd. Isa, Richard Rumpet and Sallehudin Jamon.
BOBLME-2010-FAWG-08	Status of Pelagic Fisheries in Myanmar (power point) Myint Soe.
BOBLME-2010-FAWG-09	BOBLME Workshop of "Fisheries Stock Assessment Working Group" to support Development of Regional and sub-regional Fisheries Management Plans (Sri Lanka). R.P.P.K Jayasinghe, H.P.K. Hewapathirana
BOBLME-2010-FAWG-10	Fisheries Assessment of Indian Mackerel, <i>Rastrelliger kanagurta</i> (Cuvier, 1875), along the Andaman Sea Coast of Thailand (power point and paper). Montri Sumontha, Sonthaya Boonsuk, Sichol Hoimuk

APPENDIX IV

REPORT FROM THE CHENNAI MEETING

BOBLME-India-Fishery Assessment Working Group Meeting- 25 November 2010-Chennai

FAWG-Proceedings

The Bay of Bengal Large Marine Ecosystem (BOBLME) Project Meeting of the Fishery Assessment Working Group (FAWG)

25 November 2010, Hotel Savera, Chennai

Background

Development of regional and sub-regional management plans and harmonization of data collection and standardization is an important component of the BOBLME Project, and regional consultations for fishery assessments and management plans are very important to achieve this goal. With this in view, a Regional Fishery Assessment Working Group meeting was held in Bangkok on 13- 14 September 2010. However, Indian delegates could not take part in this important event. Recognizing the knowledge and capacity available in India and the need to engage Indian scientists, a Fishery Assessment Working Group was constituted in India with representatives from scientific institutions and State fisheries departments.

The first Meeting of the Indian Fishery Assessment Working Group (FAWG) of the Bay of Bengal Large Marine Ecosystems (BOBLME) Project was held at Hotel Savera, Chennai on 25 November 2010. The outputs from this meeting are expected to add value to what came out of the Bangkok Meeting and strengthen it by adding to it an Indian perspective.

Inaugural Session

During the Inaugural Session, Dr K Vijayakumaran, National Coordinator welcomed Dr Chris O'Brien, Regional Coordinator BOBLME; Members of the Fishery Assessment Working Group and all other dignitaries present on the occasion (List of Participants attached in Annex-A). He explained the circumstances under which formation of this Working Group has become necessary. Dr V V Sugunan, National Technical Advisor outlined the background of the meeting, its objectives, format and the expected outputs. Speaking on the occasion, Dr O'Brien explained how this process will add value to the outputs of the meeting of regional Fishery Assessment Working Group at Bangkok during 13-14 September 2010. The Meeting consisted of four Technical Sessions and a Plenary Session.

Technical Session - I: Key Issues on Fishery Assessment and Management

Chair: *Dr Vijayakumaran D G, FSI and N C, BOBLME Project*

During the Technical Session I, which was intended to flag the key issues and set the tone and background for the discussions, three brief presentations were made by experts on key issues related to: a) stock assessment in multi-species fisheries b) mackerel, and c) hilsa.

Dr P U Zachariah talked on the issues and challenges in managing the shared fish stocks in a multi-species, multi-gear fishing regime. He analyzed the status of major fisheries of Bay of Bengal by craft and gear and described how different stock assessment models operate and their data requirements. Discussing the effectiveness of various approaches, he also outlined a broad framework for the stock assessment of mackerel in the Bay.

Dr Pratibha Rohit talked on mackerel fisheries in India in general and the Bay of Bengal in particular. Describing the catch trends of the three species of mackerel, viz., *Rastrelliger kanagurta*, *R. brachysoma* and *R. faughni*, she pointed out that *R. kanagurta* accounted for more than 98% of the total mackerel catch. She

also enlightened the audience about the gear employed to catch mackerel, its biological traits, length and age distribution in the catch and effect of environment on the stock. She further outlined various stock parameters such as L_{∞} , K, Z, M and E.

Dr V R Suresh talked about the hilsa fisheries of the Bay of Bengal region and the challenges in their management. Dr Mukhopadhyaya joined him later to supplement with more data and information on hilsa stocks. They made a comprehensive review of the wealth of information available on the distribution, migration routes, breeding habits, ageing, growth and aspects of population dynamics from different river basins. The authors also outlined the changes in catch above and below the Farakka barrage since its commissioning in 1975. In view of the fragmented nature of the information, the main challenge is to synthesize the data and knowledge available on hilsa from the marine and inland habitats and to draw a holistic picture of the stock size, structure and movements.

Technical Session-II: Brainstorming on Hilsa

Moderator: *Dr V V Sugunan, National Technical Advisor, BOBLME Project*

The brainstorming on hilsa was designed to flag the key issues involved in management of hilsa stock in the Bay of Bengal and the rivers on a sustainable basis. Ideas harvested from this exercise were grouped under two main heads viz.,

- Key issues on management of hilsa stocks in the Bay of Bengal region and framework for strategy and action plan
- Options for management of hilsa stock in the Bay of Bengal and providing inputs for framing a strategy and action plan

As required under the objectives, the participants critically reviewed the proceedings of Fishery Assessment Working Group Meeting held at Bangkok on 13-14 September 2010. The catch data and the information on biology, and population parameters presented in the proceedings were updated by the group. Dr Chris O'Brien agreed to explore funding support for filling the gap in knowledge (biology, stock), catch trend analysis, desk study on conservation measures. The key issues identified by the Brainstorming Session on Hilsa and the action plan suggested are summarized in Annex-B.

Technical Session-III: Brainstorming on Mackerel

Moderator: *Dr E Vivekanandan, Principal Scientist, CMFRI*

The Session reviewed the proceedings of the Bangkok meeting and identified the key issues and action plan on management of mackerel stock in the Bay of Bengal region. The delegates opined that the mackerel caught in India is predominantly *R. kanagurta*, although the other two species appear in the catch occasionally. However, the situation is different in many other member countries where capacity is rather limited in identification of fish and recording of data by species. There is need to review this data, before any attempt is made to plan sharing of common stock. The general opinion of the House was that the data available in India is reasonably good and sufficient to estimate the catch size, although it is not clear whether all countries draw from a common pool of mackerel stock. There was agreement that catch size estimation can be taken up immediately. Time line was fixed for the task and the organizations/individuals for undertaking the work identified. Dr O'Brien agreed to explore funding support for capacity building by India in other countries in species identification. The key issues identified by the Brainstorming Session on hilsa and the action plan suggested are summarized in Annex -C.

Technical Session-IV: Presenting Outcome of the Technical Sessions

Chair: Dr Chris O'Brien; Co-Chairs: Dr K Vijayakumaran & Dr V V Sugunan

During the Session, the House further reviewed the views emerged from the three previous sessions. Dr O'Brien, by explaining the background of Bangkok Session and the rationale behind the recommendations made it, put the discussions in a right perspective. The overall tone of discussions favoured an approach of arriving at a strategy to share resources using all available inputs, rather than waiting endlessly for generating more data. With this in view, the house introspected on the size and quality of available data to assess whether these data are sufficient for developing management plans. The assessment of the House was that the region is more comfortable with the data on mackerel, as opposed to hilsa. In case of the latter, it was more pragmatic to make a catch trends analysis rather than attempting a full scale stock assessment in view of data limitations. After a thorough discussion, the set of key issues and action plan as given in Annex I and II were agreed. These were adopted formally in the Plenary Session that followed. The meeting was concluded with a vote of thanks proposed by Dr K Vijayakumaran, National coordinator, BOBLME Project.

□□□

BOBLME-India-Fishery Assessment Working Group Meeting- 25 November 2010-Chennai

FAWG-Proceedings

Annex - A

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25 November 2010, Hotel Savera, Chennai

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Meeting of the Fishery Assessment Working Group (FAWG)*Chennai, 25 November 2010***Key Issues identified and Action plans recommended by the Brainstorming Session on Hilsa****Key issues**

- Gap in knowledge on:
 - *Biology*
 - ❖ breeding area – in sea and in fresh water
 - ❖ Seaward migration- bathymetric abundance
 - *Stock size*
 - *Stock delineation*
 - *Dynamics of stock movement between river and marine phases*
 - *Diffused nature of data on catch and effort*
 - *By-catch issue and ecosystem approaches*
- Lack of awareness on the need for sustainable fishing
- Unregulated fishing in rivers and the sea leading to possible over-exploitation
- Environmental issues including pollution in rivers, coastal waters and land
 - *Falling river flows*
 - *Fish lock and fish ladders not effective*

Action Plan

- Consolidation of available data to assess the stock size in marine and riverine environments
- Undertaking a catch trend analysis with the available data from inland and marine sectors
 - *Data to be collected from State of West Bengal, CIFRI, and CMFRI*
 - *Identified the organizations and individuals for this purpose*
 - *Activities by different national institutes identified*
- Conservation of breeding grounds and addressing livelihood issues if affected due to conservation measures
- Awareness campaigns
- Addressing pollution in coastal and inland water bodies
- Dr. Chris O'Brien agreed to explore funding support for:
 - *Filling the gap in knowledge (biology, stock),*
 - *Catch trend analysis,*
 - *Desk study on conservation measures*

Meeting of the Fishery Assessment Working Group (FAWG)

Chennai, 25 November 2010

Key Issues identified and Action plans recommended by the Brainstorming Session on mackerel

Key Issues

- Availability of data –
 - *Fairly good, although species-wise data not very strong*
 - *~98% catch in India is *R. kanagurta*,*
 - *In other countries the species composition is not well documented*
 - *Stock identification is necessary, especially in Andaman waters*

Action Plan

- The input data required by RCU in respect of Indian mackerel will be prepared in a month's time (by 25th December)
- The stock size of mackerel in Indian waters will be arrived at by using available data applying appropriate models. The whole exercise will be completed by the end of March
- Data collection system in the country will be verified and strengthened if need especially in the north-east sector
- An Inter-institutional project for stock studies will be formulated
- Surplus production model will be applied for stock assessment with the available data
- Geo-referred data available with FSI is to be used for stock assessment
- Capacity building by India in other countries in species identification

APPENDIX V

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APPENDIX VI

DATA SUMMARIES

Bangladesh

Species: Indian Mackerel, (*Rastrelliger kanagurta*)

Data category	Component	Relevant information available (please complete)
Fishery definitions	<p>Describe the main national fisheries catching the species.</p> <ul style="list-style-type: none"> - i. Fishing method (gear) - ii. Fishing season (months). - iii. Fishery area (main region/habitat of each fishery). - iv. Size/power of vessels operating in fishery. - v. Main ports of operation. 	<p>Mainly artisanal fisheries.</p> <ul style="list-style-type: none"> i. Harvested mostly by drift gillnets (DGNs), Longlines (LLs) and marine set bag nets (MSBNs) of artisanal fishery using mechanized and non-mechanized boats (Rahman and Zaher 2006). Industrial trawlers also catch some amount of mackerel. ii. Caught round the year as a by-catch of hilsa (<i>Tenualosa ilisha</i>) fishery. Often mackerel and tunas are harvested as the target species, especially when hilsa catch is very low. Peak season: November-July, Lean season: January-February (Rahman and Zaher 2006). iii. Middle ground of the BOB, Bangladesh, lies between 20°50'N and 21°20'N latitude and 90°00'E and 91°00'E longitude; caught at depths of 10-20 m (10.5% of catch), 20-50 m (10.8% of catch), 50-80 m (21.6% of catch) and 80-100 m (57.2% of catch) (Lamboeuf 1987). iv. Boats are usually of 40-50 foot in length and 8-11 foot in breadth, inboard engines are used and power ranges from 16 to 75 HP but most boats are within 20-63 HP, Tonnage varies around 7-25. v. Major catches are landed at Cox's Bazar and Chittagong, some unestimated amount is also landed at Khepupara, the Dubla Island and Patharghata.
Catch	<p>Recent total annual catch (mt) of species.</p> <p>(include an indicative estimate if reliable statistics are not available).</p>	<p>Total combined catch of <i>S. guttatus</i>, <i>S. commerson</i> and <i>R. kanagurta</i> at Cox's Bazar and Chittagong was 1,178.5 t during 2003-04 (Rahman and Zaher 2006). In addition, there are unestimated landings at Khepupara, the Dubla Island and Patharghata.. Roughly about 1.1% of total marine catch comes from mackerel and tunas (Hussain and Rahman 2010).</p>
	<p>Time series of total catch estimates</p> <ul style="list-style-type: none"> - i. Years with data. - ii. Source of data (survey, logsheet, market, census, etc). - iii. Reliability of data. - iv. Allocation of catch among fisheries and/or fishing gears. - v. Reference documents. 	<ul style="list-style-type: none"> i. Year-wise data are not available as this is not a target fishery, rather a by-catch fishery. ii. Data of Rahman and Zaher (2006) are from landing station survey. While Marine Fisheries Wing (MFW) in collaboration with the Marine Fisheries Survey Management (MFSM) Unit of the Department of Fisheries (DoF) collects related fisheries statistics from log sheets. iii. Reliable and only available statistics. iv. DGNs (95%), LLs (1%), MSBNs (2%) and industrial Trawl net (2%), mostly as by-catch of hilsa fishery.

		<p>v. References are given in appropriate places. Please see detail References at the end of the table.</p>
	<p>i. Allocation of catch among fisheries and/or fishing gears.</p> <p>ii. Seasonality of catch (by fishery)</p>	<p>i. DGNs (95%), LLs (1%), MSBNs (2%) and industrial Trawl net (2%), mostly as by-catch of hilsa fishery (Rahman and Zaher 2006).</p> <p>ii. Peak season: November-July, Lean season: January-February (Rahman and Zaher 2006).</p>
Fishing effort	<p>i. Number of vessels by fishery (recent and available time-series of data).</p> <p>ii. Detailed fishing effort data (days fished, length of nets, etc) by fishery.</p> <p>iii. Include source of data, reliability of data, data problems.</p>	<p>i. There is no separate data of vessels exclusively fishing for mackerels. There are estimates of DGNs, LLs, MSBNs and fin-fish trawlers. Those are as follows: <u>Industrial fishery</u>: At present a total of 136 industrial trawlers are operating of which 94 are fin-fish trawler and 42 are shrimp trawler (Hoque 2010). <u>Artisanal fishery</u>: In case of artisanal fishery there are about 21,400 non-mechanized boats and 22,560 mechanized boats (Khan 2010). <u>DGNs</u>: About 95,572 nos. (Rashid 2001). <u>MSBNs</u>: 21,000 nos. (Huttington <i>et al.</i> 2008). <u>LLs</u>: About 2,641 LL vessels using 24,614 LLs (Khan 2010). ii. Caught round the year as a by-catch of hilsa (<i>Tenualosa ilisha</i>) fishery. Often mackerel and tunas are harvested as the target species, especially when hilsa catch is very low. Peak season: November-July, Lean season: January-February (Rahman and Zaher 2006). Harvested mostly by drift gillnets (DGN), Longlines (LL) and marine set bag nets (MSBN) of artisanal fishery using mechanized and non-mechanized boats (Rahman and Zaher 2006). Industrial trawlers also catch some amount. Boats are usually of 40-50 foot in length and 8-11 foot in breadth, inboard engines are used and power ranges from 16 to 75 HP but most boats are within 20-63 HP, Tonnage varies around 7-25 (personal communication with Dr. M. Sharif, MFW, DoF, Chittagong). DGNs are of 75-200 mm mesh, MSBNs are of 12-30 mm mesh, while fin-fish trawler use nets of 40-60 mm mesh at cod-end (Hussain and Rahman 2010.) iii. Source of data mentioned in appropriate places, reliable and only available statistics. Please see detail References at the end of the table.</p>
CPUE trends	<p>Describe and reference any studies that provide CPUE indices for individual fisheries.</p>	<ul style="list-style-type: none"> • CPUE (kg/day/trawler) of shrimp trawlers decreased from 750 kg in 1988-89 to about 300 kg in 2003-04. In addition there are high proportions of discard fin-fish, often reaching to 70% (Khan and Latif 1997). • Fishing efforts of fin-fish trawlers approximately doubled since 1990s. Over the last 20 years there have been big shifts in their catch composition. Catches of 1984-86 showed that major catches were white gruntters, croakers, catfish, breams, snappers and hairtails. Since 2005-06 these have mostly been replaced by low-valued species like crab juveniles and the Bombay ducks (Huttington <i>et al.</i> 2008).

		<ul style="list-style-type: none"> • CPUE (kg/boat/day) of mechanized boats using different types of DGNs decreased from 650 kg/boat/day in 2001-02 to less than 100 kg/boat/day in 2005-06 (Huttington <i>et al.</i> 2008). • Catch rates (kg/haul) of MSBNs decreased by 50% between 1985 and 2002-04 (Huttington <i>et al.</i> 2008).
Biological studies	<p>Describe any national research undertaken or planned for the species, including:</p> <ul style="list-style-type: none"> - i. Age and growth. - ii. Maximum age estimates. - iii. Length and/or age sampling of the catch (by fishery). - iv. Length/age at maturity. - v. Timing of spawning season. - vi. Length-weight relationship. - vii. Movement information (tagging). - viii. Quantitative stock assessments. - ix. Other relevant research surveys, programmes. <p>x. (Please include the name of the principal scientist responsible and any available references).</p>	<p>Various surveys were done on marine fisheries resources of Bangladesh since 1958; no survey was targeted especially for Mackerel fishery. Last survey was done in 1988-89, since then no updated survey was done due to lack of vessel. Recent survey done by the Fisheries Research Vessel M. V. SEAFDEC during 25 October through 21 December 2007 (DoF Thailand 2008) threw some light on the mackerel, tuna and shark fishery within Bangladesh waters.</p> <p>i-vi: Only of Indian mackerel, <i>R. kanagurta</i>: L_{∞} and K were found to be 27.4 cm and 0.90/year respectively. Wetherall plot estimate of L_{∞} and Z/K were 26.7 cm and 4.683 respectively. Exploitation rate was 0.652 and selection pattern L_{50} was 18.09 cm. Recruitment pattern suggests two seasonal pulses, one in March-May and another in September-October. Peak recruitment appeared in March-May. Maximum yield could be achieved by decreasing length at first capture to 13.0 cm. The relationship between total length and body weight was found to be $W = 0.01583 L^{2.8952}$. Yield and stock prediction suggests that highest yield could be achieved by decreasing the fishing mortality to 2.0 coefficient rate (Mustafa and Ali 2003).</p> <p>Total catch of Indo-Pacific King mackerel, <i>S. guttatus</i> (63.0%), Narrow Barred Spanish mackerel, <i>S. commerson</i> (3.6%) and Indian mackerel, <i>R. kanagurta</i> (4.9%) were 645.3 t at Cox's Bazar, while catches of <i>S. guttatus</i> (64.0%), <i>S. commerson</i> (3.0%) and <i>R. kanagurta</i> (3.0%) were 533.2 t at Chittagong in 2003-04. <i>S. guttatus</i> was the most important contributor among the mackerels available. The total length of <i>R. kanagurta</i> varied between 19.8 and 25.1 cm with an average of 23.0±3.4 cm. The values were 48.1 and 74.2 cm with an average of 56.6±6.5 cm for <i>S. commerson</i> indicating fairly large size of the species. The average total length of <i>S. guttatus</i> was 39.4±5.3 cm. Larger size with higher prices of the <i>S. commerson</i> indicated very high potential for domestic and export market. These mackerel species harvested in Bangladesh mostly remains close to the shore (Rahman and Zaher 2006).</p> <p>vii: No tagging work ever tried in Bangladesh.</p> <p>viii: Chowdhury <i>et al.</i> 1979; Lamboeuf 1987; Mustafa and Khan 1993; Mustafa and Ali 2006.</p> <p>ix. Hussain 1969 and Hussain 1971; West 1973; Chowdhury <i>et al.</i> 1979; Khan <i>et al.</i> 1983; Khan <i>et al.</i> 1989; Mustafa <i>et al.</i> 1996; Khan <i>et al.</i> 1997; Rashid 2000;</p>

		BFRI/MFTS 2003. x. Nobody is working as the Principal Scientist. - Marine Fisheries Wing (MFW) in collaboration with the Marine Fisheries Survey Management (MFSM) Unit of the Department of Fisheries (DoF) is collecting related fisheries statistics from log sheets. - Marine Fisheries & Technology Station (MFTS), Cox's Bazar of the Bangladesh Fisheries Research Institute (BFRI) is doing some research study in a very limited scale on the stock assessment, catch monitoring and population biology. - Besides, sporadic studies are done on Length-Frequency by M.Sc. students of various universities.
Other relevant information		

Details of the References cited in the Table

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DATA SUMMARY

Indonesia

Species: Indian Mackerel (*Rastrelliger kanagurta*)WEST SUMATRA - BANDA ACEH – MALLACA STRAIT

Data category	Component	Relevant information available (please complete)
Fishery definitions	<p>Describe the main national fisheries catching the species:</p> <ul style="list-style-type: none"> - Fishing method (gear) - Fishing season (months) - Fishery area (main region/habitat of each fishery) 2003-2004 - Size/power of vessels operating in fishery - Main ports of operation. 	<p>SBG: Purse Seine; BA: Mini Purse Seine</p> <p>WS: March & September; BA: Mar to May; EA: Dec to Feb; ESN: Jun to Aug & Sep to Nov</p> <p>SA & western part of Sumatra North (Kep. Banyak, Singkil to Simeleu, Sorkam, Barus, Bay of Tapanuli, Mursala Isl., Natal, Sikara-kara, Ilik Is, Pini Is., Kep. Batu, Telo Is.)</p> <p>East & north of Aceh & eastern part of Sumatra North</p> <p>17-58 GT (1992) to 20-130 GT (2003): 15% Medium PS (20-40 GT) & 85% Big PS; ; Inboard 115 Hp: main engine & mesin bantu 115 Hp</p> <p>Sibolga, Banda Aceh, Idie Rayeuk, Belawan, Tanjung Balai</p>
Catch	Recent total annual catch (mt) of species (include an indicative estimate if reliable statistics are not available)	2003: All species 25,707 tons (2,142 tons/month); <i>R. kanagurta</i> 1,233 ton in 2003 (5%)
	Time series of total catch estimates	<p>2003: All species, Pukat rapat 25,707 tons (2,142 tons/month)</p> <p>WS: Catch-effort monitoring for 9 sample boats in 2003</p> <p>Hariati (2005); Hariati & Fauzi (2010)</p>
	<ul style="list-style-type: none"> - Years with data - Source of data (survey, logsheet, market, census, etc) - Reliability of data - Allocation of catch among fisheries and/or fishing gears - Reference documents 	
Allocation of catch		

	among fisheries and/or fishing gears Seasonality of catch (by fishery)	Monthly fluctuation with peak season (bulk of catch) occur in Sep
Fishing effort	Number of vessels by fishery (recent and available time-series of data) Detailed fishing effort data (days fished, length of nets, etc) by fishery (2003-2004) Include source of data, reliability of data, data problems	SBG (1985-2004) : Increase since 1985 (50) – 1992 (128) – 1995 (115) – 2002 (203) Days fished: SA 13,242 days/year; Centre Tapanuli 4,878 days/year; South Tapanuli 6,871 days/year; SBG 2,763 days/year; WS north 2,703 days/year SBG: Nets length 700 m, dalam 60 m, mesh size 1 inch; 10 Fish hold @ 3 ton; Fish finder; Radio; Mercury lamps (15-150 kwh) & 30 Halogen lamps @ 1500 Watt; Compass/GPS; FAD SBG (2003) : Accurate but lack of sample boats (n=9)
CPUE trends	Describe and reference any studies that provide CPUE indices for individual fisheries	SBG-2003: Monthly catch (kg/day) of small pelagic fishes were varied, two peak season were occurred in March (lower, 500 kg/day) and Sep (higher, 760 kg/day) SA: 413 kg/day/vessel (1992-1995)
Biological studies	Describe any national research undertaken or planned for the species, including: - Age and growth (1995) - Maximum age estimates - Length and/or age sampling of the catch (by fishery) - Length/age at maturity - Timing of spawning season - - -	BA & SN: GH plot: $L_{\infty}=23.8$ cmFL, $K=0.79$ per year ($R_n=0.6423$) ELEFAN: $L_{\infty}=24.5$ cmFL, $K1.1$ ($R_n=0.126$) 24 cmFL Random sampling: 4 x 20 kg fish samples per month BA & SN: 20 cmFL WS: I : May to Oct, peak in Jul to Aug & Oct; II: Dec to March, peak Jan to March Sumatra North: May to Oct (peak in Jul-Aug & Oct & Dec to Mar (peak in Jan & Mar)

	<ul style="list-style-type: none"> - - Length-weight relationship - Movement information (tagging) - Quantitative stock assessments - Other relevant research surveys, programmes <p>(Please include the name of the principal scientist responsible and any available references)</p>	<p>a=0,0024; b=3,636 (r=0.9)</p> <p>No data. BOBP 1987: Catch of kembung in Aceh was come from north of Penang (Malaysia), then move along coast of eastern part of Sumatra north</p> <p>BA & SN: Z=3.7; M=1.3; F=2.4; E=0.65 (fully exploited) Lc (L₅₀)= 16.8 cm; Lc/L_∞= 0.707; M/K=1.645</p> <p>Small pelagic assessment in Mallaca Strait Sustainable Pelagic Fisheries in the South China Sea (by SEAFDEC in 2003-2005)</p> <p>Hariati & Suwarso Anex 1</p>
Other relevant information		

Remarks:

WS: West Sumatra; SA: South Aceh; BA: Banda Aceh (north); EA: East Aceh; ESN: Eastern Sumatra North; SBG: Sibolga;

Jakarta, 11 Sep 2010 : Suwarso, Ayi Yustiati, Neneng Pebruwanti

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DATA SUMMARY

India – east coast only

Species: Indian Mackerel (*Rastrelliger kanagurta*)

Date category	Component	Relevant information available (please complete)
Fishery definitions	<p>Describe the main national fisheries catching the species</p> <ul style="list-style-type: none"> - Fishing method - Fishing season - Fishery area (main region/habitat of each fishery) - Size/power of vessels operating in fishery <p>Main ports of operation</p>	<p>Trawls, gillnets, ring seine (in Tamil Nadu) and shore seines (not very much prevalent now)</p> <p>Throughout the year peak landing during December-May</p> <p>Coastal waters within 50 m depths; Trawls exploit at depths ranging from 10-50m, gillnets at 20-40 m and shoreseines in inshore waters.</p> <p>Indigenous, motorized and mechanized crafts used in the fishery.</p> <ul style="list-style-type: none"> • Shoreseines use small indigenous non-mechanized and outboard motorized (<10 hp) canoes (OAL). • Gillnetters mostly use outboard motorized (9-20 hp) canoes (OAL). • Trawlers exploiting mackerel are usually multiday operators targeting mostly shrimps and cephalopods. These large crafts have an OAL ranging from 12 m to 16 m and engines of 80 to 150 hp. <p>West Bengal (Digha, Diamond Harbour) Orissa (Paradeep, Puri) Andhra Pradesh (Visakhapatnam, Kakinada, Byrepallam) Tamil Nadu (Chennai, Cuddalore Tuticorin, Nagapatinam, Mandapam, Kanyakumari) Pondicherry</p>
Catch	<p>Recent total annual catch (mt) of species. (include an indicative estimate if reliable statistics are not available).</p>	<p>58,293 t during 2009 along east coast of India</p> <p>West Bengal - 7484 t Orissa - 8936 t Andhra Pradesh - 23077 t Tamil Nadu - 18432 t Pondicherry - 364 t</p>
	<p>Time series of total catch estimates</p> <ul style="list-style-type: none"> - Years with data (all gears pooled) - Source of data (survey, logsheet, market, census, etc.) - Reliability of data - Allocation of catch among fisheries and/or fishing gears - Reference documents 	<p><i>Please refer to table 1</i></p> <p>National Marine Fisheries Statistics collected and maintained in Fishery Resource assessment Division, Central marine fisheries Research Institute (CMFRI)</p> <p>Highly Reliable (There is no allocation of resource among the fisheries; it is only sharing of resource Please refer to Table 2 CMFRI Publications)</p>
	<p>Allocation of catch among fisheries and/or fishing gears</p> <p>Seasonality of catch (by fishery)</p>	<p>Please refer to table 3</p> <p>Caught throughout the year with peak during December- May. Not fished by trawls during the annual trawl ban (April-May)</p>
Fishing effort	<p>Number of vessels by fishery (recent and available time series data)</p> <p>Detailed fishing effort data (days</p>	<p>Please refer to Table 4</p> <p>Most gears except the large mechanized trawls operate on a</p>

	fished, length of nets, etc. by fishery) Include source of data, reliability of data, data problems.	single day basis. Large trawlers fish for 7-12 days at a stretch. Data source is from Central Marine Fisheries Research Institute. Data very reliable.
CPUE	Describe and reference any	Please refer to Table 4
Trends	Studies that provide CPUE indices for individual fisheries	Fishery along Indian coast is multi-species and effort not directed to capture mackerel alone. However data for individual fisheries is available based on the total effort expended and the total individual fisheries exploited. Time series data can be calculated from Table 4.
Biological studies	Describe any national research undertaken or planned for the species including <ul style="list-style-type: none"> - Age and growth - Maximum age estimates - Length and/or age sampling of the catch (by fishery) - Length/age at maturity - Timing of spawning season - - Length-weight relationship - Movement information (tagging) - Quantitative stock assessments - Other relevant research surveys, programmes. 	Several regional and national projects on mackerel covering all aspects of fishery and biology have been undertaken by Central Marine Fisheries Research Institute. $L_{\infty} = 283.5$ mm, $K = 1.7/\text{yr}$, $Z = 7.34$, $M = 2.57$ 4 yrs 0-1 yr class form the bulk of the catch. 230 mm Prolonged spawning with brooders available throughout the year. $W = 0.0000017L^{3.3403}$ Experimental tagging done. Recovery very poor. Several studies carried out and results published (Given in references)

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Malaysia

Species: Indian mackerel (*Rastrelliger kanagurta*)

Data category	Component	Relevant information available (please complete)																																																																													
Fishery definitions	Describe the main national fisheries catching the species. - Fishing method (gear)	<p data-bbox="745 392 943 424"><u>Fishing Method</u></p> <p data-bbox="725 517 2092 580">Table 1: Landings of <i>R. brachysoma</i> and <i>R. kanagurta</i> in tonnes by main fishing gears and region in Malaysia, 2008</p> <table border="1" data-bbox="712 635 2063 1011"> <thead> <tr> <th data-bbox="725 639 792 663">Gear</th> <th colspan="2" data-bbox="1005 639 1061 663">WC</th> <th colspan="2" data-bbox="1240 639 1285 663">EC</th> <th colspan="2" data-bbox="1442 639 1554 663">Sarawak</th> <th colspan="2" data-bbox="1666 639 1733 663">Sabah</th> <th colspan="2" data-bbox="1845 639 1935 663">Labuan</th> </tr> <tr> <th data-bbox="725 679 815 703">Species</th> <th data-bbox="1005 679 1061 703">RB</th> <th data-bbox="1128 679 1184 703">RK</th> <th data-bbox="1240 679 1296 703">RB</th> <th data-bbox="1352 679 1408 703">RK</th> <th data-bbox="1442 679 1498 703">RB</th> <th data-bbox="1576 679 1632 703">RK</th> <th data-bbox="1666 679 1722 703">RB</th> <th data-bbox="1756 679 1812 703">RK</th> <th data-bbox="1845 679 1901 703">RB</th> <th data-bbox="1957 679 2013 703">RK</th> </tr> </thead> <tbody> <tr> <td data-bbox="725 727 837 751">Trawl nets</td> <td data-bbox="1005 727 1095 751">19,678</td> <td data-bbox="1128 727 1218 751">8,733</td> <td data-bbox="1240 727 1285 751">197</td> <td data-bbox="1352 727 1420 751">1,521</td> <td data-bbox="1442 727 1487 751">158</td> <td data-bbox="1576 727 1644 751">2,335</td> <td data-bbox="1666 727 1688 751">-</td> <td data-bbox="1756 727 1800 751">708</td> <td data-bbox="1845 727 1890 751">266</td> <td data-bbox="1957 727 2002 751">360</td> </tr> <tr> <td data-bbox="725 767 860 791">Purse seines</td> <td data-bbox="1005 767 1095 791">48,394</td> <td data-bbox="1128 767 1218 791">11,526</td> <td data-bbox="1240 767 1263 791">1</td> <td data-bbox="1352 767 1420 791">6,401</td> <td data-bbox="1442 767 1464 791">24</td> <td data-bbox="1576 767 1621 791">477</td> <td data-bbox="1666 767 1688 791">-</td> <td data-bbox="1756 767 1823 791">6,816</td> <td data-bbox="1845 767 1868 791">4</td> <td data-bbox="1957 767 1980 791">21</td> </tr> <tr> <td data-bbox="725 807 882 831">Gill/Drift nets</td> <td data-bbox="1005 807 1095 831">50,785</td> <td data-bbox="1128 807 1173 831">281</td> <td data-bbox="1240 807 1308 831">2,114</td> <td data-bbox="1352 807 1420 831">6,886</td> <td data-bbox="1442 807 1464 831">32</td> <td data-bbox="1576 807 1621 831">284</td> <td data-bbox="1666 807 1688 831">-</td> <td data-bbox="1756 807 1800 831">138</td> <td data-bbox="1845 807 1868 831">12</td> <td data-bbox="1957 807 1980 831">44</td> </tr> <tr> <td data-bbox="725 847 927 903">Others (Hooks and Lines, Traps)</td> <td data-bbox="1005 847 1050 871">203</td> <td data-bbox="1128 847 1151 871">-</td> <td data-bbox="1240 847 1263 871">-</td> <td data-bbox="1352 847 1397 871">502</td> <td data-bbox="1442 847 1464 871">1</td> <td data-bbox="1576 847 1599 871">2</td> <td data-bbox="1666 847 1688 871">-</td> <td data-bbox="1756 847 1823 871">1,409</td> <td data-bbox="1845 847 1868 871">3</td> <td data-bbox="1957 847 1980 871">2</td> </tr> <tr> <td data-bbox="725 927 792 951">Total</td> <td data-bbox="1005 927 1095 951">119,060</td> <td data-bbox="1128 927 1218 951">20,540</td> <td data-bbox="1240 927 1308 951">2,311</td> <td data-bbox="1352 927 1420 951">15,311</td> <td data-bbox="1442 927 1487 951">216</td> <td data-bbox="1576 927 1644 951">3,099</td> <td data-bbox="1666 927 1688 951">-</td> <td data-bbox="1756 927 1823 951">9,072</td> <td data-bbox="1845 927 1890 951">285</td> <td data-bbox="1957 927 2002 951">428</td> </tr> </tbody> </table>	Gear	WC		EC		Sarawak		Sabah		Labuan		Species	RB	RK	RB	RK	RB	RK	RB	RK	RB	RK	Trawl nets	19,678	8,733	197	1,521	158	2,335	-	708	266	360	Purse seines	48,394	11,526	1	6,401	24	477	-	6,816	4	21	Gill/Drift nets	50,785	281	2,114	6,886	32	284	-	138	12	44	Others (Hooks and Lines, Traps)	203	-	-	502	1	2	-	1,409	3	2	Total	119,060	20,540	2,311	15,311	216	3,099	-	9,072	285	428
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- Fishing season (months).

Fishing Season

Table 2: Landings of *R. brachysoma* and *R. kanagurta* in percentage by month and region in Malaysia, 2008

Month	WC		EC		Sarawak		Sabah		Labuan		
	Species	RB	RK	RB	RK	RB	RK	RB	RK	RB	RK
January		6.7	6.2	0.4	3.4	13.4	9.5	-	7.8	1.1	11.2
February		7.1	6.7	0.6	3.9	21.3	7.5	-	8.7	10.9	6.5
March		8.3	8.8	1.2	5.9	11.6	6.2	-	11.1	15.1	7.7
April		9.6	9.6	3.0	7.0	12.5	4.1	-	7.7	15.1	6.8
May		9.6	9.7	13.4	8.3	9.7	11.9	-	8.8	10.9	5.8
June		8.9	7.6	1.0	12.1	9.3	10.4	-	8.9	4.6	6.5
July		9.0	8.3	15.0	12.9	3.2	9.4	-	7.9	7.0	11.2
August		10.1	10.2	18.3	11.6	5.1	11.1	-	7.9	0.7	5.8
September		7.6	8.9	23.4	13.8	1.4	7.5	-	8.2	14.4	8.2
October		8.0	8.2	21.3	12.6	3.7	9.6	-	7.8	7.4	8.9
November		8.1	8.6	2.0	5.0	3.7	7.6	-	6.7	8.1	10.7
December		7.0	7.4	0.5	3.4	5.1	5.2	-	8.5	4.9	10.3
Total landing (Tonnes)		119,060	20,541	2,311	15,311	216	3,099	-	9,072	285	428

Fishery area

Most of the fishing operation for *R. brachysoma* and *R. kanagurta* are in the fishing zone B (5-12 n.m) and C (12-30 n.m). According to Hadil and Richard (1991), *R. kanagurta* are more abundant offshore.

Fishery area (main region/habitat of each fishery).

Size/power of vessels operating in fishery.

Size/power of vessels

Table 3. Size /power of vessel by region in Malaysia, 2008

	WC		EC		Sarawak		Sabah		Labuan	
Species	RB	RK	RB	RK	RB	RK	RB	RK	RB	RK
Trawl:										
Zone B (<40GRT)	7.3	9.1	4.7	2.3						
Zone C (40-70 GRT)	8.7	30.2	3.7	5.5						
Zone C2 (>70GRT)	0.5	3.2	0.1	2.2						
Sub Total	16.5	42.5	8.5	9.9	73.8	75.4		7.9	93.3	84.1
Purse seines:										
Zone B (<40GRT)	5.5	0.7	-	11.0						
Zone C (40-70 GRT)	27.3	22.5	0.0	8.6						
Zone C2 (>70GRT)	7.8	32.9	-	22.3						
Sub Total	40.6	56.1	0.0	41.8	11.2	15.4		76.3	1.4	4.9
Drift/Gill Net	42.7	1.4	91.5	45.0	15.0	9.2			4.2	10.3
Others (Hook, Line & Traps)	-	-	-	-				15.8	0.7	0.7
Total M.T	119,060	20,541	2,311	15,311	214	3,098	138	8,933	285	428

	<p>- Main ports of operation.</p>	<p><u>Main port of operation</u></p> <p>Table 4: Main ports of fish landing in Malaysia.</p> <table border="1" data-bbox="707 331 1895 730"> <thead> <tr> <th></th> <th>WC</th> <th>EC</th> <th>Sarawak</th> <th>Sabah</th> <th>Labuan</th> </tr> </thead> <tbody> <tr> <td rowspan="5">Main port</td> <td>• Langkawi</td> <td>• Tok Bali</td> <td>• Kuching</td> <td>• Kota Kinabalu</td> <td>• Labuan</td> </tr> <tr> <td>• Tanjung Dawai</td> <td>• Chendering</td> <td>• Bintulu</td> <td>• Kudat</td> <td></td> </tr> <tr> <td>• Teluk Bahang</td> <td>• Kuantan</td> <td>• Tanjung Manis</td> <td>• Semporna</td> <td></td> </tr> <tr> <td>• Pulau Pangkor</td> <td></td> <td>• Miri</td> <td></td> <td></td> </tr> <tr> <td>• Perlis</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>		WC	EC	Sarawak	Sabah	Labuan	Main port	• Langkawi	• Tok Bali	• Kuching	• Kota Kinabalu	• Labuan	• Tanjung Dawai	• Chendering	• Bintulu	• Kudat		• Teluk Bahang	• Kuantan	• Tanjung Manis	• Semporna		• Pulau Pangkor		• Miri			• Perlis				
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<p>Catch</p>	<p>Recent total annual catch (mt) of species. (include an indicative estimate if reliable statistics are not available).</p>	<p>Table 5: Landing of major marine fish group in Malaysia, 2008</p> <table border="1" data-bbox="707 919 1420 1353"> <thead> <tr> <th>Fish group</th> <th>Landing (tonnes)</th> <th>%</th> </tr> </thead> <tbody> <tr> <td>Pelagic</td> <td>533,404</td> <td>38</td> </tr> <tr> <td>Demersal</td> <td>274,049</td> <td>20</td> </tr> <tr> <td>Shrimp</td> <td>82,120</td> <td>6</td> </tr> <tr> <td>Cephalopod</td> <td>85,900</td> <td>6</td> </tr> <tr> <td>Mollusc</td> <td>19,481</td> <td>2</td> </tr> <tr> <td>Others</td> <td>397,004</td> <td>28</td> </tr> <tr> <td>Total</td> <td>1,394,531</td> <td>100</td> </tr> </tbody> </table>	Fish group	Landing (tonnes)	%	Pelagic	533,404	38	Demersal	274,049	20	Shrimp	82,120	6	Cephalopod	85,900	6	Mollusc	19,481	2	Others	397,004	28	Total	1,394,531	100								
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Pelagic fish

Most pelagic fish are caught by purse seine nets at 378,391 mt (27%) as shown in Figure 11. The most dominant species landed by purse seine are round scads (24%), followed by tuna (14%), sardine (10%), Indian mackerel (7%), sclar scads (6%), yellow striped trevally (3%), trash fish (7%) and others (29%).

Time series of total catch estimates

- Years with data.

- Source of data (survey, logsheet, market, census, etc)
- Reliability of data.
- Allocation of catch among fisheries and/or fishing gears.
- Reference documents.

Year with data (1982-2008)

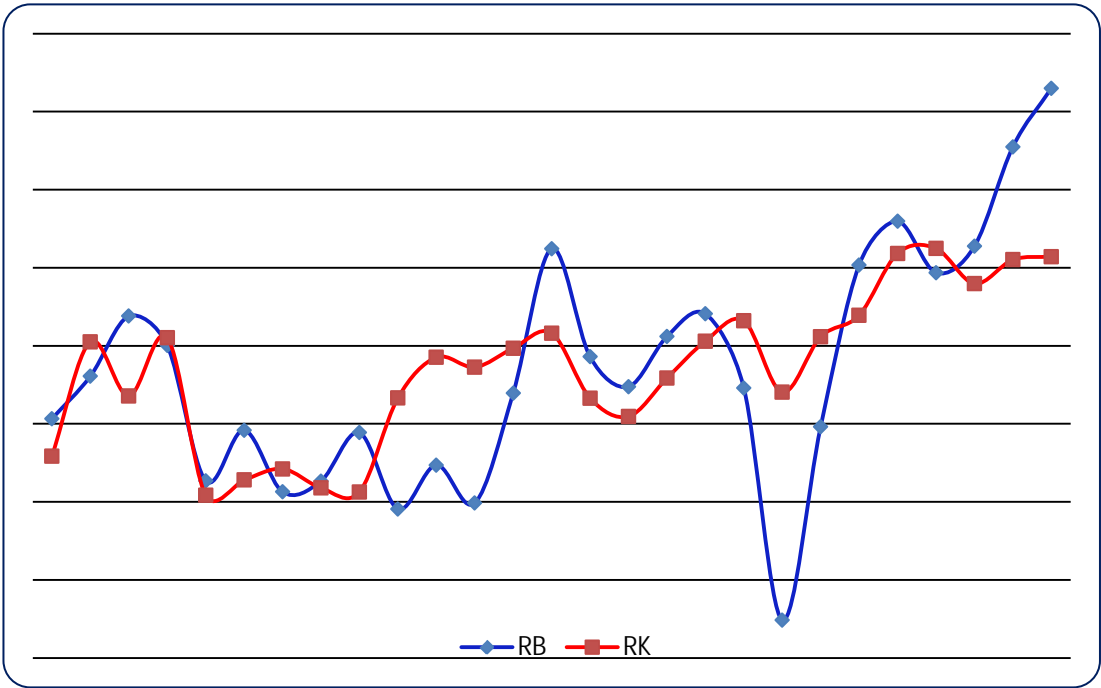


Figure 1: Landing trend (percentages) of *R. brachysoma* and *R. kanagurta* in Malaysia, 1982-2008

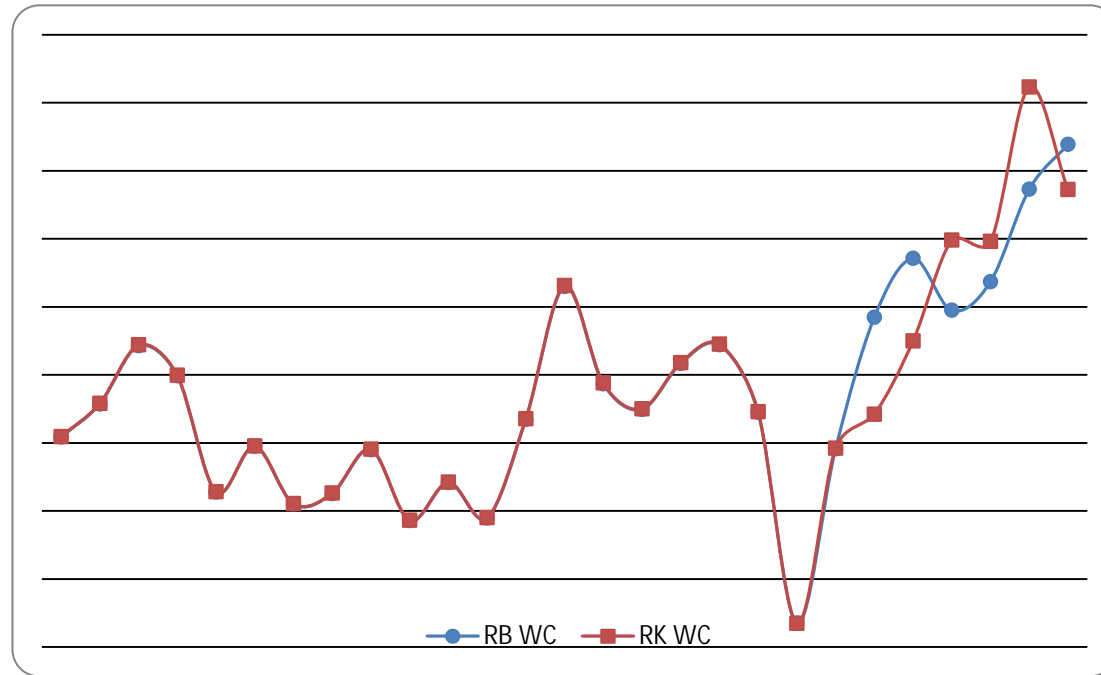


Figure 2: Landing trend of *R. brachysoma* and *R. kanagurta* in West coast of Peninsular Malaysia, 1982-2008

Source of data

1. Source of data: Annual Department of Fisheries Statistic, 1982-2008
2. Reliability: Official record of DoF Malaysia with support from research data
3. References:
 - (i) Anon 1982-2008. Annual Department of Fisheries Statistic, 1982-2008
 - (ii) Information Collection on Small Pelagic fish in South China Sea: Volume 1: National Reports. 2007. Edited by Raja Bidin Raja Hassan and Ku Kassim Ku Yaacob. SEAFDEC MFRDMD/ RM/ 22.
 - (iii) Hadil, R and Richard, R. 1991. Distribution and biological status of the pelagic resources off Sarawak, Malaysia. Fisheries Bulletin No. 68. Department of Fisheries.

Allocation of catch among fisheries and/or fishing gears.

Allocation of catch

Table 6 : Allocation of catch (tonnes) by major fishing gears and region for *R. brachysoma* and *R. kanagurta* in Malaysia, 2008

Gear Species	WC		EC		Sarawak		Sabah		Labuan	
	RB	RK	RB	RK	RB	RK	RB	RK	RB	RK
Trawl nets	19,678	8,733	197	1,521	158	2,335	-	708	266	360
Purse seines	48,394	11,526	1	6,401	24	477	-	6,816	4	21
Gill/Drift nets	50,785	281	2,114	6,886	32	284	-	138	12	44
Others (Hooks and Lines, Traps)	203	-	-	502	1	2	-	1,409	3	2
Total	119,060	20,540	2,311	15,311	216	3,099	-	9,072	285	428

Seasonality of catch (by fishery).

Seasonality of catch

Table 7: Seasonality of catch of *R. brachysoma* and *R. kanagurta* in percentage by month and region in Malaysia, 2008

Month	WC		EC		Sarawak		Sabah		Labuan	
Species	RB	RK	RB	RK	RB	RK	RB	RK	RB	RK
January	6.7	6.2	0.4	3.4	13.4	9.5	-	7.8	1.1	11.2
February	7.1	6.7	0.6	3.9	21.3	7.5	-	8.7	10.9	6.5
March	8.3	8.8	1.2	5.9	11.6	6.2	-	11.1	15.1	7.7
April	9.6	9.6	3.0	7.0	12.5	4.1	-	7.7	15.1	6.8
May	9.6	9.7	13.4	8.3	9.7	11.9	-	8.8	10.9	5.8
June	8.9	7.6	1.0	12.1	9.3	10.4	-	8.9	4.6	6.5
July	9.0	8.3	15.0	12.9	3.2	9.4	-	7.9	7.0	11.2
August	10.1	10.2	18.3	11.6	5.1	11.1	-	7.9	0.7	5.8
September	7.6	8.9	23.4	13.8	1.4	7.5	-	8.2	14.4	8.2
October	8.0	8.2	21.3	12.6	3.7	9.6	-	7.8	7.4	8.9
November	8.1	8.6	2.0	5.0	3.7	7.6	-	6.7	8.1	10.7
December	7.0	7.4	0.5	3.4	5.1	5.2	-	8.5	4.9	10.3
Total landing (Tonnes)	119,060	20,541	2,311	15,311	216	3,099	-	9,072	285	428

Fishing effort

Number of vessels by fishery (recent and available time-series of data).

Detailed fishing effort data (days fished, length of nets, etc) by fishery.

Include source of data, reliability of data, data problems.

Number of vessels by fishery (recent and available time-series of data)

Table 8 :Number of fishing gear licensed and estimated to be operating on the West Coast of Peninsular Malaysia

Year	Trawl		All Seines		F. Purseseine		Drift Net		Other Gear		Total	
	Lcnsd	Oprt	Lcnsd	Oprt	Lcnsd	Oprt	Lcnsd	Oprt	Lcnsd	Oprt	Lcnsd	Oprt
1967	180	899	1478	1342			4163	3321	3592	4270	9413	9832
1968	264	1028	1527	1485			4564	3389	3228	3898	9583	9800
1969	367	1396	1694	1879			5240	3472	3303	4498	10604	11245
1970	599	2683	1754	1556			5551	3016	3992	4805	11896	12060
1971	2594	3252	1412	1460			5216	3244	3313	4267	12535	12223
1972	2846	4068	1473	1488			5319	3698	2847	3510	12485	12764
1973	2897	3267	1650	1446			6533	3530	2776	2949	13856	11192
1974	2928	3909	1814	1535			6236	4091	2957	2696	13935	12231
1975	2815	3873	2123	1687			6702	4359	3414	2701	15054	12620
1976	3039	4008	1354	1425			7475	5092	4481	2762	16349	13287
1977	3029	4195	1877	1204			8932	5951	6350	3113	20188	14463
1978	3321	4463	2004	1394	434	195	11012	6968	4646	2814	20983	15639
1979	3316	5112	1909	1542	366	236	12363	7878	4663	3380	22251	17912
1980	3347	5265	2028	1951	421	241	13260	8453	7735	4087	26370	19756
1981	3414	5266	1755	2081	411	301	13394	8525	8183	4751	26746	20623
1982	3365	5257	1726	2133	370	343	11647	8689	9418	5463	26156	21542
1983	3236	5166	929	2046	384	325	11283	9096	6485	5803	21933	22111
1984	3487	5255	1099	1167	390	361	11033	9694	4427	5361	20046	21477
1985	3281	5163	934	2047	364	377	10710	10417	5911	4878	20836	22505
1986	3281	4505	766	1449	329	251	9940	8430	2259	3061	16246	17445
1987	3336	4442	1090	1176	328	320	9371	8402	1745	3078	15542	17098
1988	3257	4547	1251	1105	305	318	8965	8660	1736	2665	15209	16977
1989	3331	4468	1308	1013	287	217	10713	8388	1985	2389	17337	16258
1990	3187	4106	1219	1004	266	202	10728	9446	1864	2143	16998	16699
1991	3224	4599	1196	1020	257	226	10465	9095	1774	2691	16659	17405
1992	3294	4185	1160	948	249	172	9723	9376	1700	2918	15877	17427
1993	3155	3939	1116	845	235	204	8518	10232	1517	3334	14306	18350
1994	3137	3951	1048	883	220	194	7818	10351	1434	3379	13437	18564
1995	3136	3933	1022	871	221	199	10826	10360	1514	3403	16498	18566
1996	3063	4032	934	843	217	189	9289	10716	1390	3713	14676	19304

Note : Lcnsd = licensed; Oprt = operating

Table 9: Number of vessels by fishery in West Coast Peninsular Malaysia, 1997-2008

Year	Trawl nets	Fish Purse	Gill/ Drift nets	Others (Hooks	Total
1997	3107	221	9087	391	12806
1998	3737	221	8808	455	13221
1999	3791	247	8267	355	12660
2000					
2001	3099	243	7908	366	11616
2002	3047	253	7676	356	11332
2003	3102	250	9078	443	12873
2004	3015	230	9775	232	13252
2005	3319	254	10298	318	14189
2006	2867	302	12081	229	15479
2007	3071	303	11950	358	15682
2008	2978	326	12520	333	16157

Table 10: Number of vessels by fishery in East Coast Peninsular Malaysia, 1997-2008

Year	Trawl nets	Fish	Gill/	Others	Total
1997	874	450	2798	1630	5752
1998	878	363	2574	1578	5393
1999	915	481	1999	1626	5021
2000					
2001	970	505	2500	1610	5585
2002	952	527	2179	1523	5181
2003	910	524	2175	1541	5150
2004	934	492	2406	1994	5826
2005	942	494	2803	1933	6172
2006	961	489	2864	1996	6310
2007	956	516	3098	1960	6530
2008	989	567	3632	1989	7177

Table 11: Number of vessels by fishery in Sarawak, 1997-2008

Year	Trawl nets	Fish	Gill/	Others	Total
1997	579	19	1488	167	2253
1998	570	21	1308	133	2032
1999	760	25	2746	438	3969
2000					
2001	628	22	1370	76	2096
2002	628	22	1370	76	2096
2003	910	26	3938	420	5294
2004	910	26	3938	420	5294
2005	657	39	1729	177	2602
2006	642	56	2824	141	3663
2007	584	47	3158	121	3910
2008	681	53	2882	122	3738

Table 12: Number of vessels by fishery in Sabah, 1997-2008

Year	Trawl	Fish	Gill/ Drift	Others	Total
1997	1208	177	1027	622	3034
1998	1210	171	1171	679	3231
1999	1335	191	1176	625	3327
2000					0
2001	1422	124	4358	3157	9061
2002	1422	124	4356	3157	9059
2003	1422	124	4356	3157	9059
2004	1422	124	4356	3157	9059
2005	1422	124	4356	3157	9059
2006	1422	124	4356	3157	9059
2007	1422	124	4356	3157	9059
2008	1442	180	5008	28822	35452

Year	Trawl nets	Fish	Gill/ Drift	Others (Hooks	Total
1997	6	10	38	70	124
1998	7	7	17	41	72
1999	7	7	17	35	66
2000					0
2001	5	5	57	58	125
2002	5	5	57	58	125
2003	5	5	587	52	649
2004	5	5	587	58	655
2005	2	2	65	39	108
2006	2	6	64	51	123
2007	2	8	65	62	137
2008	2	7	120	167	296

Source of data, reliability of data, data problems.

1. Source of data: Annual Department of Fisheries Statistic, 1982-2008
2. Reliability: Official record of DoF Malaysia and support from research data
3. References:
 - (i) Anon 1967-2008. Annual Department of Fisheries Statistic. 1967-2008
 - (ii) Mansor, M.I., Syed Abdullah, S.A.K and Abdul Hamid, Y. 1996. Population structure of small pelagics off East Coast of Peninsular Malaysia. Fisheries Bulletin, Vol. 99.

CPUE trends

Describe and reference any studies that provide CPUE indices for individual fisheries.

In Kuching, the catches of purse seines are between 50-100 kg/day/vessel throughout the year (Hadil, 2007). In Bintulu, the landing is between 60-140 kg/day/vessel and more abundant in the middle of the year.

In Peninsular Malaysia the catches of purse seines are between 100-1090 kg/day/vessel (Samsudin, 2007). While

		Mansor et. al. (1996) reported that the small zone C purse seine are between 200-1,100 kg/boat/haul																																																																																									
<p>Biological studies</p>	<p>Describe any national research undertaken or planned for the species, including:</p> <ul style="list-style-type: none"> - Age and growth. - Maximum age estimates. - Length and/or age sampling of the catch (by fishery). - Length/age at maturity. - Timing of spawning season. - Length-weight relationship. - Movement information (tagging). - Quantitative stock assessments. - Other relevant research surveys, programmes. <p>(Please include the name of the principal scientist responsible and any available references).</p>	<p>Population parameters of <i>R. kanagurta</i></p> <p>Table 14: Population parameters of <i>R. kanagurta</i> in Malaysia.</p> <table border="1" data-bbox="707 408 1895 919"> <thead> <tr> <th rowspan="2">Area</th> <th colspan="8">Parameters</th> </tr> <tr> <th>K</th> <th>L∞</th> <th>Z</th> <th>M</th> <th>F</th> <th>E</th> <th>Rn</th> <th></th> </tr> </thead> <tbody> <tr> <td>Perlis (WC)</td> <td>1.19</td> <td>297</td> <td>6.9</td> <td>1.97</td> <td>4.93</td> <td>0.71</td> <td></td> <td></td> </tr> <tr> <td>Peang (WC)</td> <td>1.21</td> <td>29</td> <td>8.14</td> <td>.01</td> <td>6.13</td> <td>0.75</td> <td></td> <td></td> </tr> <tr> <td>To Bali (EC)</td> <td>1.1</td> <td>27.56</td> <td>4.79</td> <td>1.87</td> <td>2.90</td> <td>0.61</td> <td>0.132</td> <td></td> </tr> <tr> <td>Kuantan (EC)</td> <td>1.0</td> <td>27.60</td> <td>3.73</td> <td>1.86</td> <td>1.87</td> <td>0.50</td> <td>0.132</td> <td></td> </tr> <tr> <td>Kuching</td> <td>1.0</td> <td>27.69</td> <td>4.41</td> <td>1.86</td> <td>2.55</td> <td>0.58</td> <td>0.143</td> <td></td> </tr> <tr> <td>Kota Kinabalu</td> <td>1.0</td> <td>29.8</td> <td>3.49</td> <td>1.23</td> <td>2.26</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Kudat</td> <td>1.01</td> <td>25.3</td> <td>4.4</td> <td>1.01</td> <td>3.39</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Kunak</td> <td>0.67</td> <td>29.9</td> <td>2.48</td> <td>0.74</td> <td>1.74</td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p><u>Spawning season of <i>Rastrelliger kanagurta</i></u></p> <p>Spawning season of <i>R. kanagurta</i> in the northern part of West Coast Peninsular Malaysia occurred in March to April.</p> <p>Data in 2007, spawning season of <i>R. kanagurta</i> occurred twice a year in the South China Sea area. In the northern part of East Coast Peninsular Malaysia, spawning season occurred in March to May and October to November and in the southern part, spawning occurred from April to August.</p> <p>In the Sarawak, spawning occurred from January to April and November to December.</p>	Area	Parameters								K	L ∞	Z	M	F	E	Rn		Perlis (WC)	1.19	297	6.9	1.97	4.93	0.71			Peang (WC)	1.21	29	8.14	.01	6.13	0.75			To Bali (EC)	1.1	27.56	4.79	1.87	2.90	0.61	0.132		Kuantan (EC)	1.0	27.60	3.73	1.86	1.87	0.50	0.132		Kuching	1.0	27.69	4.41	1.86	2.55	0.58	0.143		Kota Kinabalu	1.0	29.8	3.49	1.23	2.26				Kudat	1.01	25.3	4.4	1.01	3.39				Kunak	0.67	29.9	2.48	0.74	1.74			
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Table 15: Major cohorts and the recruitment of *R. kanagurta* in Malaysia

Area	Origin of cohort	Major cohort	Length at one year	Recruitment size	Recruitment month
Tok Bali (EC)	Mar-April June-July Oct-Nov	3	>18cm	4-12 cm (5-7 months)	Feb-Apr, Nov
Kuantan (EC)	Mar-Apr Jun-Jul Oct-Nov	3	>18 cm	12-14 cm (7-8 months)	Feb, Jun, Nov
Kuching (Sarawak)	Mar-May Sep-Oct	2	>18 cm	13-16 cm (8-11 months)	Mar, Sep

Table 16: Sex Ratio of *R. kanagurta* according to areas.

Area	Female	Male
Tok Bali (EC)	1	1.01
Kuantan (EC)	1	0.96
Kuching, Sarawak	1	0.89

Table 17: The length at first maturity by *R. kanagurta* and sub-area.

Species / sub-area	Total length at first maturity (mm)	
	F	M
Penang (WC)	206	
Tok Bali (EC)	186	189
Kuantan (EC)	165	190
Kuching, Sarawak	184	194

Other relevant information	
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DATA SUMMARY

Sri Lanka

Species: Indian mackerel (*Rastrelliger kanagurta*)

Data category	Component	Relevant information available (please complete)	
Fishery definitions	Describe the main national fisheries catching the species.	(Based on 2008 data)	
	<ul style="list-style-type: none"> - Fishing method (gear) - Fishing season (months). 	Main: Gillnet (2-25 km) Others: Beach seine (1-2 km), NorthWest: June- Oct; West: Jan- Mar; Aug-Dec South: June- Nov	
	<ul style="list-style-type: none"> - Fishery area (main region/habitat of each fishery). - Size/power of vessels operating in fishery. - Main ports of operation. 	All coastal areas of Sri Lanka Fishing Depth = 10-20 m 15-30 HP Negombo, Chilaw, Beruwala, Matara, Tangalle, Trincomalee, Kalmunei	
Catch	Recent total annual catch (mt) of species. (include an indicative estimate if reliable statistics are not available).	Indian Mackerel + Barracudas 2006- 15,570 MT 2007-16,290 MT 2008- 17,620 MT For NW (Only f or this species) Gillnets (Morning): 94.97 MT; Gillnets (Evening): 3.27 MT; Beach seine: 7.05 MT	
	Time series of total catch estimates	<ul style="list-style-type: none"> - Years with data. - Source of data (survey, logsheet, market, census, etc). - Reliability of data. - Allocation of catch among fisheries and/or fishing gears. - Reference documents. 	Since 2005 Proper sampling programme by Field Enumerators Reliable
	Allocation of catch among fisheries and/or fishing gears. Seasonality of catch (by fishery).		
Fishing effort	Number of vessels by fishery (recent and available time-series of data).	FRP Boats 1972- 875; 1993- 8753; 1999-8623; 2004- 11559; 2008- 13581; 2009- 17193 Out Board Traditional Boats 1972- 2408, 1999- 14944; 2004- 15260, 2008-17178, 2009-	

	<p>Detailed fishing effort data (days fished, length of nets, etc) by fishery.</p> <p>Include source of data, reliability of data, data problems.</p>	<p>18243</p> <p>Traditional Crafts</p> <p>1972- 14553; 1996- 13,880; 1999- 14944; 2004 – 15260; 2008- 17178; 2009- 18243</p> <p>Fishing days: average 27 days/month (gillnet) but not only for this fishery.</p> <p>Range of mesh sizes: 2.5 cm to 4.5 cm</p> <p>Length of Nets: 1500 meshes</p> <p>Width: smaller sizes – 330 meshes; larger- 120 meshes</p> <p>Average net pieces per day- FRP- 10-35, traditional boats-6-10</p>
CPUE trends	Describe and reference any studies that provide CPUE indices for individual fisheries.	
Biological studies	<p>Describe any national research undertaken or planned for the species, including:</p> <ul style="list-style-type: none"> - Age and growth. - Natural Mortality (M) - Fishing Mortality (F) - Maximum age estimates. - Length and/or age sampling of the catch (by fishery). - Length/age at maturity. - Timing of spawning season. - Length-weight relationship. - Movement information (tagging). - Quantitative stock assessments. - Other relevant research surveys, programmes. <p>(Please include the name of the principal scientist responsible and any available references).</p>	<p>K = 1.7 and 1.5 per year; L_{∞} = 36.0 cm, 28.0 cm (NW);</p> <p>2.4 and 2.37 per year (NW)</p> <p>1.59 and 2.62 per year (NW)</p> <p>10.00 – 24.50 cm</p>
Other relevant information		

References:

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- Fernando, P.A.T. 2004. Population dynamics of Indian mackerel *Rastrelliger kanagurta* in northwestern coastal waters of Sri Lanka. Sri Lanka Journal of Aquatic sciences 9: 31-44.

DATA SUMMARY

Thailand

Species: Indian mackerel (*Rastrelliger kanagurta*)

Data category	Component	Relevant information available (please complete)
Fishery definitions	Describe the main national fisheries catching the species. <ul style="list-style-type: none"> - Fishing method (gear) - Fishing season (months). - Fishery area (main region/habitat of each fishery). - Size/power of vessels operating in fishery. - Main ports of operation. 	<ul style="list-style-type: none"> -purse seine (PS) -all year round. -along the Andaman sea coast of Thailand. Water depth 40-100 meter. -250-300 hp -Ranong, Phang-nga, Phuket, Krabi, Trang and Satun Province.
Catch	Recent total annual catch (mt) of species. (include an indicative estimate if reliable statistics are not available).	- (Table 1)
	Time series of total catch estimates <ul style="list-style-type: none"> - Years with data. - Source of data (survey, logsheet, market, census, etc). - Reliability of data. - Allocation of catch among fisheries and/or fishing gears. - Reference documents. 	<ul style="list-style-type: none"> -(Table 1) -from The Marine Fisheries Statistics 1997-2007 base on the sample survey -rather good source data -Indian mackerel catch by purse seine 60%, otter board trawl 37% in 2007 (Table 1)
	- Allocation of catch among fisheries and/or fishing gears. -Seasonality of catch (by fishery).	-abundance in Oct-Dec and Mar-Apr

<p>Fishing effort</p>	<p>-Number of vessels by fishery (recent and available time-series of data).</p> <p>Detailed fishing effort data (days fished, length of nets, etc) by fishery.</p> <p>Include source of data, reliability of data, data problems.</p>	<p>-415 PS (field data in 2007) and number of fishing boat registered show in table 2</p> <p>-PS 1-3 day/trip, length of net 700-1,300 meter, mesh size 25 millimeter, depth of net 80-140 meter</p>
<p>CPUE trends</p>	<p>Describe and reference any studies that provide CPUE indices for individual fisheries.</p>	
<p>Biological studies</p>	<p>Describe any national research undertaken or planned for the species, including:</p> <ul style="list-style-type: none"> - Age and growth. - Maximum age estimates. - Length and/or age sampling of the catch (by fishery). - Length/age at maturity. - Timing of spawning season. - Length-weight relationship. - Movement information (tagging). - Quantitative stock assessments. - Other relevant research surveys, programmes. <p>(Please include the name of the principal scientist responsible and any available references).</p>	<p>-Lt = $31.75(1-e^{-0.9555(t-(-0.0066))})$ (Sumontha <i>et al.</i>, 2010)</p> <p>-</p> <p>-Size distribution 4.0-30.5 centimeter</p> <p>- Female = 18.92 cm. Male = 17.83 cm.</p> <p>-Jan-Mar and Aug-Sep</p> <p>-W=$0.0145L^{2.9350}$ (Krajangdara <i>et al.</i>, 2007)</p> <p>-none</p> <p>-12,999.12 tons (2007) (Sumontha <i>et al.</i>, 2010)</p> <p>-none</p>
<p>Other relevant information</p>		

Reference

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Krajangdara, T., Puntuleng P., Chalee P. and Hussadee P. 2007. Reproductive Biology of Short mackerel *Rastrelliger brachysoma* (Bleeker, 1851) and Indian mackerel *R. kanagurta* (Cuvier, 1816) in Thai water. Technical paper No. 19/2007. Marine Fisheries Research and Development Bureau, Department of Fisheries, Ministry of Agriculture and Cooperatives. 36 p.

Sumontha M., Boonsuk S., Panjarat S., Jaiyen T. and Ritthisaman J. 2010. Stock Assessment of Indian mackerel (*Rastrelliger kanagurta* (Curvier, 1816)) along the Andaman Sea Coast of Thailand. in press.



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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