Indian Ocean Tuna Commission
Commission des Thons de l'Océan Indien

Report of the Tenth Session of the IOTC Working Party on Tropical Tunas

Bangkok, Thailand

23-31 October, 2008

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1. Opening of the Meeting and Adoption of the Agenda

1. In the opening ceremony to the Tenth meeting of the Working Party Tropical Tunas (WPTT) held in Bangkok, Thailand from 23 to 31 October 2008, the Deputy Director-General of Department Fisheries in Thailand, Dr Wimol Jantrarotai welcomed the participants to Bangkok and wished them well in their work.

2. The meeting was chaired by Dr. Iago Mosqueira and the agenda for the Meeting was adopted as presented in Appendix I.

3. The list of participants is provided in Appendix II and a list of the documents presented to the meeting is given in Appendix III.

2. The status of the IOTC Fisheries Statistics relating to Tropical Tuna Species

4. The Secretariat presented a detailed description of the status of the IOTC databases for tropical tunas. The following information is summarised from document IOTC-2008-WPTT-03.

2.1 Bigeye tuna (BET)

Retained catches are well known for the major fleets (Figure 1); but are less certain for non-reporting industrial purse seiners and longliners (NEI) and for other industrial fisheries (longliners of India and Philippines and purse seiners of Iran and Thailand). Catches are also uncertain for some artisanal fisheries including the pole and line fishery in the Maldives and the gillnet/longline fishery in Sri Lanka.

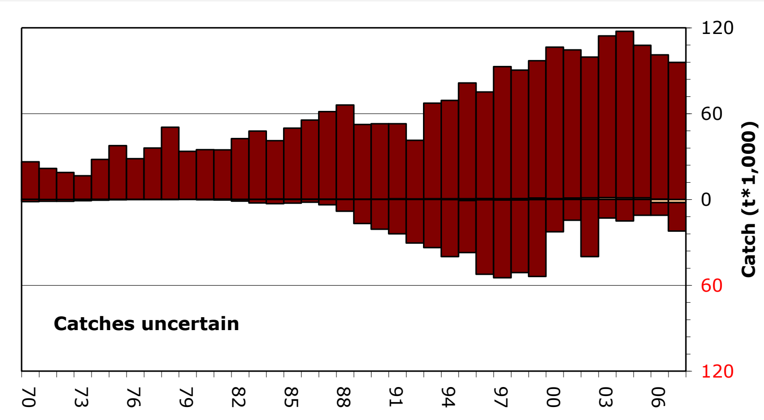


Figure 1. Uncertainty of annual catch estimates for bigeye tuna. The amount of the catch below the zero-line has been categorised as uncertain according to the criteria given in the text. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets. Data as of October 2008

Discard levels are believed to be historically low although they are unknown for most industrial fisheries, notably industrial purse seiners. Information on discards for the European purse seine tuna fishery for the period 2003 to 2007 is now available (IOTC-2008-WPEB-12) and this may assist in the estimation of current discard levels for this fleet.

Changes to the catch series: There have not been significant changes to the catches of bigeye tuna since the WPTT in 2007 (Figure 2). The changes in recent years are mostly due to revisions to the catches of the major longline fleets.

CPUE Series: Catch and effort data are generally available from the major industrial fisheries. However, these data are not available from some fisheries or they are considered to be of poor quality, especially throughout the 1990s for the following reasons:

- non-reporting by industrial purse seiners and longliners (NEI)
- uncertain data from significant fleets of industrial purse seiners from Iran and longliners from India, Indonesia, Taiwan,China (fresh tuna) and Philippines.

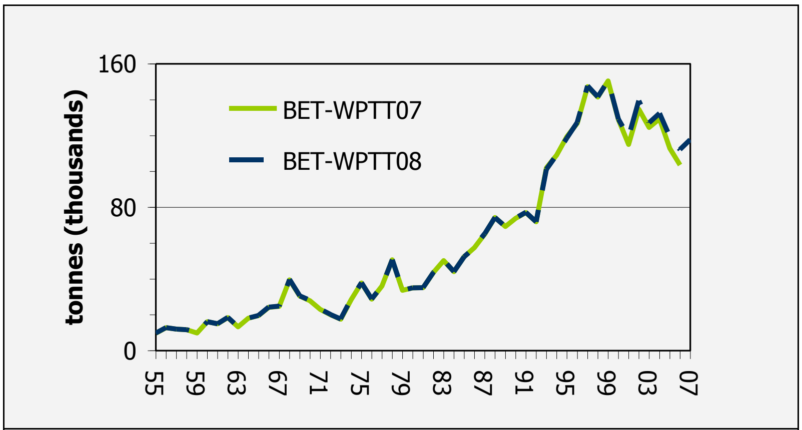


Figure 2: Bigeye tuna: Catches used by the WPTT in 2007 *versus* those estimated for the WPTT08 (1958-2007)

Trends in average weight can be assessed for several industrial fisheries although they are incomplete or of poor quality for most fisheries before the mid-1980s and in recent years (for the above fleets plus longliners from South Korea and Seychelles).

Catch-at-Size(Age) table: Estimates are uncertain for some years and some fisheries (Figure 3) due to:

- the paucity of size data available from industrial longliners before the mid-60s, from the early-1970s up to the mid-1980s and in 2007
- the paucity of catch by area data available for some industrial fleets (NEI, India, Indonesia, Iran)

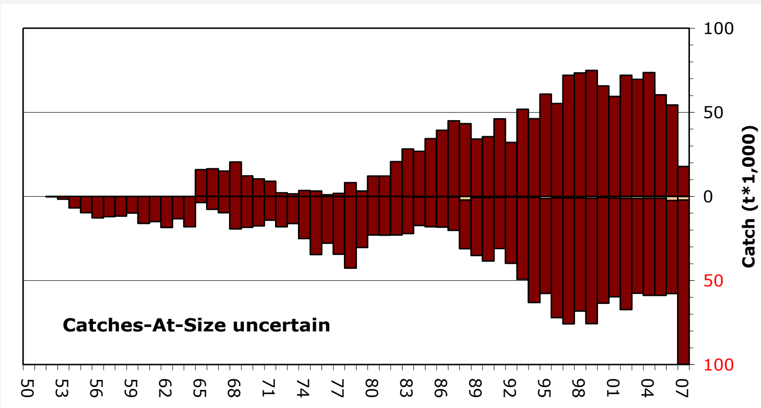


Figure 3. Uncertainty of catch at size data for bigeye tuna. The amount below the zero-line indicates the amount of catch for which the estimated catch at size has been categorised as uncertain according to the criteria given in the text. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets. Data as of October 2008

2.2 Skipjack tuna (SKJ)

Retained catches are generally well known for the industrial fisheries but are less certain for many artisanal fisheries (Figure 4), notably because:

- catches are not being reported by species
- there is uncertainty about the catches from some significant fleets including the Sri Lankan gillnet/longline fishery and the industrial purse seiners from Iran.

Discard levels are believed to be low although they are unknown for most industrial fisheries, notably industrial purse seiners. Information on discards for the European purse seine tuna fishery for the period 2003 to 2007 is now available (IOTC-2008-WPEB-12) and this may assist in the estimation of current discard levels for this fleet.

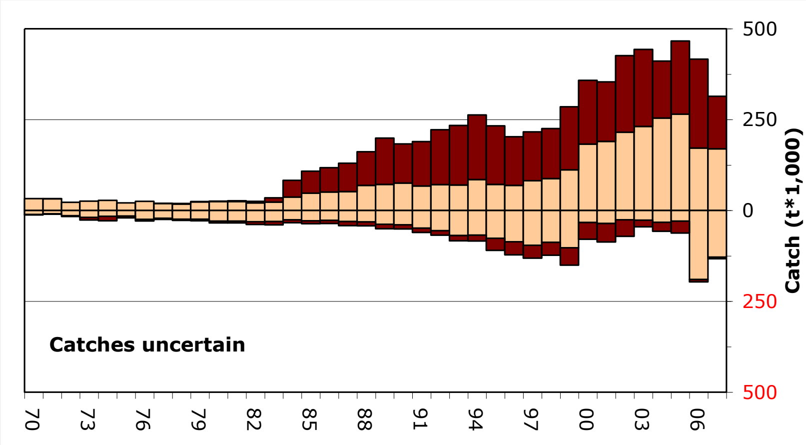


Figure 4. Uncertainty of annual catch estimates for skipjack tuna. The amount of the catch below the zero-line has been categorised as uncertain according to the criteria given in the text. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets. Data as of October 2008

Changes to the catch series: There have been no major changes to the catches of skipjack tuna since the WPTT in 2007 (Figure 5).

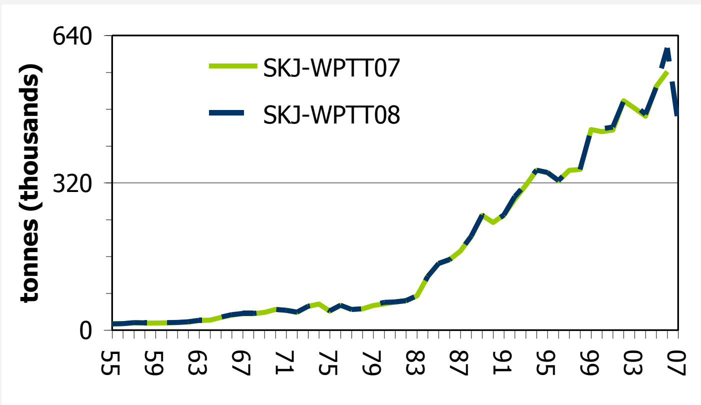


Figure 5: Skipjack tuna: Catches used by the WPTT in 2007 *versus* those estimated for the WPTT08 (1958-2007)

CPUE Series: Catch and effort data are available from various industrial and artisanal fisheries. However, these data are not available from the major artisanal fisheries or they are considered to be of poor quality for the following reasons:

- almost no data are available for the artisanal fisheries of Indonesia
- the poor quality effort data for the significant gillnet/longline fishery of Sri Lanka (for years before 2005)
- no data are available for the significant pole and line fishery of Maldives in recent years; however, nominal catch and effort data was made available during the meeting to derive CPUE's.

Trends in average weight cannot be assessed before the mid-1980s and are incomplete for most artisanal fisheries thereinafter, namely hand lines, troll lines, many gillnet fisheries (Indonesia) and the pole and line fishery of Maldives in recent years.

Catch-at-Size(Age) table: CAS and CAA are available but the estimates are uncertain for some years and fisheries due to (Figure 6):

- the lack of size data before the mid-1980s
- the paucity of size data available for some artisanal fisheries, notably most hand lines and troll lines, many gillnet fisheries (Indonesia) and the pole and line fishery of Maldives in recent years
- the lack of biological information and length-age keys for the Indian Ocean.

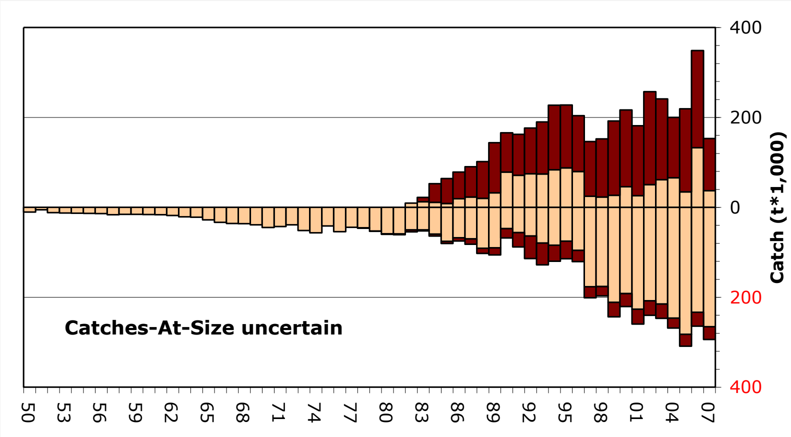


Figure 6. Uncertainty of catch at size data for skipjack tuna. The amount below the zero-line indicates the amount of catch for which the estimated catch at size has been categorised as uncertain according to the criteria given in the text. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets. Data as of October 2008

2.3 Yellowfin tuna (YFT)

Retained catches are generally well known (Figure 7); however, catches are less certain for:

- many artisanal fisheries, notably those from Indonesia, Sri Lanka, Yemen and Comoros
- non-reporting industrial purse seiners and longliners (NEI), longliners of India and purse seiners of Iran.

Discard levels are believed to be low although they are unknown for most industrial fisheries, notably industrial purse seiners. Information on discards for the European purse seine tuna fishery for the period 2003 to 2007 is now available (IOTC-2008-WPEB-12) and this may assist in the estimation of current discard levels for this fleet.

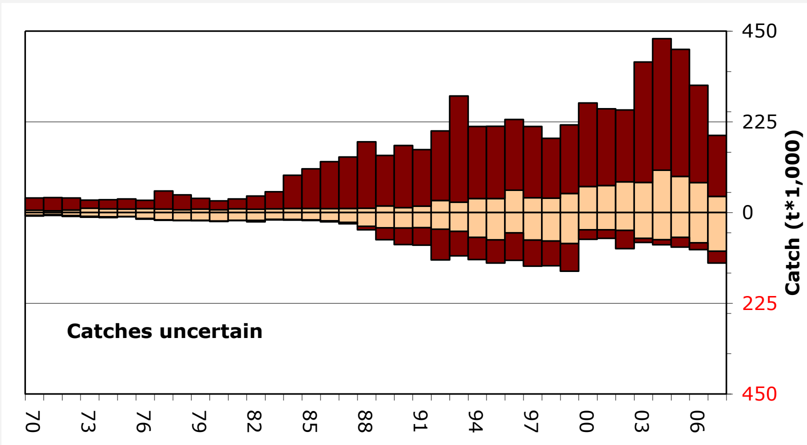


Figure 7. Uncertainty of annual catch estimates for yellowfin tuna. The amount of the catch below the zero-line has been categorised as uncertain according to the criteria given in the text. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets. Data as of October 2008

Changes to the catch series: There have not been significant changes to the catches of yellowfin tuna since the WPTT in 2007 (Figure 8).

CPUE Series: Catch and effort data are available from the major industrial and artisanal fisheries. However, these data are are not available for some important artisanal fisheries or they are considered to be of poor quality for the following reasons:

- poor quality effort data for the gillnet/longline fishery of Sri Lanka
- no data are available for the artisanal fisheries of Indonesia, Yemen and Comoros
- no data are available for the pole and line fishery of Maldives in recent years.

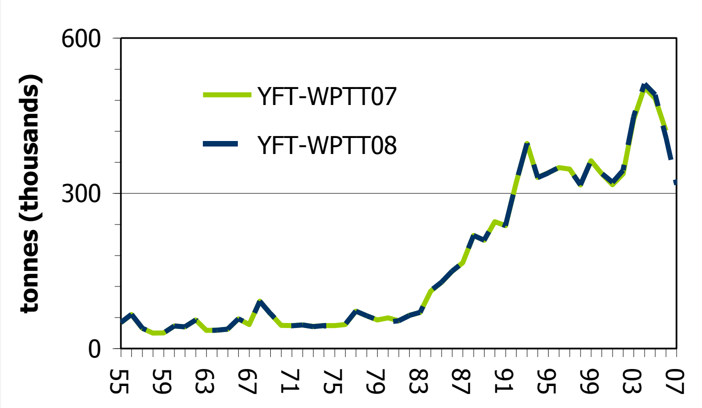


Figure 8. Yellowfin tuna: Catches used by the WPTT in 2007 versus those estimated for the WPTT08 (1958-2007)

Trends in average weight can be assessed for several industrial fisheries but they are very incomplete or of poor quality for some artisanal gears, namely hand lines, troll lines, many gillnet fisheries (Yemen, Oman, Indonesia) and the pole and line fishery of Maldives in recent years.

Catch-at-Size(Age) table: This is available although the estimates are more uncertain in some years and some fisheries (Figure 9) due to:

- size data not being available for most artisanal fisheries, notably Yemen and Indonesia (lines and gillnets), Comoros (lines) and Maldives (pole and lines) in recent years
- the paucity of size data available from industrial longliners from the late-1960s up to the mid-1980s
- the paucity of catch by area data available for some industrial fleets (NEI, Iran, India).

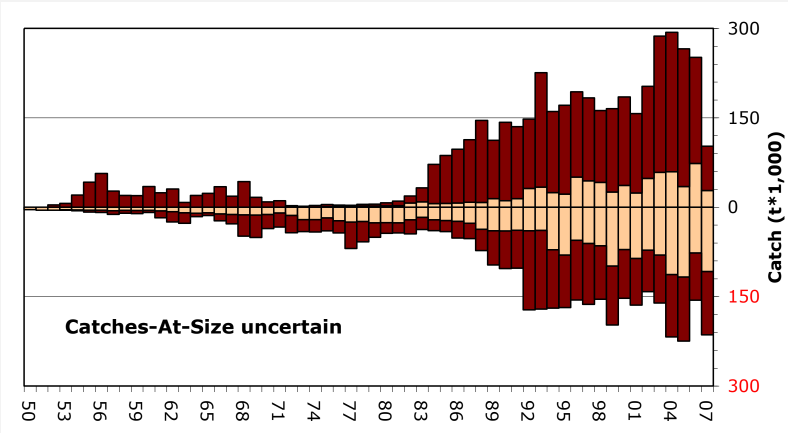


Figure 9. Uncertainty of catch at size data for yellowfin tuna. The amount below the zero-line indicates the amount of catch for which the estimated catch at size has been categorised as uncertain according to the criteria given in the text. Light bars represent data for artisanal fleets and dark bars represent data for industrial fleets. Data as of October 2008

2.4 Recommendations to improve the data available to IOTC

5. The following list of recommendations was supported by the WPTT to improve the data available to IOTC (Table 1). The recommendations include actions that if undertaken, would lead to a marked improvement in the standing of the data currently available at the Secretariat. Some of these recommendations are made over and above the existing obligations and technical specifications relating to the reporting of data.

Table 1. Recommendations to improve the data available to IOTC

1.To improve the certainty of catch and effort data available for artisanal fisheries:

- Yemen, Comoros and Madagascar implement fisheries statistical collection and reporting systems.
- Sri Lanka strengthen its data collection systems with an emphasis on providing data by species and gear.
- Maldives, Iran and Pakistan provide catch and effort data for their artisanal fisheries, notably gillnets, pole and lines and handlines.
- Countries having emerging hand line fisheries, notably Maldives, Sri Lanka and Indonesia, make the necessary arrangements to collect and provide statistics for those fisheries.
- Countries having fisheries likely to catch significant amounts of bigeye tuna, notably Maldives, Indonesia and Sri Lanka make the necessary arrangements to ensure that the catches estimated for this species are sufficiently precise.
- Fisheries data collection agencies in each country, notably those in India and Sri Lanka, collaborate to produce one consistent set of catch statistics.
- Countries increasing sampling coverage to obtain acceptable levels of precision in their catch and effort statistics.

2.To improve the certainty of catch and effort data available for industrial fisheries:

- Indonesia and Malaysia collect catch and effort information for their fresh tuna and/or deep-freezing longline fleets, including those not based in Indonesia
- Taiwan,China collect and provide catch and effort data for their fresh tuna longline fleets.
- India collect and provide catch and effort data for its longline fleet.
- Iran report catch and effort data for its industrial purse seine fleet.
- Countries having industrial fleets ensure that log book coverage is appropriate to produce acceptable levels of precision in their catch and effort statistics.
- Countries having industrial fleets implement or increase coverage of existing Vessel Monitoring Systems in order to be able to validate data collected through logbooks.
- Countries having industrial fleets increase observer coverage to produce acceptable levels of precision in their estimates of bycatch and discard levels.
- Countries having industrial fleets provide estimates of discard levels of tropical tuna species.
- Countries having industrial fleets provide information on the activities of vessels presumed to be from non-reporting fleets.

3.To increase the amount of size data available to the Secretariat:

- Pakistan, Comoros, Indonesia and Yemen collect and provide size data for tropical tunas taken by artisanal fisheries, especially gillnet, handline and troll fisheries.
- India provide its size data available for tropical tunas.
- Maldives provide size frequency data by gear
- Thailand and Iran collect and provide size data for their industrial purse seine fleets
- Taiwan,China collect and provide size data from their fresh tuna longliners.
- Indonesia and Malaysia collect and provide size data for their longline vessels based in other countries
- China, Oman, Philippines, Seychelles and South Korea provide size data from their longline fleets.
- Japan increase size sampling coverage of its longline fleet.
- Countries catching significant amounts of tropical tunas review their existing sampling schemes to ascertain that the data collected are representative of their fisheries.

4.To reduce uncertainty in biological parameters important for the assessment of tropical tuna species:

- Conversion relationships: Countries catching significant amounts of tropical tunas providing the basic data that would be used to establish length-weight keys, non-standard measurements-fork length keys, processed weight-live weight keys for these species.
- Countries collecting biological information on tropical tunas caught in their fisheries, preferably through observer programmes, and providing this information (including the raw data where possible) to the Secretariat.

6. The WPTT was informed about a statistical analysis presented by SPC scientists to the WCPFC Scientific Committee (in August 2008) that indicated that the results of species and size sampling carried out on purse seine catches in the Pacific Ocean since the early 1980's may be biased due to factors such as pre sorting of tunas, structural grab sampling and/or heterogeneity of size composition in small and large schools. While it is not known whether these biases exist in the data obtained from the Indian Ocean, the WPTT agreed that this matter should be investigated.

7. To this end, and given the global nature of the matter, the WPTT recommended that an international working group be organized in 2009 to bring together scientists working in the Atlantic, Indian, Eastern and Western Pacific oceans in order to examine the issues of potential biases in the current purse seine sampling programmes and where necessary identify ways to improve the multispecies sampling schemes.

2.5 Progress achieved on the data related recommendations outstanding from past WPTT meetings

Further collaboration with Yemen (such as that proposed by the IOTC-OFCF project) to improve the quality of fisheries information

8. Despite several visits to Yemen since April 2007, a Memorandum of Understanding and Terms of Reference for the activities to be carried out by the Marine and Biological Research Authority with the support of the IOTC-OFCF Project has not been fully agreed among the parties to date.

9. To expedite work, the IOTC-OFCF Project will be proposing a phased approach, the first phase involving simply the collection of historical data from the MFW (numbers of fish unloaded and numbers of boats operated per month and landing place), cooperatives (fish size categories) and canning factories(size categories). A Second Phase, if the first proves successful, would involve the implementation of sampling in various locations of the Yemen coast. A trip to Yemen has been scheduled for December 2008 and the activities will be initiated as soon as the MFW agrees with the above plan.

10. Using information collected in previous trips to Yemen the Secretariat estimated in 2008 (for the first time) annual catches and effort per month and Province for the period 2003-07. The catches of yellowfin tuna show a strong seasonality with high catches during the winter months and usually low catches from May-June to September-October.

Regular analysis and reporting of the results of biological sampling programmes undertaken at tuna canneries

11. To-date, the Secretariat has not received any new information relating to the above recommendation.

Recognising that the best opportunities for obtaining accurate fisheries data are likely to come from observer programmes, the WPTT strongly encourages the expansion and implementation of new observer programmes in the Indian Ocean. Furthermore, like the WPEB, the WPTT strongly recommended that a high level of regional coordination be provided by the Commission covering data collection, data exchange, training and the development of guidelines for the operational aspects of such programmes

12. The Secretariat attended during 2008 to a meeting in Indonesia that included results from three observer programmes currently ongoing in this country. The Secretariat is involved in the coordination of observer activities in this country. The Secretariat will be also providing training to staff from the Directorate General for Capture Fisheries and the Research Centre for Capture Fisheries on the implementation of a logbook system to monitor the activities of longliners and other fleets from Indonesia.

3. New information on the fisheries, biology, ecology and oceanology relating to tropical tunas

3.1 Bigeye tuna

3.1.1 Latest statistics on the bigeye tuna fisheries from the IOTC databases (from IOTC-2008-WPTT-03, IOTC-2008-WPTT-INF05)

13. Bigeye tuna is mainly caught by industrial longline and purse seine fisheries (Figure 10). Total annual catches averaged 121,700 t over the period 2003 to 2007. The 2006 catch was 112,100 t and the provisional 2007 catch stands at 117,900 t. The location of the fishery has changed little since 1990. Bigeye tuna is fished throughout the Indian Ocean, with the majority of the catch being taken in western equatorial waters (Figure 11).

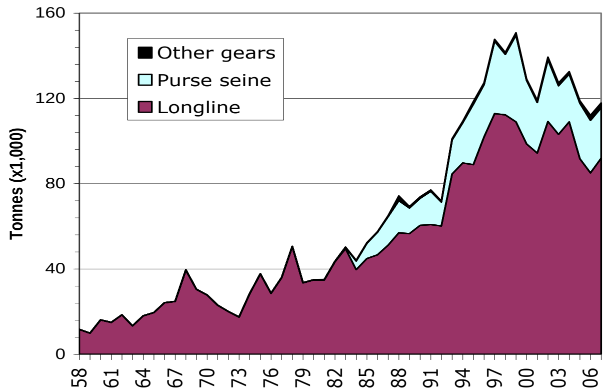
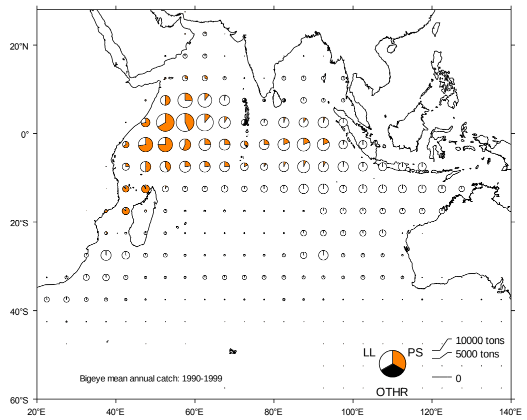
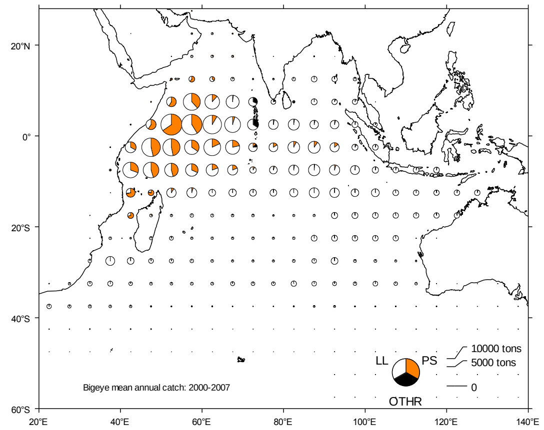


Figure 10. Annual catches of bigeye tuna by gear from 1958 to 2007.

1990-1999

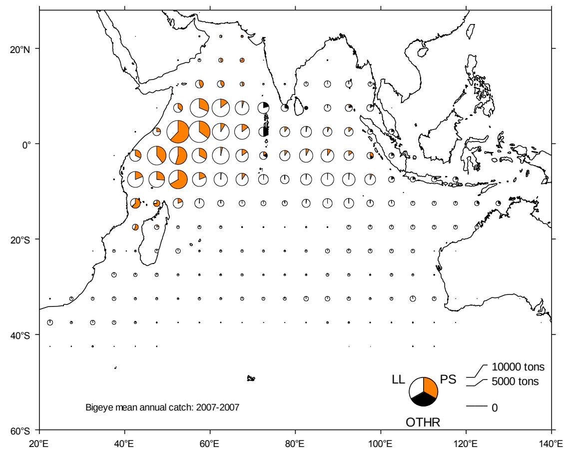


2000-2007



2007

Figure 11. Mean of annual total catches of bigeye tuna by longline and purse seine vessels operating in the Indian Ocean over the period 1990-1999, 2000-2007 and 2007. PS = purse seine, LL = longline.



3.1.2 STATUS OF BIGEYE TUNA PURSE SEINE STATISTICS (IOTC-2008-WPTT-05, 06, 07)

14. Over 75% of purse seine bigeye catches are taken in log-schools along with skipjack and yellowfin tuna. Catches increased since the beginning of the fishery, peaked at over 30,000 t from 1997 to 1999 and then stabilized at around 20,000 t (Figure 12).

15. Catch per unit effort (expressed as tonnes per searching days) follows the catch variations on log schools, while remaining stable on free schools. Catch per set does not show any trend. In general catch rates were found to be difficult to interpret.

16. The mean weight of bigeye tuna in the purse-seine fishery reflects mainly the log school catches, and remains very stable around 6kg (Figure 13). By contrast, free schools sets exhibit large variations, remaining high (over 30 kg) these last years. It was noted that this could be due to sampling procedures, and/or from highly variable proportions of small and large bigeye in the catch, and so results should be interpreted with some caution.

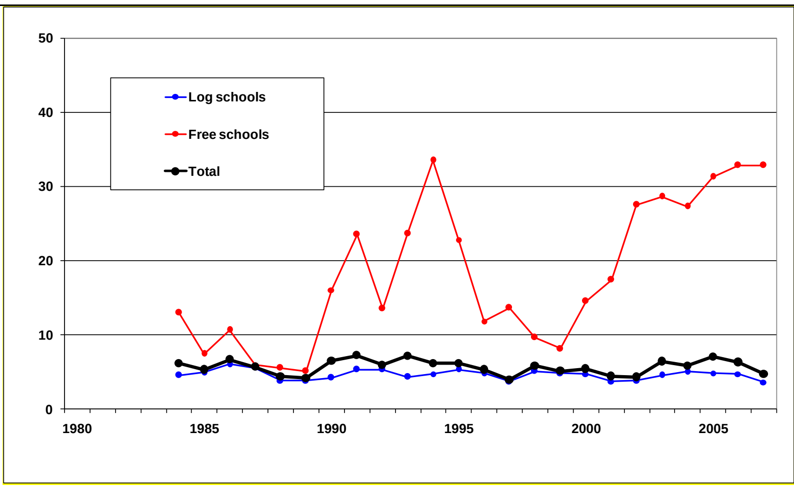


Figure 12. Mean weight of bigeye tuna attributed to purse seine fishing on free schools and logs

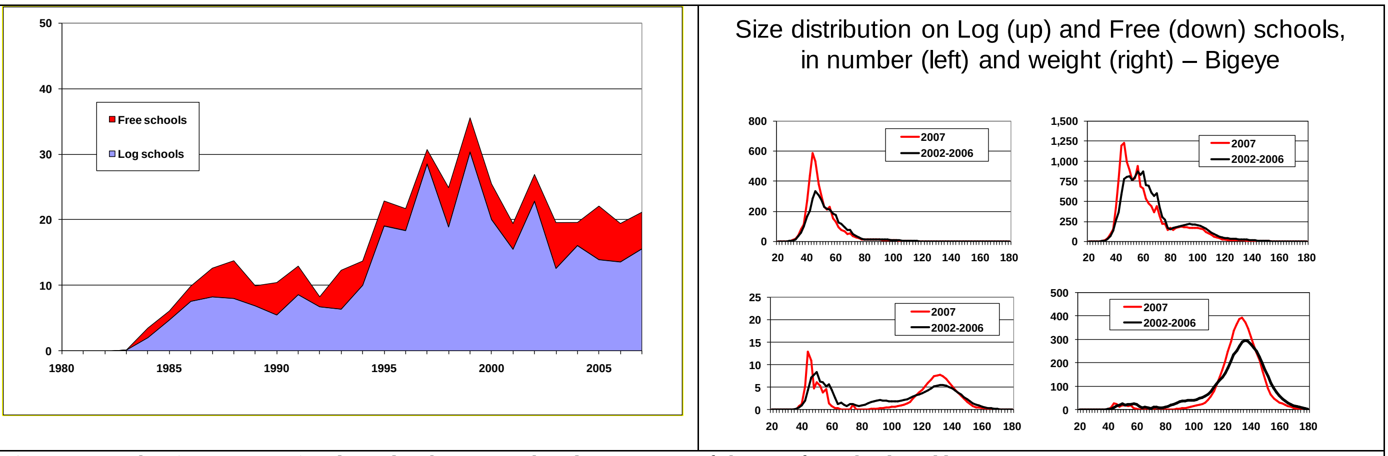


Figure 13. Catches (tonnes x 1000) and size distributions attributed to purse seine fishing on free schools and logs.

3.2 Yellowfin tuna fisheries statistics

3.2.1 LATEST STATISTICS ON THE YELLOWFIN TUNA FISHERIES FROM THE IOTC DATABASES (FROM IOTC-2008-WPTT-03, IOTC-2008-WPTT-INF05)

17. Yellowfin tuna is mainly caught by purse seine, longline and gillnet fisheries but also by handline and pole and line fleets (Figure 14). Total annual catches averaged 434,800 t over the period 2003 to 2007. Total catches peaked at 447,700 t in 2003, 511,200 t in 2004 and 490,400 t in 2005 before decreasing to 407,000 t in 2006. Catches in 2007 were 316,700 t and it appears that the catches have returned to pre 2003 levels. The location of the fishery has changed little since 1990. Yellowfin tuna is fished throughout the Indian Ocean, with the majority of the catches being taken in western equatorial waters (Figure 15). The location and relative magnitude of the extraordinary high catches made in 2003 to 2005 is also shown.

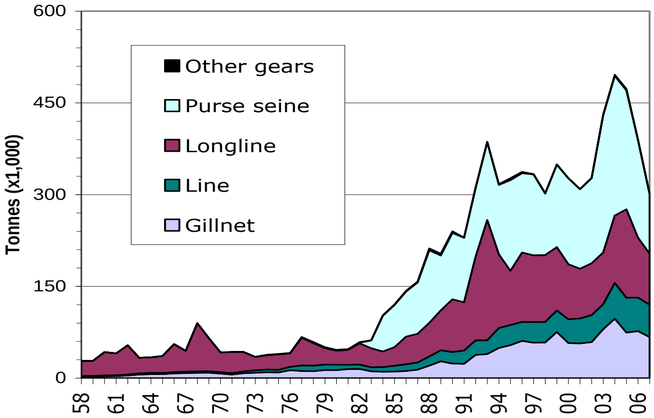
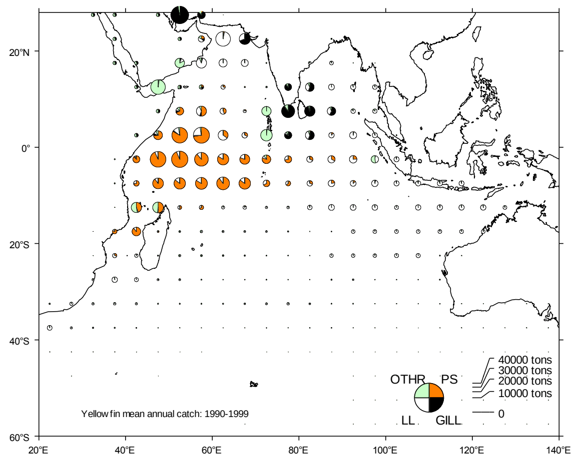
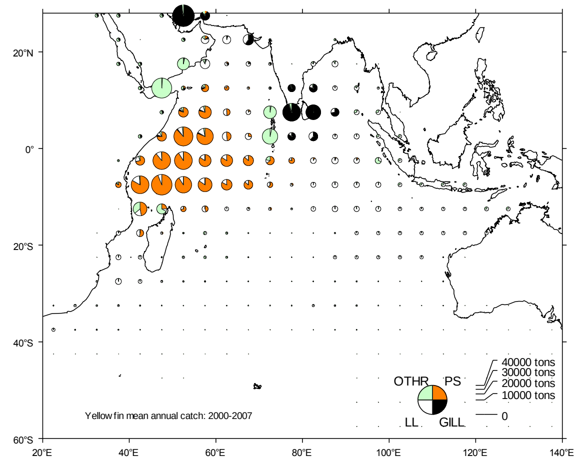


Figure 14: *annual catches of yellowfin tuna by gear from 1958 to 2007.*

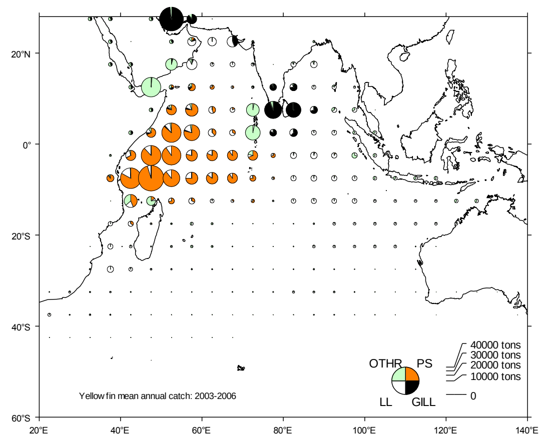
1990-1999



2000-2007



2003-2006



2007

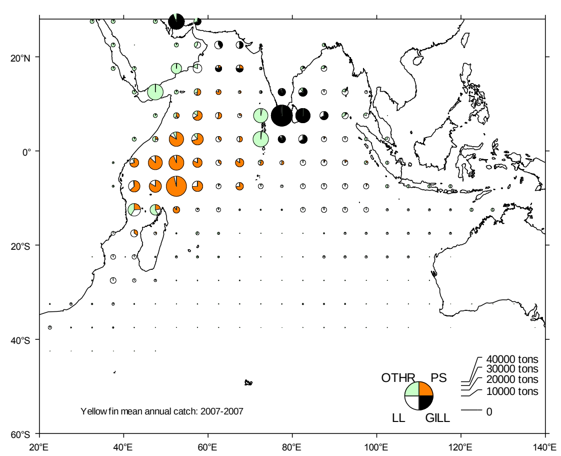


Figure 15: *location and size of yellowfin tuna catches in the Indian Ocean by gear type for 1990-99, 2000-07, 2003-2006, and 2007). GILL = gillnet, LL = longline, PS = purse seine.*

3.2.2 STATUS OF YELLOWFIN TUNA PURSE SEINE STATISTICS (IOTC-2008-WPTT-05, 06, 07)

18. Over 40% of purse seine yellowfin catches are taken in log-schools along with skipjack and bigeye tuna. Catches increased since the beginning of the fishery, peaked over 200,000 t in 2004 decreasing sharply thereafter to 100,000 t in 2007 (Figure 16).

19. Catch per unit effort (expressed as tons per searching days) follows the catch variations on free schools, while remaining stable for log schools (around 3.2 t/search day up to 1994, around 5.5 t/sd over the period 1995 to 2006, before falling back to the previous low levels in 2007 of 2.7 t /sd. Catch per positive set remained stable at 10 t on logs and 25 t on free schools, except for the high values for 2002-2005 (Figure 17).

20. Mean weight (for all yellowfin tuna caught by purse seiners) fluctuated between 10-20 kg until 1996, and since then has been between 6-15 kg. Mean weight has remained stable for log caught yellowfin (4-10 kg), with relatively lower levels (4-6 kg) since 1996. Mean weight fluctuates more widely for free school yellowfin (15-32 kg), but it has been relatively stable at high levels since 2002 (35-40 kg) (Figure 18). The observed size distributions in 2007 are similar to those over the period 2002-2006, but they are at lower levels (Figure 19). .

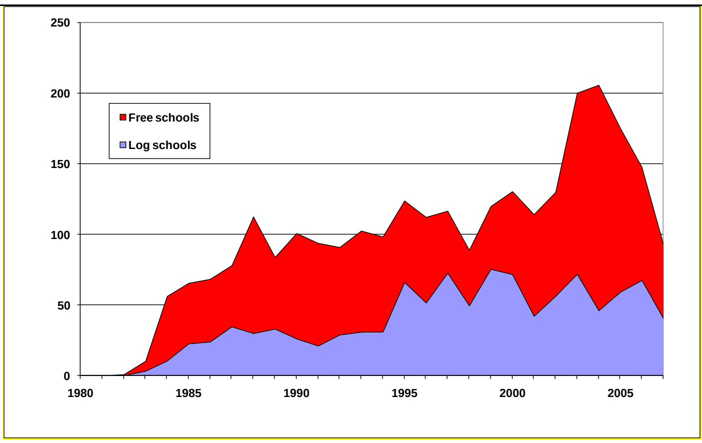


Figure 16. Catches (tonnes x 1000) of yellowfin attributed to purse seine fishing on free schools and logs

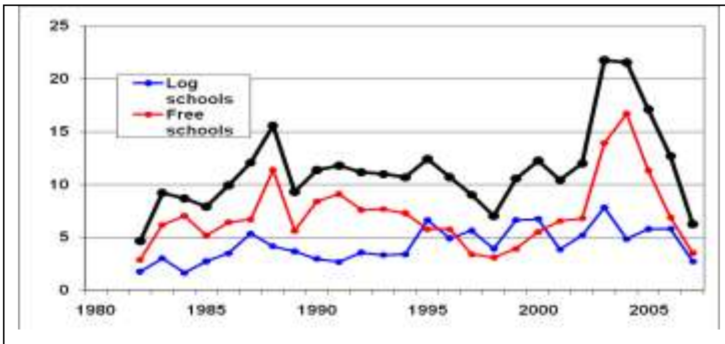


Figure 17.. Catch rates (tonnes per searching day) of yellowfin tuna attributed to purse seine fishing on free schools and logs

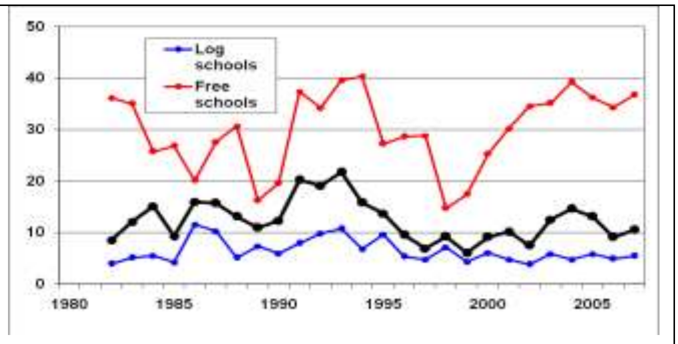


Figure 18.. Mean weight (kg) of yellowfin tuna attributed to purse seine fishing on free schools and logs

Size distribution on Log (up) and Free (down) schools, in number (left) and weight (right) – Yellowfin

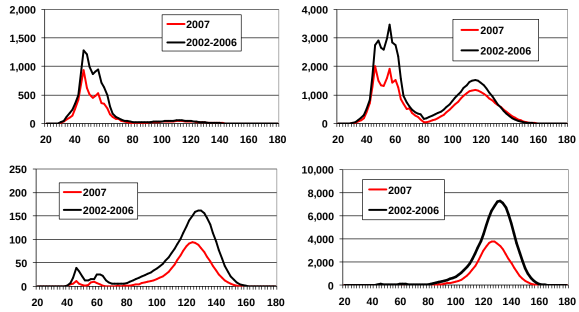


Figure 19. Size and weight distributions of yellowfin attributed to purse seine fishing on free schools and logs.

3.2.3 *Developments in Yellowfin Tuna Fishery of Maldives (IOTC-2008-WPTT-29)*

21. Yellowfin tuna (*Thunnus albacares*) is the second most important species caught in the Maldives. Reported annual catches are currently around 25,000 t (Figure 20a) which represents 16% of total tuna landings in Maldives. Yellowfin tuna is caught from pole-and-line, handline and longline gears with lesser amounts caught using trolling gear. The pole-and-line fishery currently contributes 60% of the total reported catch (by weight) and mainly catches juveniles between 30-60 cm (FL) (Figure 20b) taken from surface mixed schools of skipjack, yellowfin and bigeye tuna. This fishery operates around anchored-FADs located within 12-15 miles from the atoll reef. A network of over 40 FADs is now regularly maintained by the Ministry of Fisheries, Agriculture and Marine Resources. A small proportion of bigeye tuna (*T. obesus*) is also caught along with yellowfin and skipjack. Bigeye is not reported separately in Maldives. Estimates show that 5% of the yellowfin tuna reported in Maldives will be bigeye tuna.

22. An important segment of the yellowfin fishery is the handline fishery which targets large yellowfin tuna (> 100 cm) (Figure 20b). The developments this fishery are driven by the export demand and investments in fresh-packing and processing facilities. Recent export figures shows about 7,500 t of fresh yellowfin (whole, gill and gutted, head and gutted, loins, fillets, belly cuttings, etc) were exported. However, reported catches from handline fishery were 6,500 t (16%), much less than declared weight at customs authority. Handline fishing is done in large (> 25+m) pole-and-line vessels with exception that they carry ice boxes (10-15 t capacity). Regular handline with hooked livebait (often scads) are commonly used method. Records show that over 90% of the catches are from dolphin associated schools. A fishing trip often lasts about seven days and catch is landed at packing/processing facilities located close to Malé area.

23. Yellowfin tuna is also caught in the Maldives by the longline fishery. This fishery operates in the EEZ (beyond 75 miles) and is carried out by foreign vessels under a license agreement between government authorities. They are under a VMS maintained at Coast Guard Centre. Maldivians have made few attempts in operating longline vessels but have failed, thus longline fishing is done entirely by foreigners. The vessels are about 50-60 GT (18-22 m LOA). Records shows about 20-30 vessels operated in recent years. During 2007 many left due to poor fishing and rising fuel prices. The reported catches from longline fishery are just over 3,000 t in the recent years representing about 12% of the total yellowfin catch. The catches comprise yellowfin (71 %) and bigeye (23%) (Figure 20c). The processing and export opportunities in Maldives had meant that many vessels now land their catch in Maldives.

24. Fishing effort is poorly reported in the Maldives. It is reported in “number of days of fishing”. While this may be appropriate for the pole-and-line fishery which continues to be a “day-trip” it is becoming problematic for the handline fishery. Catch reported by the handline gear are of multi-day fishing which may be caught from more than one locality. Their catch is stored in large ice boxes and landed to packing facilities close to Malé. Catch location (i.e., atoll) from handline fishery is complicated as most, if not all, their catch is reported as Malé catches. This has resulted in very high catches of yellowfin tuna being reported in Kaafu Atoll (Malé area).

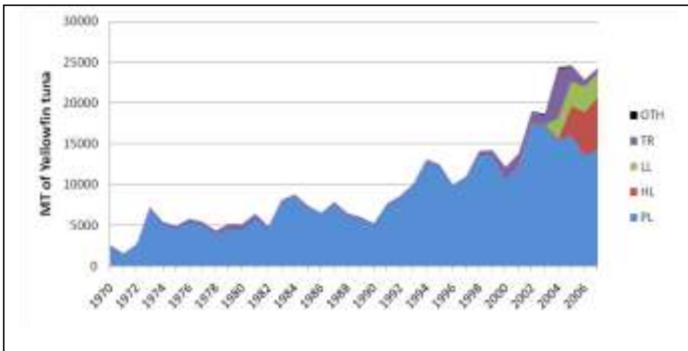


Figure 20a. Catches of yellowfin tuna in the Maldives by gear

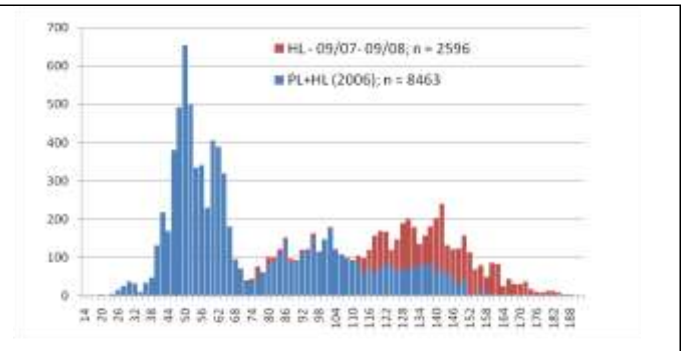


Figure 20b. Size composition of yellowfin catches in the Maldives.

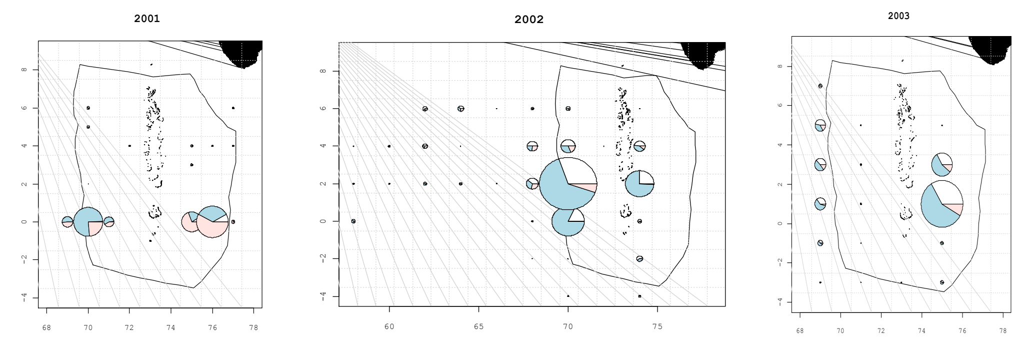


Figure 20c. Relative longline catches in the Maldives 2001-2003 by species (blue = yellowfin, pink = bigeye, white = other.

3.3 Skipjack

3.3.1 Latest statistics on the skipkjack tuna fisheries from the IOTC databases (IOTC-2008-WPTT-03, IOTC-2008-WPTT-INF05)

25. Skipjack tuna is mainly caught by purse seine, gillnet and baitboat —using pole and line (Figure 21). Total annual catches averaged 509,000 t over the period 2003 to 2007 and are increasing. The 2006 catch jumped to 612,900 t while the provisional catch estimate for 2007 stands at 447,100 t. The location of the fishery has changed little since 1990 (Figure 22). Skipjack tuna is fished throughout the equatorial waters of the Indian Ocean with the majority of the catch being taken in western areas.

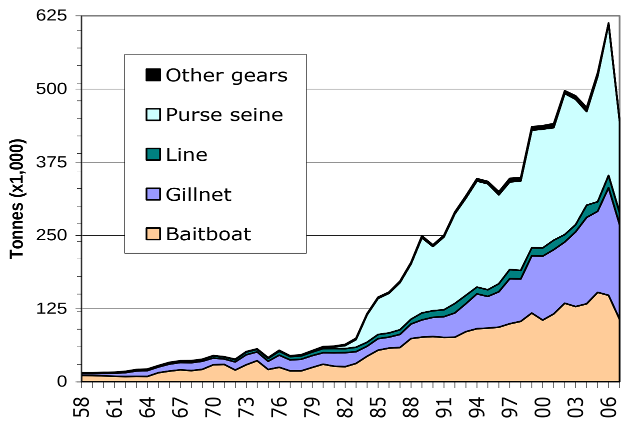
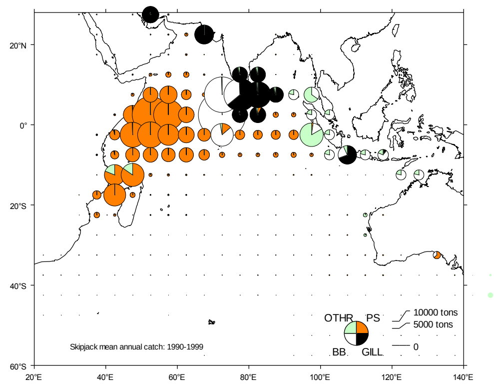
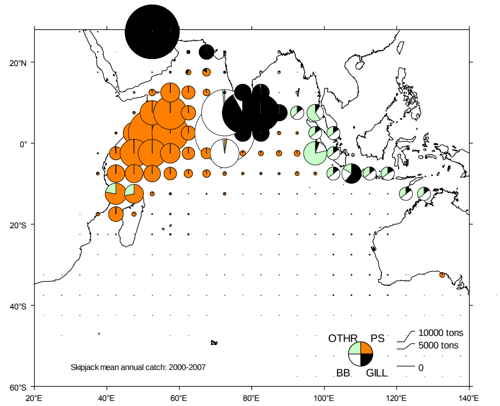


Figure 21: *annual catches of skipjack tuna by gear from 1958 to 2007.*

1990-1999



2000-2007



2007

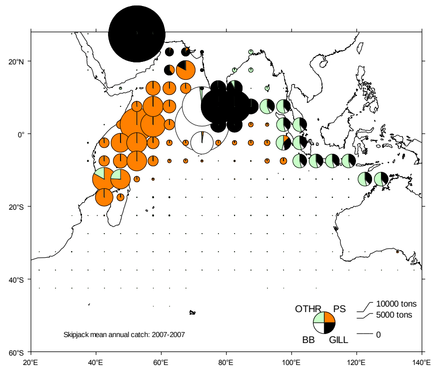


Figure 22: mean catches of skipjack tuna in the Indian Ocean by gear type, 1990-1999 and 2000-2005. BB = bait boat (pole and line); GILL = gillnet; LL = longline; PS = purse seine.

3.3.2 Status of Skipjack Tuna Purse Seine Statistics (IOTC-2008-WPTT-05, 06, 07)

26. Over 80% of the purse seine skipjack catches from EC fleets from log schools. Catches in 2007 (132,300 t) were low relative to those in 2005 and 2006 catch (193,000 to 220,000 t), and the lowest since 1998 (Figure 23).

27. While annual catch rates (expressed as tonnes per searching day) on free schools of skipjack tuna have been relatively stable over time, catch rates on log schools increased steadily up to 2002, fluctuated over the period2003 to 2006 then) and dropped markedly in 2007 to a level not seen since the mid 1980's (Figure 24).. The higher catch rates in 2003-2006 coincided with the presence of favourable environmental conditions for tunas in the surface layer (IOTC-2008-WPTT-27).

28. The mean weight of the skipjack in the catches reflects mainly the catches from log school (Figure 25). The mean weight from log school tuna has varied between 2.4 and 3.0 kg since the 1990's. Changes in mean weight may be attributed to high demand in the skipjack market that leads to smaller-sized skipjack being retained, or changes in the location in the fishing grounds (e.g. such as that experienced recently when vessels avoided certain areas close to the coast of Somalia for security reasons. By contrast with yellowfin and bigeye, there is little difference between the sizes of skipjack tunas caught on logs and free schools (Figure 26).

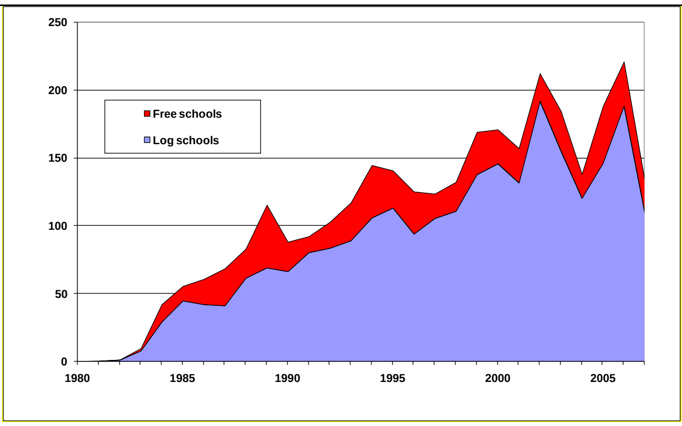


Figure 23. Catches (tonnes x 1000)of skipjack tuna attributed to purse seine fishing on free schools and logs

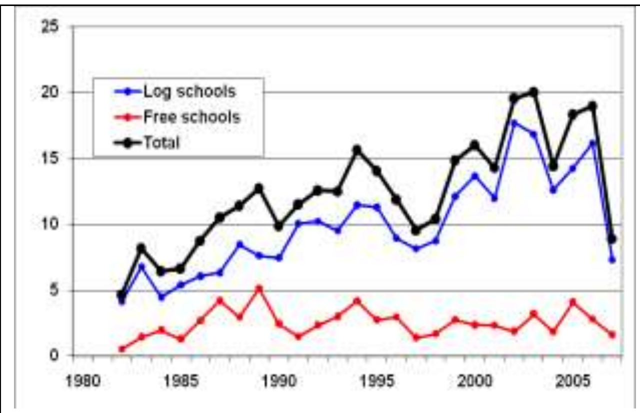


Figure 24. Catch rates for skipjack (tonnes per search day) attributed to purse seine fishing on free schools and logs

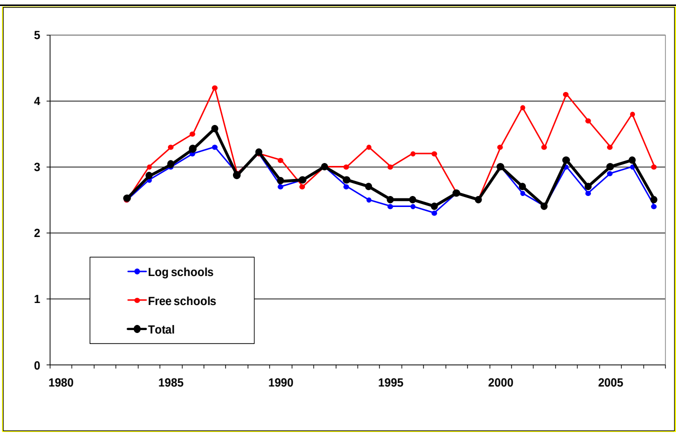


Figure 25. Mean weight (kg) of skipjack tuna attributed to purse seine fishing on free schools and logs.

Size distribution on Log (up) and Free (down) schools, in number (left) and weight (right) – Skipjack

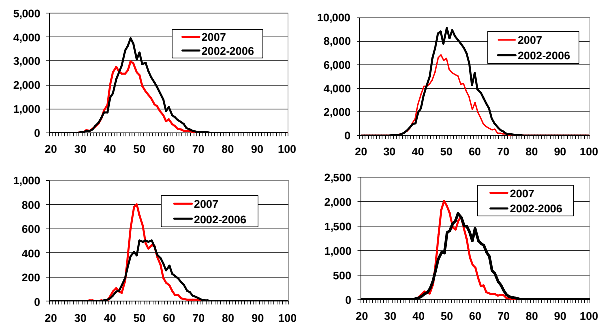


Figure 26. Size and weight distributions of skipjack weight of skipjack tuna caught by purse seiners on free schools and logs.

3.4 Papers presented

3.4.1 Fisheries

Tunas Unloading in Phuket, Thailand during 1995-2007 (IOTC-2008-WPTT-17)

29. Since the industrial purse seine and longline vessels started to land tunas at Phuket fishing port in 1993 the port has developed, as has the collection of catch, effort and CPUE and biological data. For longliners, port-sampling was conducted monthly including collecting landing catch (t), effort (number of trips), a random sample of fish is weighed and measured. For purse seiners, the fishing masters are interviewed as well and logbook are used to acquire the data of catch (t), effort (number of operating sets), fishing ground and etc. Samples of fish are weighed and measured.

30. With respect to fresh tuna longliners, fishing effort increased steadily from 187 trips in 1995 to 883 trips in 1999, since then the numbers of trips has fluctuated with 494 trips in 2007. Total landings have increased from 1,415 t in 1995 to 6,477 t in 2007. The main species landed were yellowfin tuna, bigeye tuna, bill fish (Makaira spp., *Tetrapturus* spp, *Istiophorus* spp.) and swordfish. Sharks contributed 3% of the total landing during 1995 to 2007. In 2007, the total landings of yellowfin tuna, bigeye tuna, billfish and swordfish 4,413 t, 748 t, 533 t and 103 t, respectively. Six Japanese tuna purse seiners have landed fish in Phuket during the last six years.

31. The WPPT agreed that given the level of long line landings, extra effort should be made to obtain RTTP-IO tags in Phuket.

Analysis of tuna catches and CPUEs by Purse Seiners fishing in the Western Indian Ocean over the period January to July 2008 (IOTC-2008-WPTT-20).

32. An update on the most recent data from the purse seine fleet were presented in document IOTC-2008-WPTT-20. Catch and CPUE series for the first seven months of 2008 showed a recovery of yellowfin catches to pre-2003

levels, in contrast with the very low catches registered in 2007 (Figure 27), although some changes have been observed on the length structure of the catch. Skipjack catches, however, have been at a record low during this part of 2008, probably due to the decrease in the numbers of vessels taking part in the fishery and the limitation to fishing in the area close to the coast of Somalia. It was also noted than bigeye catches on free schools were much larger than usual.

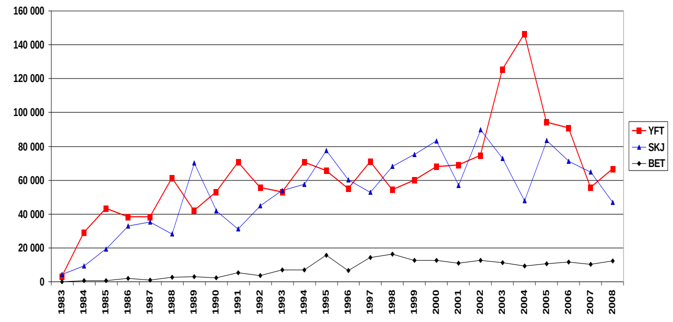


Figure 27. Nominal catches (t) of tropical tunas during the months January to July over the period 1984 to 2008

Target strength of Bigeye, Yellowfin and Skipjack measured by split beam echo sounder in a cage (IOTC-2008-WPTT-22)

33. Catch of juvenile bigeye and yellowfin by purse-seine FADs operations is considered to be harmful for the stock. Practical methods to reduce the proportion of juvenile tuna in catches are needed. One of the potential solutions for the problem is acoustic estimation of size and species of the fish gathering around FADs. Provided that the composition of schools can be predicted, it would be possible to avoid fishing schools with high proportions of juvenile bigeye. Target Strength (TS) is a basic parameter in fisheries acoustics. For a given species, TS is considered to be a function of size. TS also varies among species. The results indicate that TS is strongest for bigeye > Yellowfin > Skipjack. High variance of TS was observed when fish moved up and down the water column, especially for bigeye and yellowfin. This can be explained by "back-scattering pattern". The swimming pattern of a fish has a large influence on TS distribution of the fish. In order to achieve the goal of acoustic estimation of fish species and size, variance needs to be reduced. Further analysis is also required to determine the relationship between tilt angle and TS for each species.

Effect of mesh size on the size distribution of bigeye, yellowfin and skipjack caught by purse-seiners in the eastern Indian Ocean (IOTC-2008-WPTT-23)

34. Catches of juvenile bigeye and yellowfin by purse-seine FADs operations could be harmful for the stock. Practical methods to reduce the proportion of juvenile tuna in the catch are needed. Using nets with larger mesh size could be a solution to this problem. The size distributions of fish caught with nets of different mesh size were compared. Larger mesh size seemed to have limited effect on reducing juvenile catch by purse-seine. It appears that size selectivity of purse-seine net is influenced by many factors other than mesh size, e.g. movement of the net during haul, current etc. Thus our preliminary conclusion is that using larger mesh alone might not reduce the numbers of small tunas caught by purse seine nets. The following work in the field could be undertaken to examine the problem further: studying the mechanism of escape of fish through net - when, how and where they go out from the net; the effect of using sorting grid or square mesh; and explore the way to decrease the contact of fish with the net during the fishing operation.

Where have the tags gone? SImulatioN of TAGs (SINTAG): A simple model to estimate the number and size of tunas tagged by the RTTP-IO that are currently still alive (IOTC-2008-WPTT-24)

35. The large scale Regional Tuna Tagging Programme in the Indian Ocean (RTTP-IO) has reported a 14% return rate of the 168,000 tuna tagged between 2005 and 2007. Approximately 96% of these returns have been reported from the purse seine fishery. This has led to speculation that the tagged tuna have not yet reached sizes at which they could be caught by longliners (bigeye and yellowfin) or by the baitboat fishery (skipjack). A simple exponential decay and growth model has, however, indicated that this may not be the case, and tagged individuals should be available to these fisheries. It would thus appear that tagged tuna are not being reported by the longline

and baitboat fisheries and an effort should be made to increase the level of tag reporting in those fleets in order to maximise the usefulness of the data obtained from the RTTP-IO. This model may have application to estimate the number and sizes of tagged fish (for the three species) expected to be still alive in the Indian Ocean.

A new fishery indicator: The average 3 best monthly catches and CPUEs by 5°squares (IOTC-2008-WPTT-25)

36. The average of the “3Best” monthly catches are calculated on the estimated total catches by the combined longline fleets, monthly & by 5°squares since 1955. The average 3Best monthly CPUEs are also calculated in numbers/weight of tunas taken by 1000 hooks, for Japanese and Taiwanese longline fleets, monthly and by 5°squares, for all squares significantly fished by longliners (minimal effort taken: 20.000 hooks/month & square). The analysis of the cumulative catches in the 20 « best 5° squares » fished monthly by longliners shows that a small numbers of heavily squares tend to produce a large percentage of the yearly catches (Figure 28). This pattern is most clear for southern bluefin tuna where the 3 best monthly squares produce >70% of annual catches, and also apparent for other species: the 3 best monthly squares producing during the 1955-2005 period 40% of yellowfin catches, 34% of bigeye catches, and 45% of albacore catches. The reason for the use of these two indicators is to better understand the relationship between CPUEs (assumed to be representative of local densities) and total catches, that are the consequence of three combined parameters: (1) local biomass, (2) local fishing effort and (3) fish availability to the gear deployed & its targeting. These results are a potential source of information, allowing a better understanding in the changes of stock status, in the understanding of national CPUEs, in the changes of fisheries behaviour (by flag) and in the rates of tuna concentration in given strata (spawning or/and feeding strata). « 3Best » monthly/yearly 5°-Month strata is a new fishery indicator that can help to track changes in fisheries and resources. These heavily fished strata are important as they produce a large part of total catches. An interesting result from these analyses was that although a major decline in the best yellowfin CPUE occurred over the period from 1953 to 1975 period, the best monthly total catches index showed no such decline. Moreover, this index has been fluctuating during the 1955-2006 period without any trend (showing average monthly maximum at about 350 t). This apparent inconsistency between CPUE and catch is rather striking and it should be further analyzed.

37. As an extension of this work, the WPTT recommended that some extra analyses be undertaken to examine the phenomenon of vessels causing a temporary localised depletion in a particular area and consider how the complete distribution of relative rankings have changed over time.

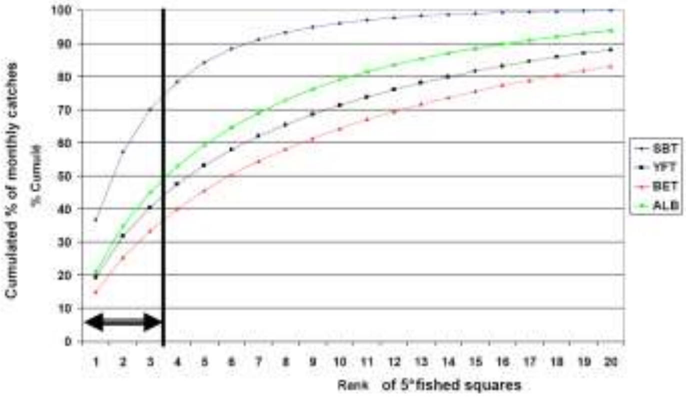


Figure 28. Plots of the cumulative catches in the 20 best 5° squares fished monthly by longliners.

Change of tuna size distribution from tuna purse-seine landings in Phuket, Thailand, from 2003 to 2007 (IOTC-2008-WPTT-33)

38. Port sampling was conducted to collect fishing and biological data of tunas from tuna purse seine that unloaded tuna catch during 2003 to 2007 at Phuket deep-sea port. Sizes distributions of skipjack per quarter varied from 25 to 70 cm FL and 5 to 10 kg. Change of mean FL in quarter 1 was increased from 50 cm in 2005 to be 52 cm in 2007 and in quarter 2 was increased from 2005 (44 cm) to 2007 (51 cm). Weight size distribution varied from 5 to 10 kg and mean weight was consistently 5 kg. Yellowfin size distribution by quarter varied from 25 to 120 cm in FL and 5 to 35 kg in weight. Change of mean FL and weight by quarter fluctuated from 54 cm to 90 cm, and 6 kg to 15 kg, respectively. The mean size of yellowfin decreased in 2007. Sizes distributions of

bigeye varied from 20 to 100 cm and 5 to 20 kg by quarter. Mean FL and weight by quarter increased in 2007. Length frequency distribution of the three species showed multiple modes mode in all quarters.

Trends in the recoveries registered by the Regional Tuna Tagging Project-Indian Ocean (IOTC-2008-WPTT-34)

39. Tag recoveries continue to be registered by the RTTP-IO but in decreasing numbers (Figure 29). However part of this decrease is linked to the low purse seine catch especially during recent months. The overall recovery rate reach 15.4 % in mid-October 2008 and it remains quite similar between species underlying close recovery rates between species. Increased awareness of the purse seine fishermen (large increase of the percentage of recoveries found at sea) and of the stevedores to the tags resulted in a decrease in the numbers of recoveries made in canneries. About 90 % of available tags are detected and reported to the RTTP-IO as proved by the IOTC tag seeding operation. Recoveries from purse seiners are still very dominant but recoveries from other gears are slowly increasing and at a faster rate for longliners even if this number of longline recoveries is still too low as non-reporting rate is probably very high (Table 2). The RTTP-IO is devoting a lot of effort towards longline fisheries. It seems that purse seine low selectivity for large bigeye is starting to affect the number of BET recoveries from purse seiners. These large BET are then recruited into the longline fisheries but as mention previously reporting is still very low. The distributions of the time-at-liberty reveal the effective and rapid mixing of the tagged tuna among the rest of the tuna population which is a very positive aspect for stock assessment studies (Figure 30). Data quality is an everyday concern by the staff of the RTTP-IO and some aspects related to the data quality are presented and discussed, an approach not well publicized by other large-scale tagging projects.

40. The Working party reiterated it strong support for the RTTP-IO. Moreover, it stressed the fundamental need to maintain a permanent effort to maximise the recovery of tagged tunas over the next 10 years, as these recoveries will be essential for the analysis of tuna movements and of tuna growth.

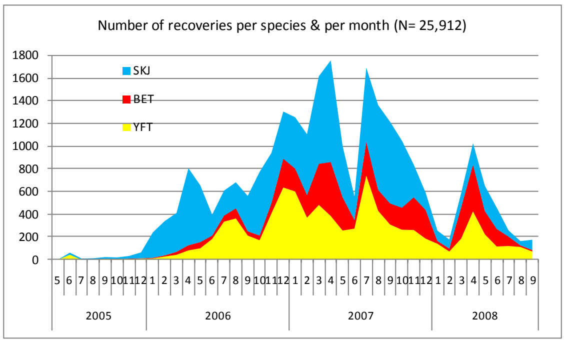


Figure 29. Numbers of recoveries of tagged tropical tunas over the period 2005 to 2008.

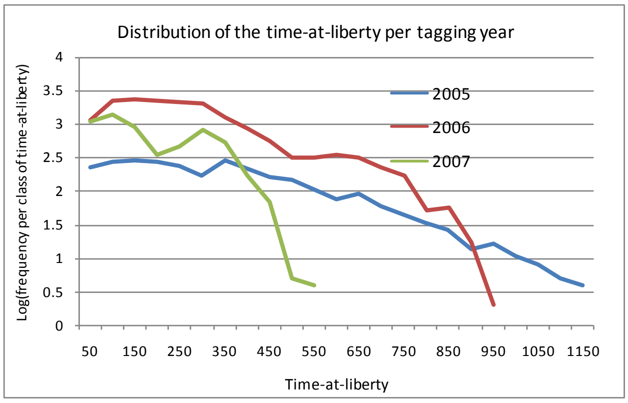


Figure 30. Time at liberty of tagged tuna (all species combined)

Table 2. RTTP-IO tag recovery statistics for 2006 and 2007.

Year	2006	2007
Number of yellowfin recoveries with FL>=1m by purse seine	219	1166
Number of yellowfin recoveries with FL>=1m by longline	7	21
Number recovered per1000 t of large yellowfin caught by purse seine	2.26	17.22
Number recovered per 1000 t of large yellowfin caught by longline	0.11	0.44
Ratio Purse seine: longline return rates of large tagged yellowfin	20	39

Catch of Tuna Purse Seine from Research Vessels in the Eastern Indian Ocean during 1993 – 2007 (IOTC-2008-WPTT-35)

41. This presentation described the catches from research cruises undertaken on the R.V. *Mahidol* and M. V *Seafdec* in the north east Indian Ocean waters between during 1993 and 2007. Thirty-five species of large pelagic fish and one meso-pelagic octopus are reported. The main species comprised skipjack tuna, yellowfin tuna and bigeye tuna. Catch composition and catch rate information is given.

Considerations of implications of large unreported catches of southern bluefin tuna for assessments of tropical tunas, and the need for independent verification of catch and effort statistics (IOTC-2008-WPTT-INF01)

42. Japanese catch and effort data provided through commercial log books constitute a central component of most stock assessments for the world's major tropical tuna and billfish fisheries (e.g. yellowfin tuna, bigeye tuna and swordfish). A review of Japanese market statistics was undertaken in 2006 by Australia and Japan in relation to catches of southern bluefin tuna (SBT). On the basis of this review, the Commission for the Conservation of Southern bluefin Tuna (CCSBT) concluded that very substantial and continuous over-catches of SBT had been occurring by longline vessels since at least the early 1990s. While there is uncertainty about the identity of fleets contributing to the over-catch, the assumption used within the CCSBT and its Scientific Committee is that a significant proportion of these unreported over- catches were taken by Japanese longliners. If this assumption is correct, estimates of Japanese catches have exceeded officially reported catches by at least a factor of 2 over this period. This paper discusses potential implications of the large, unreported catches of SBT on Japanese longline catch and effort data for other tuna and billfish species, and for stock assessments that are dependent upon these data. All of the information on the overcatch utilized in this paper was derived from publicly available documents (e.g. Reports of the CCSBT Commission and its Scientific and Stock Assessment Committees).

43. Analysis of the available data and information indicate it is plausible that the large unreported over-catches of SBT may have resulted in the misreporting of catches of other tuna species and/or misreporting of the location of fishing effort. Both of these hypotheses, if true, would bias CPUE indices and the stock assessments for other species of tuna (especially bigeye tuna). The magnitude and extended period of the over-catches of SBT highlight the significant and wide-spread risks of relying on fishery dependent data from commercial logbooks as the primary source of stock abundance indices for stock assessments in the absence of appropriate verification. There is an urgent need for the fisheries science community to be more pro-active in the development and implementation of independent ways to monitor and verify catches and fishing effort (e.g. scientific observers, video monitoring, port sampling, etc) and international standards for their use in scientific assessments.

44. A scientist from one of the CCSBT member countries expressed his unease about the presentation of this study. He informed the group that a formal investigation by CCSBT was underway and that IOTC should request CCSBT to provide the Secretariat and the Scientific Committee with the results of such investigation, once it becomes available.

45. The WPTT agreed that misreporting species, effort and location of fishing in the SBT fishery could have considerable implications for the accuracy of IOTC catch data (most likely bigeye) and effort data for all IOTC species in the southern ocean waters. The WPTT requested that the Secretariat contact CCSBT and request the results of the investigation.

46. The WPTT concurred that the only means for obtaining accurate fisheries statistics including data on target, bycatch and associated species is from observer programmes. To this end, the WPTT joined the WPEB in strongly recommending that IOTC Recommendation 05/07 *Concerning a management standard for the tuna fishing vessels*, to deploy if appropriate, scientific observers on-board the vessels according to the Commission's Resolution (Appendix I-ii), become binding on members.

47. Furthermore, noting that data from existing and future observer programmes have the potential to improve the stock assessment analyses, the WPTT recommended that arrangements be instituted to develop a central database of observer data to allow for archiving and analyses of these data with appropriate security and confidentiality arrangements

"What are the effects of the closed Somalian area on tuna stocks and fisheries?" IOTC-2008-WPTT-AdHoc03

48. The WPTT were informed about the effects that pirates operating out of Somalia are having on the fisheries for tropical tunas. The presence of pirates has resulted in many tuna fishing vessels avoiding traditional fishing grounds off the coast of Somalia (beyond 400 miles). The upwelling off Somalia results in high productivity and tuna fishers target the area as small tropical tunas aggregate to feed. Tuna catches per 5°sq. off Somalia are among the highest in the Indian Ocean with 12,000 t to 20.000 t of fish caught annually. Currently around 48 % of the skipjack, 24% of the yellowfin and 37 % of the bigeye tuna catches (by weight) by purse seiners are taken in this area (Figure 31).

49. The WPTT agreed that this unusual event will need to be kept in mind by scientists in their analyses of tropical tunas in the future.

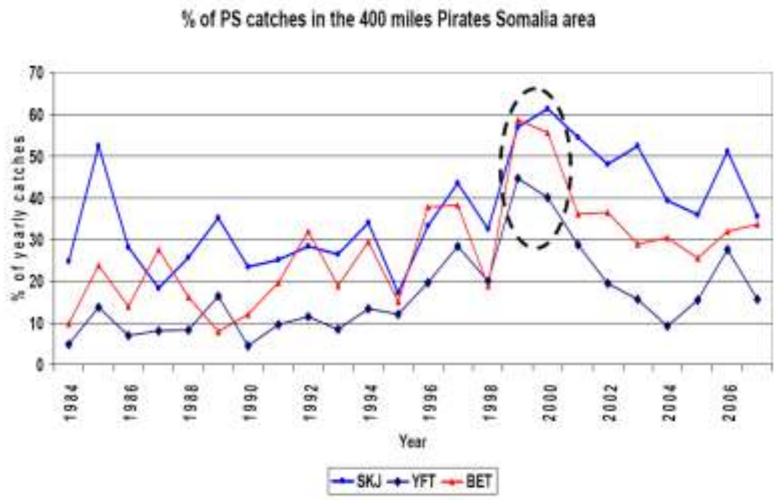


Figure 31. Percentages of the purse seine catches of tropical tunas (by weight) taken in the area off the coast of Somalia before the activities of pirates resulted in purse seine vessels avoiding the area.

3.4.2 ENVIRONMENT

Ocean climate variability in the West tropical Indian Ocean, 1997 to 2008 (IOTC-2008-WPTT-27)

50. The trend of the major environmental parameters during the decade 1997 to 2008 is presented. The decade analysed is characterized by two large anomalous events related to the Indian Ocean Dipole (IOD) events that reduced the catch rates of the purse seine fleets in the West Indian Ocean (WIO). During the IOD events, the western Indian Ocean had above average sea surface temperatures, a deeper than average thermocline and low chlorophyll concentrations, and these factors are believed to produce unfavourable foraging conditions for tunas in the surface layer (Figure 32). The most recent IOD event (2006-2007) did not reach the magnitude of that of 1997-98 but purse seine catches declined sharply from the previous years (Figure 33). Such a decline is appears to be due to conditions affecting catchability, but the hypothesis of a reduced biomass after some years of very high catches may be an additional reason to this decline.

51. Between the two major dipole events, there was a period of enhanced biological productivity that peaked in 2003-2004. This resulted in favourable foraging conditions for tunas (involving high concentrations of mantis shrimp) and a concentration of tuna schools between Seychelles (55°E) and the East African coast and corresponded in high catches of tuna. In 2008, the environmental conditions have returned to normal.

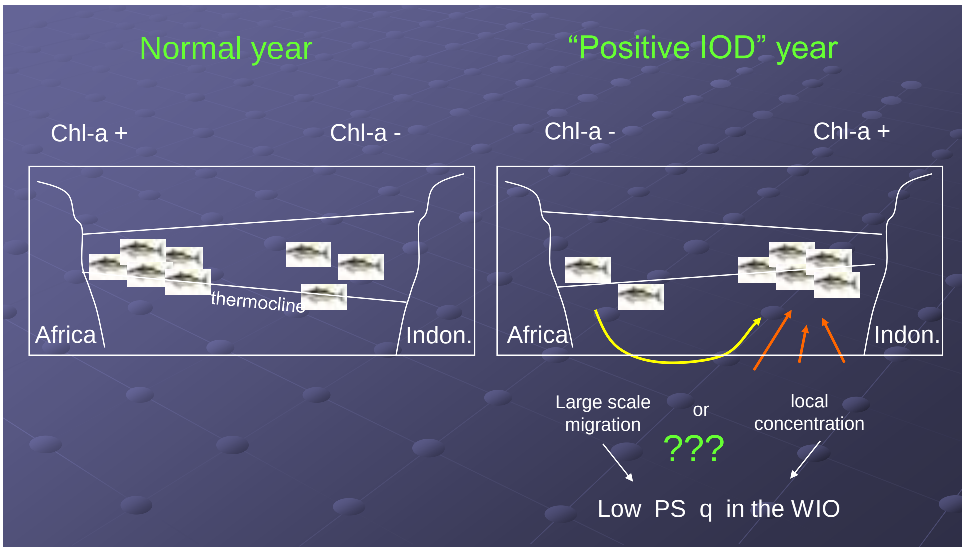


Figure 32. Differences in oceanographic conditions and concentration of tunas during a "normal" year and a year when an Indian Ocean Dipole event is evident.

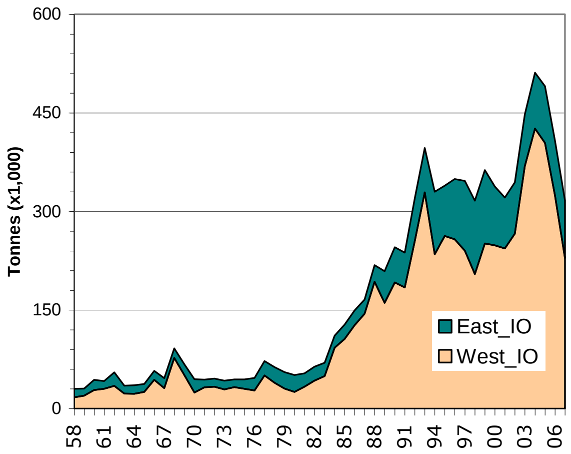


Figure 33. Catches of yellowfin tunas over the period 1958-2007.

52. The WP noted that these results indicate the importance of examining environmental factors in any analysis of catches, and the importance of having fine scale catch data as environmental effects can be highly localised. The author informed the working party that analyses using 1 degree square catch statistics from both the purse seine and longline fisheries are underway.

53. The WP agreed that this analysis provides valuable insight into the current hypotheses put forward by the SC to explain the extraordinary high catches observed over the 2003-2006 period; specifically, that the high catches were due to an increase in catchability by surface fleets due to a high level of concentration of fish across a reduced area and depth range. The analysis confirms the presence of favourable environmental conditions for tunas in the surface layer during this period, thus suggesting an increase in catchability was a likely to be a major reason for the high catches (as opposed to an increase in recruitment). This information was subsequently incorporated into the advice on the status of the yellowfin stocks.

Integrated habitat index of bigeye tuna (Thunnus obesus) in the Indian Ocean based on longlining data (IOTC-2008-WPTT-32)

54. Two surveys of bigeye tuna fishing grounds were carried out on board Chinese longliners in 2005 and 2006 fishing the high seas of the Indian Ocean to examine possible environmental factors variables influencing the spatial distributions of bigeye tuna. Models were developed to estimate integrated habitat indices (IHI) for bigeye tuna incorporating depth class and water column characteristics to predict the spatial distribution of the bigeye tuna in the Indian Ocean. Regression models were developed analysing bigeye tuna catch rates with respect to depth class, and the synchronal environmental variables (water temperature, salinity, chlorophyll-a, and dissolved oxygen) obtained in the survey. The results suggest: (1) in general, the predictive power of IHI models developed in this study were relatively good; (2) in 2005, in the survey area, the optimal depth of bigeye tuna was 160-240 m, defined by the area 1ºN-6ºN, 62ºE-68ºE (3) the IHI models developed for 2005 were applied to a specific area, period, and La Nina year and appear to be limited to areas of similar environmental conditions; (4) the method used to predict the spatial distribution of bigeye tuna in this study could be used for other pelagic fish species caught by longline.

3.4.3 TAGGING: INTRODUCTION TO TAGGING DATA 1ST ANALYSIS

55. The first results of the RTTP-IO were available for the 1st time to the WPTT in 2008. These results are for IOTC tropical tuna scientists a "dream come true" as now movement patterns, growth, natural mortality, exploitation rates can be estimated for yellowfin, skipjack and bigeye tuna, based on firm data that are relatively independent of fisheries. Many of these results are widely in contradiction with the previously agreed hypotheses used by IOTC scientists: for instance tuna growth, their movements and their natural mortality are now quite well estimated and widely different from previous hypothesis. Never in the history of tuna working parties has such a very rich data set covering the three tropical tuna species been available to scientists. This data set will soon bring an invaluable input to the future stock assessments of yellowfin, skipjack and bigeye tuna. However it was fully recognized by the WPTT that these analysis were only a 1st step in the full use the recovery data: the WPTT concluded that the analysis of this very rich and very complex data set, and the full incorporation of these RTTP-IO results will need major further research that will need more time, scientists and money. Furthermore, it should

also be acknowledged that the full use of the RTTP-IO results will also need several additional years, simply in order to recover larger tagged tunas, then allowing to estimate the variability in growth and in the L infinity parameters (for the various species), the adult natural mortalities and exploitation rates.

4. STOCK ASSESSMENT FOR YELLOWFIN TUNA

4.1 Introduction

56. The yellowfin tuna stock assessment work in the Indian Ocean is an extremely difficult task because of the conflicting trends in the basic data, total yearly catches and abundance index used based on the longline CPUE: the observed trends in YFT catches and cpues are not consistent with production-model dynamics, or really with any known theory of fishing. For any fished stock, to give larger and larger yields with no significant decline in abundance, cannot be explained, unless there is some major unexplained factor.

57. There is now a wide consensus that the initial decline in the early longline CPUEs during the 1953 -1970 period was due to a decline of stock catchability (Polacheck 2006[1]) and not to a major decline in stock density and biomass due to an early stock overfishing, as it was concluded by Myers and Worm in 2003[2]. However, the moderate decline of recent CPUEs, that has been observed since 1980 during the period of large increases of total catches (especially of small YFT) remains difficult to evaluate.. Present GLM CPUEs may correspond to a real trend in stock densities (the present hypothesis), but it may well underestimate the declining trend in stock biomass due to “cryptic” technological factors (not incorporated in the present GLM) that may have increased the fishing power of longliners.

4.2 Growth and catch at size and catch at age

58. A catch at age matrix provides information on the numbers of fish caught by fish age (and other strata such as year and gear) and is a major input into integrated assessment models. CAA is estimated on the basis of Catch at Size using growth curves and age-length keys or cohort slicing techniques (size, usually length data is typically more available than age information).

59. Tagging data obtained through RTTP-IO were used in document IOTC-2008-WPTT-09 to fit a growth model for Indian Ocean yellowfin tuna. The method applied was presented in document IOTC-2008-WPTDA-7. The authors noted that the tagging data, at present, contain very limited information about growth of older fish. However, this situation should improve in future as tags are returned from fish that have been at liberty for longer periods. Consequently, the model was constrained to a value of Linf of 146 cm and a size at 6 months of 33 cm, agreed inter-sessionally by the group. The two-stage 'VB log k' model applied appeared to fit well the growth data from the tagging dataset.

60. Catch-at-length data were provided by the Secretariat, as presented in document IOTC-2008-WPTT-08. These were initially combined with the growth model presented in document IOTC-2008-WPTT-09. Tagging data were used in that case to estimate growth, although the information currently available limits its use at estimating both length-at-infinity (Linf - given the limited age range of current recaptures) and size at 6 months (L6m - as tagging data carry no information on this parameter). Those two parameters were thus fixed at values agreed by WPTDA (IOTC-2008-WTPDA): Linf=146cm and L6m=33cm. A catch-at-age matrix for yellowfin was subsequently generated by the Secretariat and circulated before the meeting.

61. The generated catch-at-age matrix for yellowfin was considered too different from previous years and likely to lead to problematic inferences. It appeared the values for both Linf and size at 6 months chosen by the group were not fully appropriate, and further work, probably based on recent otolith readings (IOTC-2008-WPTT-30) is likely to improve our estimate of yellowfin growth. The group thanked Paige Eveson for the work carried out at its request.

62. The WPTT noted that the main problem with using the results from the VBlogK model could be overcome by adjusting the value used for t0, which is not an estimable parameter from the tagging data. Time did not permit this approach to be persued at this meeting, but it should be considered in the future as a way to generate estimates of length at age with CV’s – the CVs being required for some of the assessment models

1 Tom Polacheck_2006 ; Tuna longline catch rates in the Indian Ocean: Did industrial fishing result in a 90% rapid decline in the abundance of large predatory species? Marine Policy 30 (2006) 470–482

2 Myers, R., and Worm, B. 2003, 'Rapid worldwide depletion of predatory fish communities' , Nature, vol. 423, pp. 280-283.

63. An alternative growth curve, intending to provide a catch-at-age matrix comparable to that obtained in previous years, was presented in document IOTC-2008-WPTT-04. The possible existence of two or three growth stanzas in yellowfin was discussed and an 'ad-hoc' growth rates vector was presented. A slicing table was also provided as a temporary solution for generating a new catch-at-age table. Following some discussions, the group agreed to use this alternative catch-at-age matrix for some assessment runs and noted the need to further investigate this issue.

64. The current and future availability of both tagging and otolith data is likely to provide an unique opportunity for deriving a more accurate growth curve for yellowfin tuna. To this end, the WPTT concurred that this species appears to to exhibit multiple phases of growth and that traditional Von Bertalanffy approaches may not be appropriate for this species.

4.3 CPUE

65. The WPTT worked intersessionally to derive a five region spatial stratification for the CPUE analyses in 2008 (Figure 34). The current demarcation of areas is similar to that used in previous years, with modifications based on the results obtained from the tagging project and the most expeditious use of these data in the MFCL assessment.

66. Document IOTC-2008-WPTT-19 presented the standardization of the Japanese longline CPUE in which the change in gear configuration (as number of hooks-between-floats, NHF) and gear materials (main and branch line material), temporal and spatial distribution of effort and environmental factors (SST) were applied into the model to account for changes in the catchability of this species. A GLM including those factors and various interactions at both quarterly and yearly time steps was applied.

67. The standardized CPUE smooths out some of the variability observed in the nominal series (Figure 35) but the initial sharp downward trend, that corresponds with relatively low catches, is still present. The relatively flat trend observed for the remaining of the fishery seems to be in contradiction with the large increase in catches. The difference between recent nominal and standardised CPUE appears to have been caused by Japanese longline effort shifting and concentrating into a relatively small area where yellowfin is most abundant.

68. Standardized series of CPUE for the Taiwanese (TWN) LL fleet were presented in document IOTC-2008-WPTT-31. Both generalized linear models (GLM) and generalized linear mixed models (GLMM) were used, on the set by set dataset obtained from logbooks. Data for the 1979-2007 period were used from those boats fishing in the tropical area only. The main factors considered to affect catch in addition to effort were year, season (quarter), fishing area and targeting. One run also considered sea surface temperature (SST) as an environmental factor. Catch ratios of yellowfin against albacore and bigeye tuna, in addition to hooks-per-basket (HPB), were tested in this study as proxies for targeting by this fleet. Interactions among some of those factors were also considered.

69. Up to 50% of the variance in the series appeared to be explained by some of the model configurations. Targeting behaviour appears still to be not fully accounted for by the model, and the authors noted that the level at which targeting occurs (trip or boat vs. set level) could be added to the model in future analyses. It might also be possible to explain the differences between this and the Japanese series by selecting a subset of the fleet with higher catches of Bigeye tuna (> 75%), again indicating that targeting is an important issue in longline fisheries. The WPTT recognised the work carried out in recent years on improving the quality and analysis of the TWN LL CPUE series, and commended the authors for it.

70. A number of issues related to the use of the various CPUE series as indices of abundance and the results of the standardization procedure were discussed in detail. The constant trend observed in the series for the last two decades (Figure 36) could be confounded by changes in the efficiency of fleets. Although technological changes are likely to have been limited when compared with other industrial fleets, the general increase in availability of electronic equipment and satellite-derived information has possibly had an impact on this fleet. Any increase in effective effort would decrease the inferred trend in abundance, thus providing a worse view of the status of the stock than is currently inferred from these CPUE series.

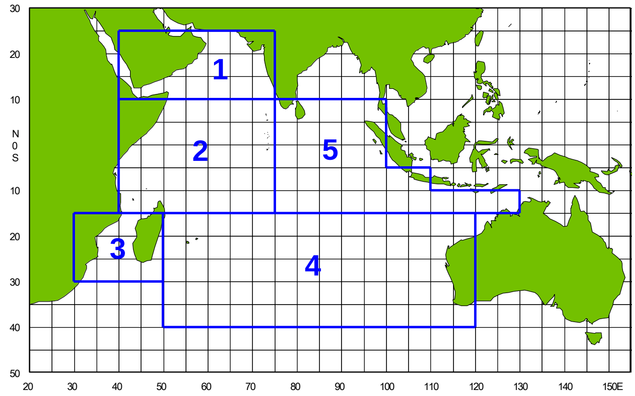


Figure 34. Areas used for CPUE analyses of yellowfin tuna in 2008.

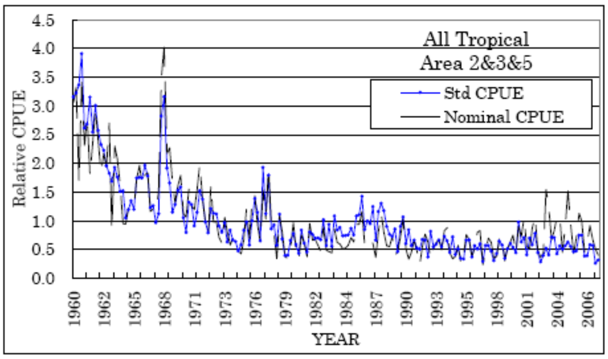


Figure 35. Nominal and Standardised CPUE for the Japanese longline fishery catching yellowfin tuna

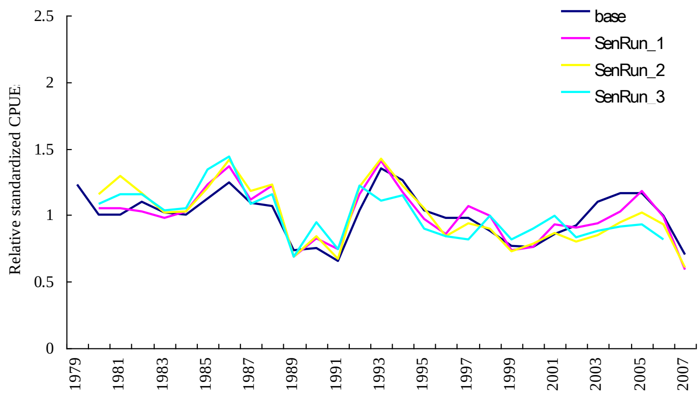


Figure 36. Standardised CPUE for the Taiwanese longline fishery catching yellowfin tuna

71. A first attempt at incorporating technological and environmental factors in order to explain changes in catch rates of yellowfin by the purse seine fleet was documented in IOTC-2008-WPTT-26. GLM models were separately applied to catches under log and free schools, with effort measured correspondingly in t per positive set and per searching hour. SST, depth of the 20 degree isotherm and concentration of chlorophyll-a were used as environmental covariates.

72. Results presented for both logbook level and aggregated catch data appear to be affected by the technological changes know to have taken place in the fishery, with CPUE levels showing increasing trends probably due to the difficulty of accounting for differences between nominal and effective effort. A suggestion was made that non-linear relationships like the one observed for thermocline depth would be better treated by linearizing them through an appropriate transformation.

73. The WPTT recognised the usefulness of this and similar exercises at understanding the impact on catch rates of various factors affecting the fishery and strongly recommended that work continue to develop reliable abundance indices for tropical tunas taken by the industrial purse seine fisheries.

74. The WPTT acknowledged the considerable work that has been undertaken in recent years to develop and improve the CPUE indices for tropical tunas. With respect to future work in this area, the WPTT recommended that the relationship between CPUE and biomass be examined, especially for the longline and purse seine fisheries, and be reported back to the WPTT in 2009.

4.4 Tagging analyses

75. Document IOTC-2008-WPTT-13 presented an exploratory analysis using the tagging and catch data and employing the age-structured models to estimate abundance, exploitation and natural mortality rates for yellowfin tuna in the Indian Ocean. The analyses was intended more as an investigation of the information content within the tagging data themselves, looking at consistency between release and subsequent recapture events, potential availability changes of the population over time and whether information on natural mortality might be extracted from these data.

76. Estimates of quarterly abundance and gear-specific exploitation rates for ages 0 to 3 and in 2006 and 2007 were obtained using the Seychelles landed and at sea Purse Seine tag recaptures, catch-at-age by gear and the reference catch associated with the tag recaptures using the methods detailed in paper IOTC-2008-WPM-04. Good fits to the different release and recapture events were obtained suggesting good consistency in the mixing assumptions and a strong indication that the tagging data can provide consistent and precise information on abundance and exploitation patterns. Expected recruitment in 2006 and 2007 was estimated to be 50 million and 46 million, respectively, with indications of a continual decrease in recruitment from 2004 to 2007. Expected yearly exploitation rates (averaged over both years) were 0.15 on age 0, 0.19 on age 1, 0.47 on age 2 and 0.22 on age 3.

77. The group acknowledged the importance of multiple uses of the tagging data and considered that independent estimates of fishing mortality were a very useful tool to consider in the discussion of those obtained from stock assessments.

78. Estimates of reporting rates on RTTP-IO tags for some fleets were presented in document IOTC-2008-WPTT-18. These were obtained from data obtained through the tag seeding programme on the PS fleet. Bayesian techniques were employed to explore the information in the various predictors and the uncertainty in the reporting rate estimates. Key factors explored were year, quarter, seeder type (skipper or observer), species and commercial size category.

79. A clear and substantial increase in the reporting rate is seen over time – for all species and size categories – which clearly correlates with the onset of the reward and recapture program section of the RTTP-IO and with the increase of the number of fish being recovered, increasing the awareness of the stevedores. A GLM approach was employed to identify informative factors and potential interactions between them, and then the Bayesian estimator was applied to estimate reporting rate distributions at the GLM-derived aggregation level. No effect of fish size could be detected, although sample size was possibly too small for this to be well estimated. In the years and quarters accounting for most tag returns, a very high reporting rate (above 90%) for all species was estimated. Given the small differences observed among species, the authors suggested that a combined reporting rate for all species should be used, as this makes use of all the available data. The possible effect of tag colour (different between the tag seeding and OTC tagging operations) was noted. The group was informed that future tag seeding events will be carried out with tags of the same colour as the OTC tags to assess its effect. The group reiterated its support for the tag seeding programme and acknowledged the importance of this information for the use of tagging data in stock assessments.

80. An analysis of the tag release and return data was presented during the meeting based on the Brownie3 approach for mark and recapture experiments (IOTC-2008-WPTTT-36). The Brownie approach relies on multiple release and recapture events (at least 3) to provide estimates of natural and fishing mortality independent of the catch data. The primary information for the estimation of the mortality rates comes primarily from comparison of

[3] [3] Brownie tagging experiments involve multiple releases on the same cohorts in at least three distinct time periods. The approach allows for the estimation of both age-specific natural and fishing mortality rates if reporting and shedding rates are available. The primary information for the estimation of the mortality rates comes primarily from comparison of the return rates over time from the multiple release events combined with the overall decline in the number of tags over time. See Brownie, C., Anderson, D.R., Burnham, K.P., and Robson, D.S. 1985. Statistical inference from band recovery data: a handbook. U.S. Fish and Wildlife Resource Publication 156.

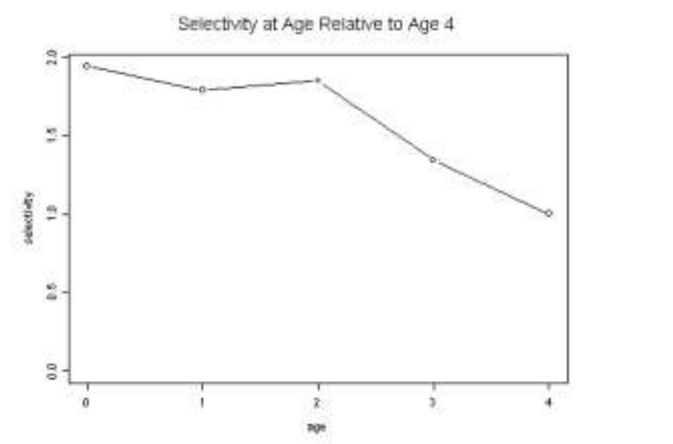
the return rates over time from the multiple release events combined with the overall decline in the number of tags over time. The application also requires estimates of the reporting rates and shedding rates. In the application presented, overall reporting rates were estimated based on the tag seeding estimates for purse seiners unloading in the Seychelles. It was assumed that reporting rates for purse seiners unloading in other ports were similar. In order to account for tags not reported by other gears, only tags recovered from the purse seine fishery were used in the analysis (i.e. the reporting rate was assumed to be zero for these fleets). Overall age specific reporting rate were then estimated by dividing the above purse seine reporting rate by the estimated proportion of the catch by age that was caught by purse seiners (Table 3). The sensitivity to assuming alternative reporting rates was explored (e.g. no correction for catches by other fleets).

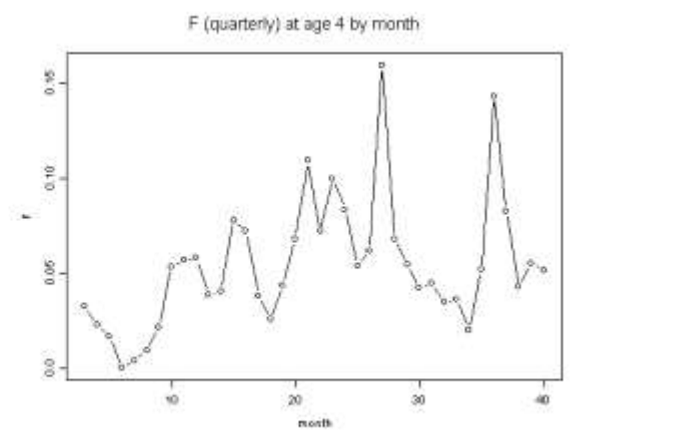
81. In the application presented, the each tag release was assigned an age based cohort slicing using the Fonteneau growth curve (IOTC-2008-WPTT-04). Releases were then aggregated by estimated release age and month of release. Only releases for ages 0 to 3 and recaptures through age 4 were used. For each age/month of release group, the predicted number of subsequent returned in each month were estimated using standard population and Barnow catch equations corrected for reporting rates. In the analyses presented no account was taken of shedding rates due to time constraints but the sensitivity to assuming alternative reporting rates was explored (e.g. no correction for catches by other fleets) were explored. Maximum likelihood estimates for F and M assuming a multinominal distribution for the number of recoveries per month. Various parameterizations were explored for F and M. Of those parameterization that were explored, the best fit based on AIC was one that had annual age specific natural mortality rates with fishing mortality separable by age and varying each month. Note estimates of natural mortality rates cannot be estimated for the oldest age classes of release and thus M for ages three and four was assumed to equal that for age two). Figure 37 provides the resulting estimates of M, month fishing mortality rates (age 4) and the relative rates for the other age classes. It was noted that the estimates of M were substantially lower than those used in the initial assessment runs using Multifan-CL and those used in previous assessments. The estimates of natural mortality rates were relatively insensitive to alternate parameterizations and reporting rate estimates.

Table 3: Estimates of age and year specific overall tag reporting rates used in the "Brownie" analysis of the tagging data (note since catch by age and gear are not available for 2008, the average for the 2005-2007 estimates was used for the returns from 2008).

			Age		
Year	0	1	2	3	4
2005	0.59	0.64	0.30	0.37	.38
2006	0.84	0.70	0.24	0.36	.37
2007	0.79	0.63	0.32	0.32	.29

82. The WPTT acknowledged the considerable advance in the knowledge gained from the first year of analyses of the tagging data and strongly recommended that further analyses of the tagging data continue in support of the assessments of the tropical tuna species.





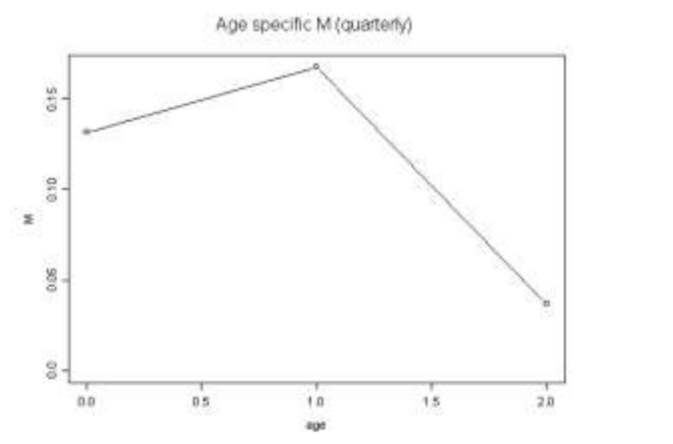


Figure 37: Estimate of selectivity relative to age four (upper panel), monthly estimates of fishing mortality rates (middle panel) and age specific natural mortality rates (lower panel) from the "Brownie" analysis of the tagging data.

4.5 Stock assessments

4.5.1 SURPLUS PRODUCTION MODEL

83. A simple surplus production model was used to explore the relative information content of the Japanese and Taiwanese longline CPUE (Document IOTC-2008-WPTT-12). Life-history methods were used to define a Monte Carlo distribution for the r parameter, while the K parameter was estimated, with CPUE catchabilities estimated as nuisance parameters. The two CPUE series were used separately and in combination. Both series produced very similar biomass trends over time and the early rapid declines in CPUE for low, stable catch levels seen in both series cannot be explained as reductions in abundance. Based on the production model results, the predicted stock status was very similar for all cases. Thus, the two indices appear to have similar information content within the context of a surplus production model. Overall, the results from fitting the surplus production model would indicate that the biomass is below the MSY-based level and that the catch and harvest rates are slightly above MSY levels.

4.5.2 STOCK SYNTHESIS 2 (SS2)

84. An assessment using the Stock Synthesis 2 (SS2, Methot, 2005-07) was presented in document IOTC-2008-WPTT-21. SS2 uses catch-at-length data, a growth model and a CPUE series to model the stock dynamics. Initial runs had difficulty in estimating all of the parameters of the stock-recruitment relationship. Consequently, additional analyses were conducted using a fixed value for steepness of 0.8. Analyses were conducted which utilised both the JPN and TWN longline CPUE series. The results were relatively similar which ever series was used or if both series were used together. The model had some difficulties in fitting the length distribution of the catch from the purse seine fleet. This appears to be due to the bi-modality in the length frequency distributions resulting from combining the catches from log and free school catches. WPTT suggested that this difficulty with the PS length frequency data might be overcome by treating these two fishing modes as separate fisheries within the model. Exploratory runs conducted in response to this suggestion markedly improved the fit to the PS length frequency data. A model run with fixed steepness (0.8), using both the Japanese and Taiwanese longline CPUEs,

and separating the PS fishery according to fishing mode, estimated values of MSY to be around the 300,000 t, which would lead to the stock being above the BMSY level (Figure 38). However, the estimates of MSY reference values are dependent on the growth curve (Stequert), estimates of selectivity and annual recruitments applied.

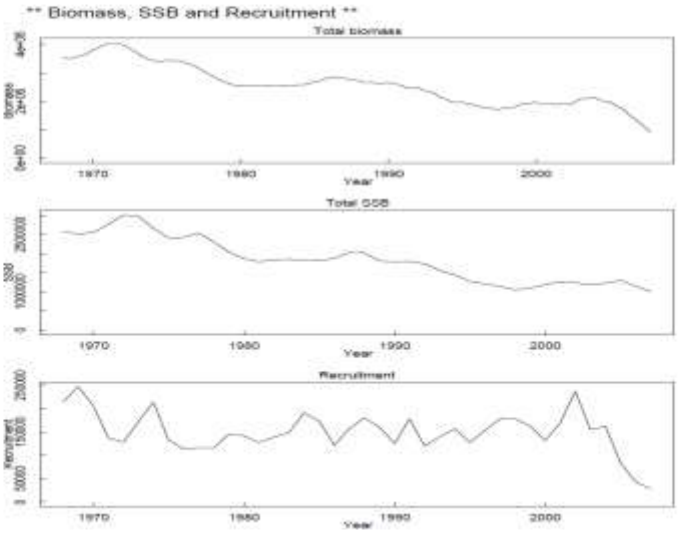


Figure 38 SS2 stock assessment of yellowfin tuna: trends in total yellowfin biomass, spawning biomass and recruitment over time

4.5.3 AGE-STRUCTURED PRODUCTION MODEL (ASPM)

85. The ASPM model, an age specific production model working at the scale of an Indian yellowfin tuna stock exploited by multiple fisheries but without any geographical stratification (full & permanent mixing at the scale of the Indian Ocean) was also used by the WPTT to assess the yellowfin tuna stock status.

86. A new version of the Age-structured Production Model (ASPM), recoded in ADMB was applied to the Indian Ocean yellowfin stock (1950-2007) (IOTC-2008-WPTT-28). The model uses catch-at-age data and a CPUE series to estimate biomass trends and management-related parameters. Selectivities are estimated separately, using a Separable Virtual Population Analysis (VPA). Biological parameters such as natural mortality, weights-at-age, fecundity and maturity were fixed. In ASPM analyses 82 scenarios (42 in 1st run and 40 in the 2nd run) were implemented to search optimum levels of the following seven parameters, i.e. (a) start year of catch (1950, 1960, 1968 or 1980), (b) start year of CPUE (1960, 1968 or 1980), (c) steepness (estimated or 0.8), (d) longline selectivity (dome or flat shaped), (e) growth (LEP method or alternative), (f) natural mortality (ICCAT value or 60% of MFCL estimate), and (g) CPUE (Japanese index or with four alternatives using Taiwanese CPUE).

87. As a result, only three scenarios out of 82 with the different parameterisation considered were able to produce converged estimates and provide biologically reasonable results. Among the three, scenario 20 in the first run was selected for presentation. Scenario 20 suggests that the most reasonable assumptions for applying this model are (a) start year of catch (1960) – Figure 39, (b) start year of CPUE (1968) – Figure 39, (c) steepness (0.8), (d) longline selectivity (dome), (e) growth (LEP method), (f) natural mortality (ICCAT value), and (g) CPUE (Japanese index). Scenario 20 suggested that both Japanese and Taiwanese longline CPUE series, the latter using different proxies for targeting, provided reasonable results. Results (Figures 40-44) suggest that Indian Ocean yellowfin tuna is now entering into an overfished status after four years of high catches (2003-2006) (Figure 40) and the stock will be likely recover to the SSBMSY level in a few years (Figure 43) if the catch does not exceed the level of catch in 2007 (316,000 t). But it is noted that recovery and the status of the stock depends on the value of steepness used in the stock-recruitment relationship.

88. Comments on the impact of the use of a reduced series of catch and CPUE focused on the likely impact this could have on estimates of the MSY reference values. For example, the level of SSB likely to support catches at the MSY levels was estimated to be only 10% of the virgin biomass (Figure 40). This estimate was probably highly dependent on the stock-recruitment relationship used being correct, a parameter which is highly uncertain. The decline in biomass estimated for the 2004-2007 period was in disagreement with the flat trend observed on the index of abundance used for that period. The reason for that difference should be explored further. It was also noted that this models appears to have great difficulty at estimating the levels of fishing mortality over the most recent years, and this has implications for the results produced. The use of dome-shaped selectivities for the

longline fleets was also pointed out as requiring further exploration. Concerns were expressed that this method does not fully utilize the information content in the length frequency data since it only uses them to estimate selectivities in the separable VPA pre-fitting component. The uncertainties associated with the selectivity values used in the model are not considered.

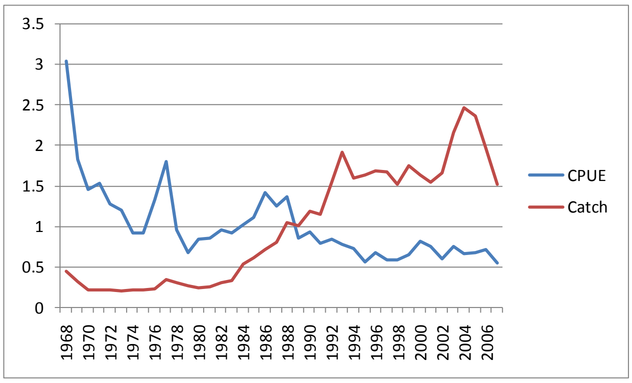


Figure 39. ASPM stock assessment for yellowfin tuna: CPUE versus catch

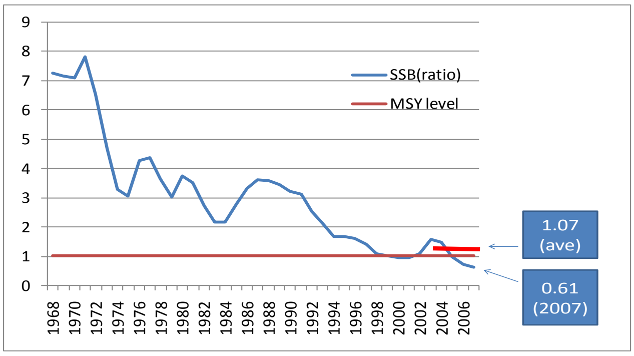


Figure 40. ASPM stock assessment for yellowfin tuna. Spawning stock biomass levels 1968-2007. MSY represents the level of the spawning stock that will support the maximum sustainable yield of the stock

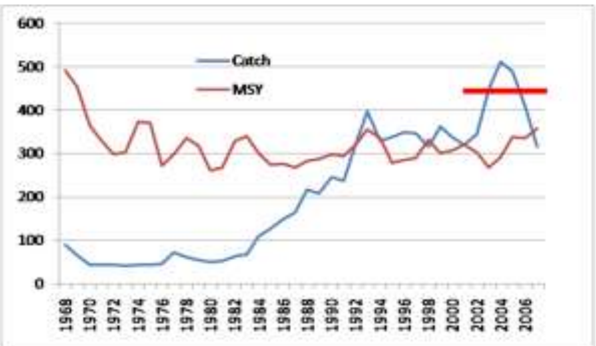


Figure 41. ASPM stock assessment for yellowfin tuna. Catch versus MSY

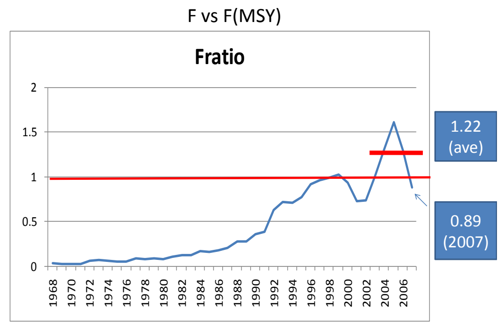


Figure 42. ASPM stock assessment for yellowfin tuna. Fishing mortality.

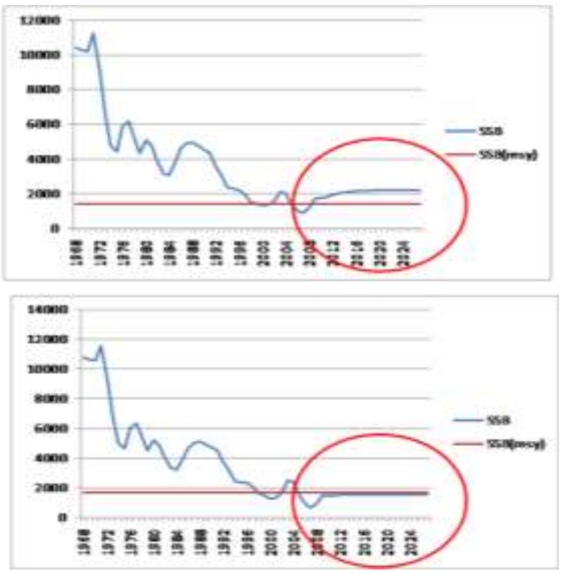


Figure 43. ASPM stock assessment for yellowfin tuna Top Scenario 1 C(2007), bottom Scenario 2 c(av 2003-2007).

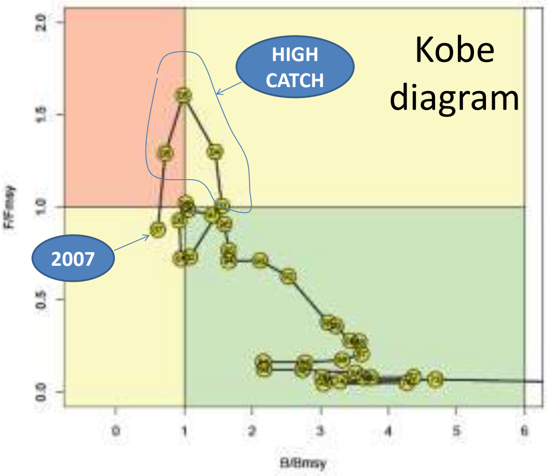


Figure 44. ASPM stock assessment for yellowfin tuna. Temporal trend in annual stock status, relative to BMSY (x-axis) and FMSY (y-axis) reference points, for the model period.

4.5.4 MULTIFAN-CL, (MFCL)

Introduction

89. A size-based, age- and spatially-structured population model (Multifan-CL, MFCL) was applied for the first time to the Indian Ocean yellowfin tuna stock, as presented in document IOTC-2008-WPTT-10. This method is routinely used to conduct the stock assessment of tuna stocks of the western and central Pacific Ocean, including yellowfin tuna. Multifan-CL has the functionality to integrate tagging data. For this reason, the IOTC Working Party on Tagging Data Analysis held in June–July 2008 recommended conducting an assessment of the Indian Ocean yellowfin tuna stock using MFCL software (IOTC-2008-WPTDA-R).

Fisheries structure

90. A five-region spatial stratification (Figure 34) with quarterly time steps for the 1960-2007 period were adopted for this model. A number of fisheries were defined by aggregating all LL catches by area, separating PS catches between log and free school catches, and assigning the various artisanal fleets to separate fisheries by area. The standardised CPUE series from the longline fisheries in each region was essentially used as the index of relative stock size.

Steepness

91. The steepness of the stock-recruitment relationship was initially estimated, although information on this parameter is typically scarce on most datasets. Later runs were conducted with a range of fixed values of steepness (0.6-0.8) based on biological and demographical considerations and results from a population viability analysis, conditional on maturity, natural mortality and recruitment variability (IOTC-2008-WPTT-AdHoc07, Figure 45).

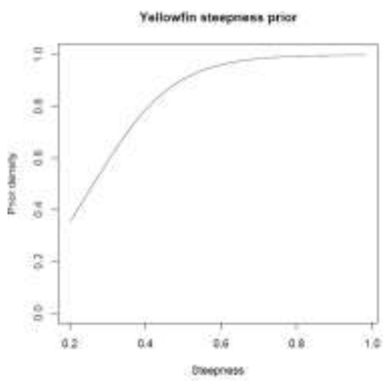


Figure 45. Results of a population viability analysis to derive plausible values of steepness to be used in the MFCL assessment

Growth

92. The group considered than given the difficulties at estimating growth based on tagging data without any information on maximum length or length at age zero, for the purpose of assessment runs growth was better modelled inside MFCL, although further work in required on this important aspect of the assessment process.

93. Two initial options were considered for growth: growth parameters were estimated within the model or fixed at values equivalent to the LEP growth. Growth was initially incorporated using the two alternative curves presented above (IOTC-2008-WPTT-09 and IOTC-2008-WPTT-04). After some discussion, a number of runs were conducted where growth was allowed to be estimated within the assessment process or fixed to approximate an alternative (AF) growth curve (Figure 46).

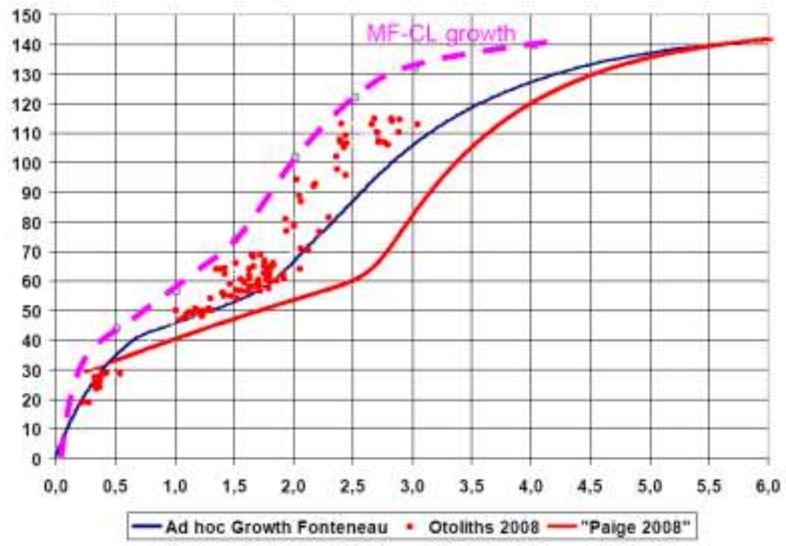


Figure 46. Estimated growth of yellowfin derived from (a) the base-case assessment model (MFCL derived purple line) (b) the estimated mean length at age from the tag analysis (LEP derived red line) and (c) an alternative curve tabled at the meeting (blue curve).

Movement

94. Movement among the five areas was estimated by the model, although very limited information exists in either the catch or tagging datasets, as both releases and recaptures have so far concentrated in area 2. The assumptions regarding growth were recognized by the group as being important to investigate in future assessments, as growth can have a major effect on model estimates of certain parameters.

95. Estimated movement coefficients for some region boundaries are close to zero, while overall, most estimated movement rates are low. These results were likely to be due to limited data for the estimation of the movement parameters. Alternative model scenarios were used to explore the possible influence of movement parameters on overall results. Catches from purse seines fleets in area 5 were being added to those of area 2 in order to reduce the number of fisheries, as they are generally quite low. This could have prevented information on movements between those 2 areas from appearing on the movement rates estimates.

Natural mortality

96. Natural mortality was initially assumed to be fixed at the values adopted for the Pacific Ocean assessment of yellowfin tuna (Figure 47). The group considered those values were not fully appropriate for the Indian Ocean stock and adopted a lower vector of natural mortality by age (similar to that used in previous years), in correspondence with the indications of the analyses of tagging data. Complete mixing of tagged fish, within area 2, was initially assumed to occur after 6 months, but after some discussion the group considered that 3 months was a sufficient time given the characteristics of the tagging operation of the RTTP-IO. Final model runs therefore used this value.

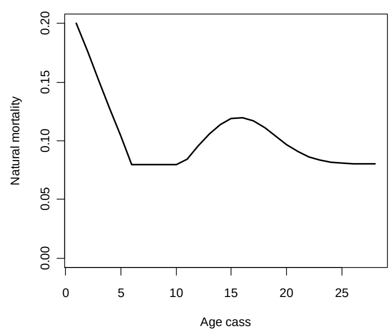


Figure 47. Age-specific natural mortality assumed for the assessment. Age class units are quarter years.

Results

Performance of the model

97. For almost all fisheries, there is good fit to the length frequency data revealed from a comparison of the observed and predicted length data aggregated over time (Figure 48). For most fisheries, the size composition of individual length samples is consistent with the temporal trend in the size composition of the fishery-specific exploitable component of the population. Similarly, tag returns for most quarters are well explained.

98. Overall consistency with the observed effort data was also noted, except for the early period of the longline fisheries (Figure 48). Lack of fit and highly variable CPUE indices were encountered with the Japanese longline series in area 1 as representing the activity of fleets using that gear in that area due to lack of activity of the Japanese fleet in this area. This index was later substituted by an index obtained from the Taiwanese fleet, as this fleet is actively targeting yellowfin in area 1.

99. The initial model runs assumed catchability in the longline fisheries was assumed to be constant over the entire model period. However, this assumption resulted in very high estimates of recruitment in the early period and a strong decline in biomass during a period of low catch as the model attempted to fit a sharp decline in CPUE from 1960 to 1972. This result was not considered plausible and the longline catchability assumption was later relaxed by separating the longline in two periods, ending and starting in 1972, and allowing catchability in the first part of the series to vary. This resulted in early recruitments being comparable to the equilibrium level and removed some of the strong temporal trend in recruitment and biomass.

100. Extra runs were carried out that incorporated a number of suggestions made by the group, some of them mentioned above. The influence of the value assumed for the steepness parameter on the stock-recruitment relationship was investigated by a series of model runs using values of 0.6, 0.7 and 0.8. The impact of alternative growth curves and natural mortality vectors was similarly explored. The final agreed model estimated the growth parameters and natural mortality varying with age about an average level of 0.4 per annum.

101. The WPTT acknowledged the effort put into this first attempt at applying such a complex model, able to use multiple sources of data, to this stock. The importance of the results obtained from the RTTP-IO tagging programme was further emphasized by the role played in this assessment exercise.

102. Given the information content of the datasets used, it appears that the model is currently unable to provide a satisfactory explanation of movements across regions (Figure 50). This is not surprising, given the difficulties generally encountered in estimating movement, and the limited spatial spread of tagging releases and recaptures currently available. Concerns were expressed about the impact this factor could have on the overall estimates obtained, and the WPTT agreed further work is necessary to improve this aspect of this assessment. The still limited availability of tag recoveries from fleets operating outside of the main area for tag releases further limits its use for estimating movement. The authors also noted that the estimates of reporting rates from field experiments available only covered part of the purse seine fleet and none of the other fleets returning or likely to return tags. Obtaining reporting rates for these fisheries would increase the utility of the total tag release/recovery data set. The WPTT emphasized the importance of obtaining such information if possible.

103. Given the current limitations on recoveries from various areas, it is likely that tagging data will not be able to resolve the issue of movement across areas with additional sources of information. The WPTT considered that a concerted effort should be made to analyse possible spatial stratifications and movement matrices that better reflect the knowledge on tuna movement across the Indian Ocean for further use in MFCL analyses.

104. The number of tags recovered from the PS fishery was corrected to account for the reporting rates estimated (quarterly) from the tag seeding trials. Information concerning reporting rates were not available for other components of the fishery and the reporting rates for these fisheries were estimated by MFCL. These estimates were typically low indicating low levels of tag returns from these fisheries. Increased publicity may result in an increase in tag recoveries from these fisheries. However, it would also be necessary to include independent estimates of reporting rates, which are likely to prove very difficult to obtain without tag seeding taking place.

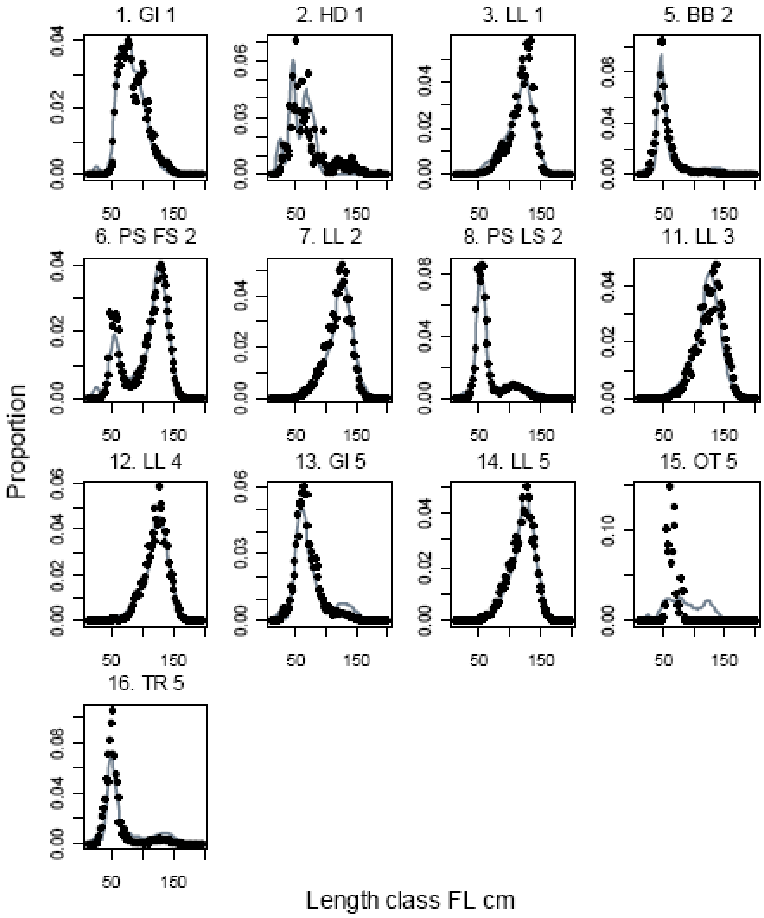


Figure 48. Observed (points) and predicted (line) length frequencies (in cm) for each fishery aggregated over time.

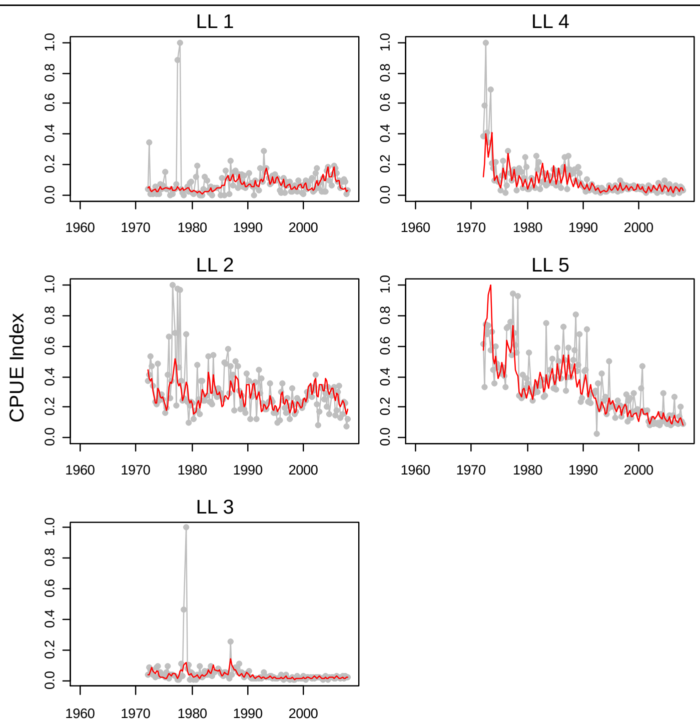


Figure 49. A comparison of longline exploitable biomass by quarter and region (red line) and the quarterly standardised CPUE indices (grey line and points) for the fisheries. For comparison, both series are scaled to the average of the series

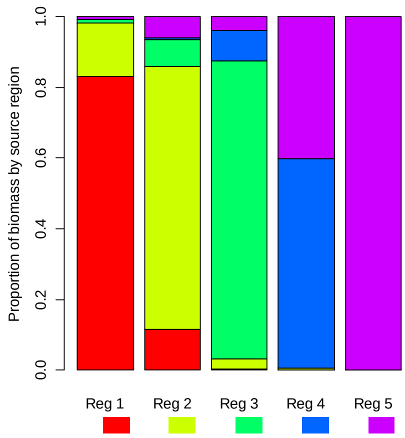


Figure 50 –Proportional distribution of total biomass (by weight) in each region (Reg 1–5) apportioned by the source region of the fish. The colour of the home region is presented below the corresponding label on the x-axis. The biomass distributions are calculated based on the long-term average distribution of recruitment among regions, estimated movement parameters, and natural mortality. Fishing mortality is not taken into account.

105. The assessment assumes a constant catchability of yellowfin by the longline fisheries, as indexed by the Japanese standardized CPUE index. The initial decline in the early LL CPUEs during the 1953 -1970 period was likely due to a decline of stock catchability and not to a major decline in stock density and biomass due to an early stock overfishing. However, the moderate decline of recent CPUEs, that has been observed since 1980 during the period of large increases of total catches (especially of small YFT) remains difficult to evaluate.. It is uncertain if the CPUE standardization could have sufficiently accounted for the change in efficiency of the longline fleet with respect to yellowfin tuna. More detailed information regarding gear technology and fishing strategy would be necessary to investigate changes in longline catchability over the model period.

106. Overall, the WPTT strongly recommended that the development of the MFCL model on Indian Ocean tunas continue and that in addition to further refinement of the yellowfin tuna assessment, assessments for bigeye and skipjack be attempted. The WPTT noted that this work should include further analyses to determine the most representative spatial structure for the fisheries and explore various mixing rate scenarios.

Stock status

107. Results obtained appear to indicate that recent levels of fishing mortality are at an historical high level and the stock has experienced a period of overfishing during 2003-2006 (i.e. Fcurrent > F_{MSY}) for all values of steepness. Current catches are likely to be higher than the estimated MSY, which ranges from 250,000 to 300,000 t, depending on the shape of the stock-recruitment relationship. Biomass based reference points also vary with the assumed level of steepness. For the lowest value of steepness (0.60), spawning biomass in 2007 is estimated to be below the MSY level (SB/SB_{MSY} <1); i.e. the stock is in an overfished state. For higher values of steepness, recent (2007) biomass is above the MSY level (SBcurrent > SB_{MSY}) and the stock is not in an overfished state. The model estimates that recent recruitment has been lower than average (Figure 51) and on this basis total and spawning biomass could be expected to decline further over the next few years (Figure 52).

108. The trend in the status of the yellowfin tuna stock relative to $F_t/\tilde{F}_{MSY}$, $B_t/\tilde{B}_{MSY}$ and $SB_t/S\tilde{B}_{MSY}$ reference points over the period 1960 to 2007 is illustrated in Figure 53.

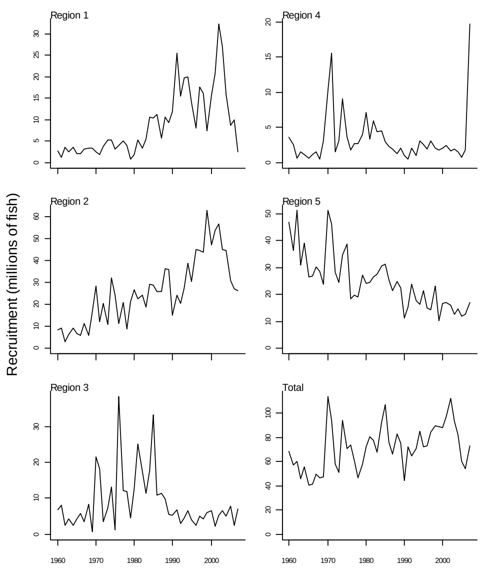


Figure 51. Estimated annual recruitment (millions of fish) by region and for the Indian Ocean.

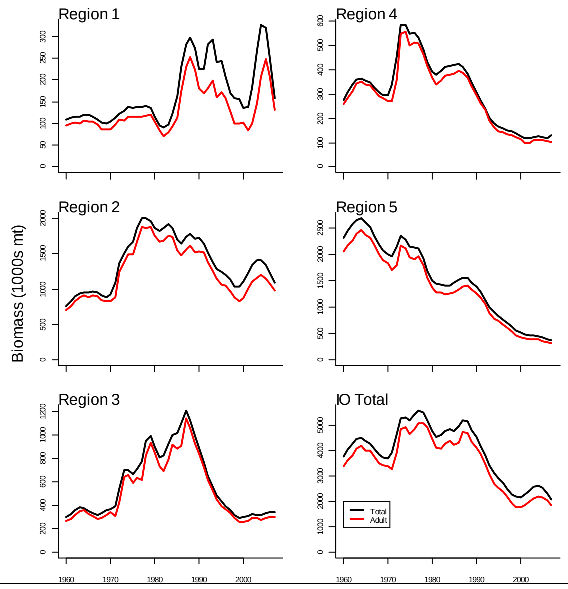


Figure 52 Temporal trend in total and adult biomass (1000s mt) by region and for the entire IO.

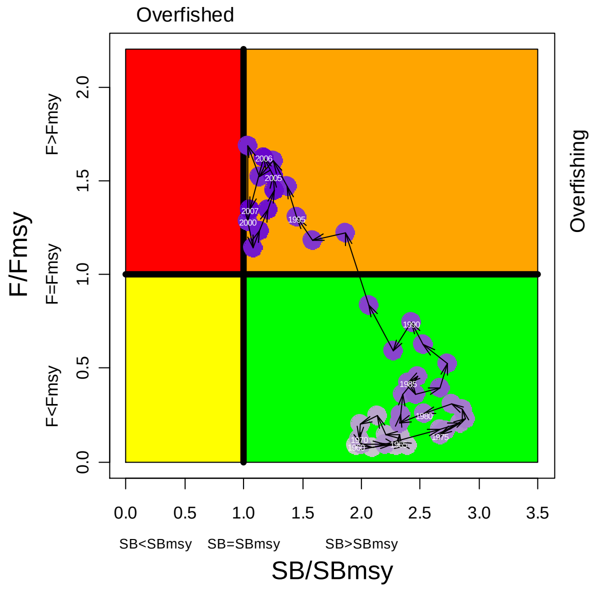


Figure 53. Temporal trend in annual stock status, relative to B_{MSY} (x-axis) and F_{MSY} (y-axis) reference points. The colour of the points is graduated from mauve (1960) to dark purple (2007) and the points are labelled at 5-year intervals.

4.5.5 Comment on the MFCL and other assessment models

109. The MFCL model enabled scientists to use the tagging data and other information as the first time in an Indian Ocean tuna stock assessment and the WPTT endorsed its use in the future. The WPTT noted that other models with alternative structures that do not require particular inputs such as tagging or size frequency data, provide valuable alternative views of an assessment situation and in some circumstances can better evaluate the information content of the omitted data sets. Moreover, the WPTT agreed that is always a useful exercise to examine the results from a range of models in order to assess the conflicts and consistencies of the different data used in the models. To this end, the WPTT suggested that a range of stock assessments approaches continues to be conducted (with and without tagging data) in the future.

4.6 Technical advice on yellowfin tuna

110. A range of assessments were presented in 2008, and the WPTT was able to consider in great detail their outputs as well as elaborate on further scenarios and assumptions to be explored. Most of the models appear to provide similar perspectives on the status of the stocks despite their different levels of complexity and the uncertainties.

111. An assessment model was applied this year that was able to make use of the tagging data obtained through the RTTP-IO programme. The results from this model demonstrated the value of the tagging information for assessment purposes and improved the basis for the advice this group was able to provide compared with previous assessments of this stock. The value of this source of information is likely to increase over time as more tag are returned, over a wider area and for older fish, and as analyses on this dataset progress and improve.

112. All assessments are greatly dependent on the use of the longline CPUE series as indices of abundance of the stock. Although current standardization procedures applied various technological and environmental variables into the model it is uncertain if it could fully explain the change in fishing efficiency..

MANAGEMENT ADVICE:

Current status

Estimates of current status of the stock in relation to biomass and fishing mortality reference points were sensitive to the value assumed for steepness of the stock-recruitment relationship so the following results are reported with respect to a range of plausible steepness values (0.6 to 0.8).

Estimates of current adult and total biomass are above or just below their respective MSY-based reference points (B_{MSY} and SB_{MSY}), indicating that the stock is close to, or possibly has recently entered, an over-fished state.

Current (2007) fishing mortality estimates were above their respective MSY-based reference points for all but one of the assessments examined, i.e. $F_{CURRENT}/F_{MSY}$ ratios range from 0.9 to 1.60 indicating that overfishing is occurring. This current degree of overfishing is somewhat lower than that estimated occurred during the 2003-2006 period when the F/F_{MSY} ratio ranged from 1.22 to 1.75.

The stock assessments, including independent analyses of the tagging data, indicate that recruitment has declined in recent years.

The estimates of MSY ranged between 250,000 t and 300,000 t based on the integrated assessment that used the tagging data, although other model results expand this range to 360,000 t. The 2007 catch of 317,000 t may have been above the MSY while annual catches over the period 2003-2006 (averaging 464,000 t) were substantially higher than this range of MSY estimates.

Outlook

Catches in 2007 (317,000 t) were slightly lower than the average catch taken in period 1998-2002 (336,000 t) i.e. preceding the 2003 to 2006 period when extraordinarily high catches of yellowfin were taken. Purse seine catches in the first seven months of 2008 were slightly higher than those reported for the corresponding period in 2007 indicating that catch levels might be returning to pre-2003 levels. While there is a large amount of uncertainty about likely future catches, recent events in 2008 where some vessels have left the fishery, together with fleets avoiding the historically important fishing grounds in the waters adjacent to Somalia for security reasons, may reduce catches in the short-term to below the pre-2003 levels.

Two hypotheses have been put forward in the past to explain the very high catches in the 2003-2006 period: (i) an increase in catchability by surface fleets due to a high level of concentration across a reduced area and depth range, and (ii) increased recruitment over the 1999-2001 period. Recent analyses of environmental and oceanographic conditions appear to be consistent with the first hypothesis, which would mean that the catches likely resulted in a depletion of the stock. Conversely, MFCL accounts for the period of higher catches by estimating substantially higher than average levels of recruitment in 2001, 2002 and 2003. Environmental anomalies also appear to be a factor linked to the lower catches in 2007.

The range of model runs indicate that overfishing is currently occurring. Under equilibrium conditions, the recent (2003-2006) and current (2007) levels of fishing mortality will result in the stock becoming overfished ($B_{CURRENT}<B_{MSY}$ and $SB_{CURRENT}<SB_{MSY}$) in the medium term (3-5 years). Recent recruitments (in 2005, 2006 and possibly 2007) are estimated to be below the equilibrium (long-term average) level and if lower

recruitment persists then the stock will decline below the MSY level more rapidly. Similarly, overfishing may continue to occur even if fishing pressure returns to pre-2003 catch levels, especially if recruitment continues to be low and the expected decrease in some age classes due to recent low recruitments eventuates.

Recommendation.

While the WPTT acknowledges the preliminary nature of the yellowfin tuna assessment in 2008, all results indicate that fishing mortality should not return to the high levels observed in recent years (2003-2006).

Given the extraordinarily high catches in 2003-2006, it is likely that overfishing was occurring over that period; however, it is not clear if the stock is currently overfished or whether a return to a level of fishing pressure equivalent to that existing just prior to 2003 will lead to the stock being overfished.

The WPTT considers that the status of the stock of yellowfin is not going to change markedly over the next year and recommends that fishing pressure be closely monitored and assessments be undertaken annually for the next several years. However, the WPTT forewarns, that if the results of the 2008 assessment are confirmed in 2009, then changes to the current fishery in terms of catches and/or effort will likely be recommended.

5. BIGEYE TUNA

5.1 Papers presented

External Analysis of bigeye Tagging data (IOTC-2008-WPTT-14)

113. The document presents exploratory analyses of bigeye tagging and catch data employing the age-structured models detailed in document IOTC-2008-WPTT-16. The analysis attempts to estimate abundance, exploitation, and where feasible, natural mortality rates. The material presented was more an investigation of the information content within the tagging data themselves, looking at consistency between release and subsequent recapture events, potential availability changes of the population over time and whether information on natural mortality might be extracted from these data.

114. It was shown that the tagging data considered (2006 and 2007) clearly possess information on exploitation rate and abundance (when combined with the catch data). In terms of abundance estimates the numbers were smaller than those estimated for yellowfin as might be expected but show a similar indication of successively smaller year classes from 2004 to 2007. For both years estimates of age 3 fish were noticeably low.

115. Exploitation rates were low on ages 0 to 2 (<<10%) but high in both years and sometimes very high on age 3 fish in 2007 (20-40 %). The fits to the tagging data held a common trend across years related to both age and release time suggesting potential for a complex relationship between age, migration pattern, release location and availability.

116. Given these result the WP felt that a closer look on the bigeye tuna tagging data were required. This included looking into recoveries by gear by spatially and temporally for effects of mixing etc.

Bigeye tuna Surplus Production Model Analysis (IOTC-2008-WPTT-12)

117. This document details the application of a simple surplus production model to longline CPUE and total catch biomass data. Parametric boot-strap approaches were used to explore the uncertainty in the key parameters. Monte Carlo distributions for key parameters (M, age at maturity and steepness) were defined and are then used to estimate r the intrinsic rate of increase parameter for the surplus production model. The reason for this was that CPUE displayed a classical one-way trip attributes and the CPUE are unlikely to possess information on both the r and K parameters simultaneously. The analysis used the Japanese long-line CPUE series from 1968 to 2004 and the catch data from 1950 to 2007.

118. The results showed that the probability of B2007 being greater than B_{MSY} was 0.863. The stock and harvest rate dynamics for bigeye tuna is given in Figure 54. Average exploitation rates for ages 0 to 2 did not exceed 0.2.

119. In the light of these assessments it was asked what the IOTC policy on reporting on limit reference points were? It was the generally accepted that Commission requires reporting the MSY values of the stock.

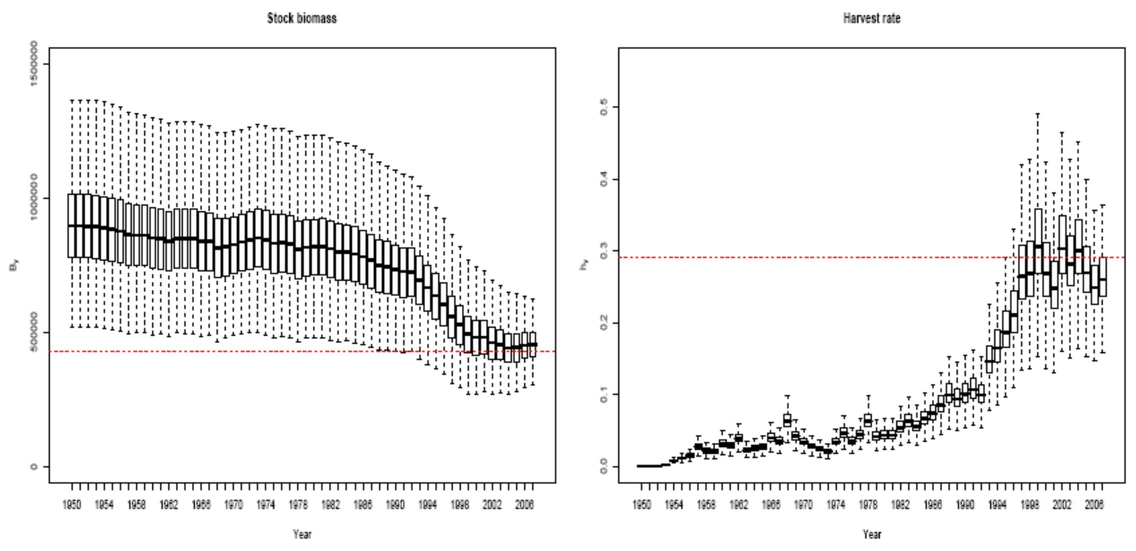


Figure 54. Bigeye stock biomass (left) and harvest rate (right) dynamics for the all-Indian Ocean Japanese long-line CPUE case. The red line represents the expected MSY level.

5.2 Technical advice on bigeye tuna

120. No comprehensive stock assessment was conducted for bigeye tuna during this meeting. However, initial analyses of tagging data indicate that the probability of B2007 being greater than B_{MSY} was high (i.e. an 86 % chance) and exploitation rates for ages 0-2 years appear to be below MSY levels.

121. Given the limited nature of the work carried out on bigeye in 2008, no new advice is provided for the stock.

6. SKIPJACK TUNA

6.1 Papers presented

Standardized Catch for the EU PS fleet 1984-2007 (IOTC-2008-WPTT-26)

122. The objective of this work was to identify significant factors affecting purse seiners CPUE through the explorative analysis using GLMs. The factors considered were both technical (e.g. vessel size, changes in targeting etc) and environmental (e.g. SST, Chl-a). Standardized CPUE from 1984-2007 for EU purse seiners were produced. CPUE was found to be correlated with 20° isotherm and chlorophyll content in the north equatorial area. It was found that standardization on the aggregated data does not modify the nominal CPUE. Logbook data for the north equatorial area suggest a decrease in CPUE concurrent with the observed decrease in mean weight in the catch during 1984-1997 (25%). The trends exhibited in the Western Indian Ocean and North Equatorial were found to be similar. In general, although significant, environmental covariates included in the CPUE standardisation had limited influence on the standardised CPUE.

123. An unfortunate limitation of these analyses was that no covariates was included that attempted to take into account the changes in the fishing power and efficiency of purse seiners (for instance the use of supply vessels, or technological improvements in sonar, bird radar etc). Such an analysis would be of great interest and provide more complete picture in the standardized CPUE, although the group acknowledged the difficulties given the available data and their capacity to truly reflect the dynamics of this fleet.

124. The WPTT was briefly informed of an ongoing project that aims to study the economic factors linked to efficiency changes in the purse seine fleet. This study will look into the history of technological change and the associated investments and returns. The WPTT expressed its interest in receiving the results of this study and recommended that such type of analysis be carried out more frequently. It was also noted that beyond technology, skippers are a major variable to consider, as their experience and abilities change greatly and might explain a large percentage of the variability in catches within the fleet.

External Analysis skipjack tagging data (IOTC-2008-WPTT-15)

125. This document details exploratory analyses using the tagging and catch data and employing the age-structured models detailed in document IOTC-2008-WPTT15. The work looks to estimate abundance, exploitation and natural mortality rates for skipjack tuna in the Indian Ocean. The works should be considered as an investigation of the information content within the tagging data themselves, looking at consistency between release and subsequent recapture events, potential availability of changes of the population over time and whether information on natural mortality might be extracted from these data. The initial plan was to use the length-based form of the model for skipjack, given the difficulties in obtaining the age-related growth parameters. However, the tagging data do not cover the recruiting ages of this stock and this proves a problem when wishing to apply a length-based model as abundance in length classes we have no initial observations on will move through the tagging data range over time. With an age-based model this issue is not such a problem. By using the tagging data-derived estimates of growth (assuming a von Bertalanffy growth curve, we used $K = 0.288$, $L\infty = 74.8$cm and $t0 = -0.5$) we constructed catch, reference catch and tagging release and recapture data-at-age for ages 2 to 5 for 2006 and 2007. No recruitment dynamics are included in this approach for obvious reasons and all that is done is that each cohort is simply modelled through the quarters in each year, according to the population, tag and recapture models.

126. For both 2006 and 2007 estimated abundances of skipjack were large than estimates of recruits of both bigeye and yellowfin (in similar analysis, see relevant papers) even though they cover older ages suggesting substantially larger numbers of skipjack than both yellowfin and bigeye tuna in the Indian Ocean. Exploitation rates are generally fairly low - never exceeding 20% even over the most selected age-range of the stock. Abundances in 2006 are predicted to be higher than those in 2007 and it is worth noting the stable age-structure apparent in both years - there is a very similar decrease in relative abundance from ages 2 to 5. This hints at a reasonably stable year-class regime at least for the cohorts that encompass these data (2000-2005). Also, the numbers at the start of 2007 as predicted by the 2006 abundances and exploitation rates are all higher (and by a similar fraction of about 10-15%) than what we estimate using the 2007 data suggesting a potential for a slight decrease in availability (and therefore the exploitable stock size) of skipjack in 2007, when compared with 2006.

GENERAL DISCUSSION ON CATCH TRENDS

127. Recent declines of catch rates have appeared in both the industrial purse seine fishery and Maldives artisanal fishery. While the activities of pirates from Somalia have meant that vessels have been avoiding traditional skipjack fishing grounds it appears that the decline of catches in the Maldives fishery could be due to environmental causes such as anomalously high sea surface temperatures. The marked increase of the fuel price has also substantially reduced the fishing operations in the Maldivian fishery. Given the varied nature of the factors influencing catches of skipjack, the WPTT recommended that any standardization of catch rates from these two fisheries incorporate environmental covariates, technological and economic trends.

6.2 Technical advice on skipjack tuna

128. No comprehensive stock assessment was conducted for skipjack tuna during this meeting. However, initial analyses of tagging data indicate that exploitation rates on the most selected length classes did not exceed 0.3

129. Given the limited nature of the work carried out on skipjack in 2008, no new advice is provided for the stock.

7. OTHER BUSINESS

7.1 Access to historical documents work

130. The WPTT agreed that having access to electronic versions of the Indian Ocean Tuna Programme (IPTP) documents would be useful for their work, and it would enable the documents to be appropriately archived. To this end the WPTT requested that the Secretariat explore ways of scanning and making available all the historical IPTP documents.

7.2 Presence of the IOTC data manager at technical meetings

131. Some WPTT scientists requested that the IOTC Data Manager be present at all working party meetings in the future.

7.3 Intersessional work

132. Over the last two years, the WPTT has conducted its inter-sessional work using a mailing list system to facilitate technical discussions among members. The chair asked the members of WPTT for feedback on their experiences and opinions on this system and on ways in which the system might be improved. The WPTT welcomed the adoption of such system and indicating its willingness to continue using it. A suggestion was made to implement a system to help condensing the discussions that take place in the list for future reference

7.4 Election of a chair

133. The current Chair of the WPTT, Dr Iago Mosqueira, was unanimously re-elected as Chair of the WPTT for the next biennium.

8. SUMMARY OF WPTT RECOMMENDATIONS IN 2008

DATA
1. That the actions in Table 1 (Page 8) be taken to improve the standing of the data on tropical tuna species currently available at the Secretariat (Paragraph 5).
The WPTT was informed about a statistical analysis presented by SPC scientists to the WCPFC Scientific Committee (in August 2008) that indicated that the results of species and size sampling carried out on purse seine catches in the Pacific Ocean since the early 1980's may be biased due to factors such as pre sorting of tunas, structural grab sampling and/or heterogeneity of size composition in small and large schools. While it is not known whether these biases exist in the data obtained from the Indian Ocean, the WPTT agreed that this matter should be investigated (Paragraph 6). 2. To this end, and given the global nature of the matter, the WPTT recommended that an international working group be organized in 2009 to bring together scientists working in the Atlantic, Indian, Eastern and Western Pacific oceans in order to examine the issues of potential biases in the current purse seine sampling programmes and where necessary identify ways to improve the multispecies sampling schemes (Paragraph 7).
OBSERVER PROGRAMMES
3. The WPTT concurred that the only means for obtaining accurate fisheries statistics including data on target, bycatch and associated species is from observer programmes. To this end, the WPTT joined the WPEB in strongly recommending that IOTC Recommendation 05/07 Concerning a management standard for the tuna fishing vessels, to deploy if appropriate, scientific observers on-board the vessels according to the Commission's Resolution (Appendix I-ii), become binding on members (Paragraph 46).
4. Furthermore, noting that data from existing and future observer programmes have the potential to improve the stock assessment analyses, the WPTT recommended that arrangements be instituted to develop a central database of observer data to allow for archiving and analyses of these data with appropriate security and confidentiality arrangements (Paragraph 47).
DATA ANALYSES
The average of the "3Best" monthly catches are calculated on the estimated total catches by the combined longline fleets, monthly & by 5°squares........The analysis of the cumulative catches in the 20 « best 5° squares » fished monthly by longliners shows that a small numbers of heavily squares tend to produce a large percentage of the yearly catches......... The reason for the use of these two indicators is to better understand the relationship between CPUEs (assumed to be representative of local densities) and total catches, that are the consequence of three combined parameters: (1) local biomass, (2) local fishing effort and (3) fish availability to the gear deployed & its targeting. These results are a potential source of information, allowing a better understanding in the changes of stock status, in the understanding of national CPUEs, in the changes of fisheries behaviour (by flag) and in the rates of tuna concentration in given strata (spawning or/and feeding strata)......[The] apparent inconsistency between CPUE and catch is rather striking and it should be further analyzed (Paragraph 36 abbreviated). 5. As an extension of this work, the WPTT recommended that some extra analyses be undertaken to examine the

phenomenon of vessels causing a temporary localised depletion in a particular area and consider how the complete distribution of relative rankings have changed over time (Paragraph 37).

A first attempt at incorporating technological and environmental factors in order to explain changes in catch rates of yellowfin by the purse seine fleet was documented in IOTC-2008-WPTT-26...... (Paragraph 71 abbreviated).

Results presented for both logbook level and aggregated catch data appear to be affected by the technological changes know to have taken place in the fishery, with CPUE levels showing increasing trends probably due to the difficulty of accounting for differences between nominal and effective effort. A suggestion was made that non-linear relationships like the one observed for thermocline depth would be better treated by linearizing them through an appropriate transformation (Paragraph 72).

6. The WPTT recognised the usefulness of this and similar exercises at understanding the impact on catch rates of various factors affecting the fishery and strongly recommended that work continue to develop reliable abundance indices for tropical tunas taken by the industrial purse seine fisheries (Paragraph 73).

7. The WPTT acknowledged the considerable work that has been undertaken in recent years to develop and improve the CPUE indices for tropical tunas. With respect to future work in this area, the WPTT recommended that the relationship between CPUE and biomass be examined, especially for the longline and purse seine fisheries, and be reported back to the WPTT in 2009 (Paragraph 74).

8. The WPTT acknowledged the considerable advance in the knowledge gained from the first year of analyses of the tagging data and strongly recommended that further analyses of the tagging data continue in support of the assessments of the tropical tuna species (Paragraph 82).

9. Overall, the WPTT strongly recommended that the development of the MFCL model on Indian Ocean tunas continue and that in addition to further refinement of the yellowfin tuna assessment, assessments for bigeye and skipjack be attempted. The WPTT noted that this work should include further analyses to determine the most representative spatial structure for the fisheries and explore various mixing rate scenarios (Paragraph 106).

10. The WPTT was briefly informed of an ongoing project that aims to study the economic factors linked to efficiency changes in the purse seine fleet. This study will look into the history of technological change and the associated investments and returns. The WPTT expressed its interest in receiving the results of this study and recommended that such type of analysis be carried out more frequently. It was also noted that beyond technology, skippers are a major variable to consider, as their experience and abilities change greatly and might explain a large percentage of the variability in catches within the fleet (Paragraph 124)

11. Recent declines of catch rates have appeared in both the industrial purse seine fishery and Maldives artisanal fishery. While the activities of pirates from Somalia have meant that vessels have been avoiding traditional skipjack fishing grounds it appears that the decline of catches in the Maldives fishery could be due to environmental causes such as anomalously high sea surface temperatures. The marked increase of the fuel price has also substantially reduced the fishing operations in the Maldivian fishery. Given the varied nature of the factors influencing catches of skipjack, the WPTT recommended that any standardization of catch rates from these two fisheries incorporate environmental covariates, technological and economic trends (Paragraph 127).

134. In order to evaluate the efficiency and effectiveness of the working party, the WPTT agreed that a review of WPTT recommendations become a permanent item on the WPTT meeting agenda each year.

9. Items put forward by the WPTT for consideration by the Scientific Committee in 2008

135. Advice on the stock status of yellowfin, skipjack, and bigeye tuna for consideration (Sections 4.6, 5.2 and 6.2).

136. Recommendations for endorsement (Section 8).

137. The re-election of the Chair of the WPTT for endorsement.

10. ADOPTION OF THE REPORT

138. The Report of the Tenth Session of the Working Party on Tropical Tunas was adopted by correspondence with comments up to 24 November 2008.

APPENDIX I
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APPENDIX II
AGENDA OF THE MEETING

1. REVIEW OF THE DATA

Review of the statistical data available for the tropical tuna species (Secretariat). [Doc = 03]

2. NEW INFORMATION ON BIOLOGY AND STOCK STRUCTURE OF TROPICAL TUNAS

Review new information on the biology, stock structure of tropical tunas, their fisheries and associated environmental data

1. Papers as provided by Members [Doc = 17, 22, 23, 24, 25, 27,32, 33, 34 , 35, INF01]

3. REVIEW OF NEW INFORMATION ON THE STATUS OF YELLOWFIN

Data for input into stock assessments:

- Catch and effort [Doc = 5, 6, 7, 20]
  - LL and other gears
- Catch at size [Doc = 8]
- Growth curves and age-length key [Doc = 4, 9]
- Catch at age [Doc = 11]
- CPUE [Doc = 19, 26, 31]
  - Raw CPUE indices / Standardised CPUE indices (LL and other major gears)
  - factors influencing CPUE — such as change of targeting practices, environment and technology
- Tagging analyses [Doc = 13, 18]

Stock assessments [Doc = 10, 12, 21, 28]

Selection of Stock Status indicators

4. REVIEW OF STOCK STATUS INDICATORS FOR SKIPJACK

Review of data:

- Catch and effort
  - PS, gillnet and other gears [Doc = 5, 6, 7]
- Catch at size
- CPUE
  - Raw CPUE indices / Standardised CPUE indices
  - factors influencing CPUE — such as change of targeting practices, environment and technology

Tagging analysis [Doc = 15]

Selection of Stock Status indicators

5. REVIEW OF NEW INFORMATION ON THE STATUS OF BIGEYE

Update the stock status indicators for bigeye [Secretariat][Doc = 12, 14]

6. DEVELOP TECHNICAL ADVICE ON THE STATUS OF THE STOCKS

Yellowfin tuna

Skipjack tuna

7. RESEARCH RECOMMENDATIONS AND PRIORITIES

8. OTHER BUSINESS

- Update: Regional Tuna Tagging Programme – Indian Ocean
- Election of chairperson
- Feedback on WPTT inter-seasonal working procedure

APPENDIX III
LIST OF DOCUMENTS PRESENTED TO THE MEETING

Document	Title
IOTC-2008-WPTT-01	Draft agenda of the Working Party on Tropical tunas
IOTC-2008- WPTT -02	WPTT List of documents
IOTC-2008- WPTT -03	Status of IOTC databases. *Secretariat*
IOTC-2008- WPTT -04	A working proposal for a yellowfin growth curve to be used for the 2008 YFT Stock assessment. *A. Fonteneau*
IOTC-2008- WPTT -05	Statistics of the main purse seine fleets fishing in the Indian Ocean (1981-2007). *R. Pianet, A. Delgado de Molina, J. Doriso. P. Bretaudeau , A. Hervé and J. Ariz.*
IOTC-2008- WPTT -06	French PS fishery. *R.Pianet, P. Bretaudeau and A. Hervé*
IOTC-2008- WPTT -07	Statistics of the purse seine Spanish fleet in the Indian Ocean (1984-2007). *Delgado de Molina A., JJ. Areso, M. Soto, J. Ariz.*
IOTC-2008- WPTT -08	Estimation of Catch-at-Size, Catch-at-Age and Total Catch per Area. *Secretariat*
IOTC-2008-WPTT-09	Growth of tropical tunas using the Laslett, Polacheck and Eveson (LEP) method. *P. Everson*
IOTC-2008-WPTT-10	Preliminary stock assessment of yellowfin tuna in the Indian Ocean using MULTIFAN-CL. *A. Langley, J. Hampton, M. Herrera and J. Million*
IOTC-2008-WPTT-10add1	MFCL yellowfin assessment Addendum 1
IOTC-2008-WPTT-10add2	MFCL yellowfin assessment Addendum 2
IOTC-2008-WPTT-11	vacant
IOTC-2008-WPTT12	Surplus production analyses for Indian Ocean yellowfin and bigeye tuna. *R. Hillary*
IOTC-2008-WPTT13	External analysis of yellowfin tagging data. *R. Hillary*
IOTC-2008-WPTT14	External analysis of bigeye tagging data. *R. Hillary*
IOTC-2008-WPTT15	External analysis of skipjack tagging data. *R. Hillary*
IOTC-2008-WPTT16	Models for exploring the information content of the RTTP-IO tagging data. *R.Hillary*
IOTC-2008-WPTT17	Tuna Unloadings in Phuket, Thailand During 1995-2007. *S. Panjarat, T. Chaiyen, P. Nootmorn and K. Maeroh*
IOTC-2008-WPTT-18	Reporting rate analyses for recaptures from Seychelles port for yellowfin, bigeye and skipjack tuna. *R. Hillary, IOTC Secretariat, JJ. Areso*
IOTC-2008-WPTT-19	Standardization of annual and quarterly CPUE for yellowfin tuna caught by Japanese longline fishery in the Indian Ocean up to 2007 using general linear model. *H. Okamoto and H. Shono*
IOTC-2008-WPTT-20	Analysis of tuna catches and CPUEs by Purse Seiners fishing in the Western Indian Ocean over the period January to July 2008. *J. Dorizo, C. Assan and A. Fonteneau*
IOTC-2008-WPTT-21	Updated Stock Assessment for Yellowfin Tuna in the Indian Ocean using Stock Synthesis II (SS2). *H. Shono, H. Okamoto and T. Matsumoto*
IOTC-2008-WPTT-21add1	SS2 addendum 1
IOTC-2008-WPTT-22	Target strength of Bigeye, Yellowfin and Skipjack measured by split beam echo sounder in a cage. *T. Oshima*
IOTC-2008-WPTT-23	Effect of mesh size on the size distribution of Bigeye, Yellowfin and Skipjack caught by purse-seiners in the eastern Indian Ocean. *T. Oshima*
IOTC-2008-WPTT-24	Where have the tags gone? A simple model allowing to estimate the number and size of tunas tagged by the RTTP-IO that are presently surviving. *P. de Bruyn, H. Murua and A. Fonteneau*
IOTC-2008-WPTT-25	A new fishery indicator: the « 3 BEST », The average 3 best monthly catches and CPUEs by 5° squares. *A Fonteneau*
IOTC-2008-WPTT-26	Standardized catch rates for yellowfin (Thunnus albacares) and skipjack (Katsuwonus pelamis) for puse seine fleets of the Indian Ocean, 1984-2007. *M. Soto, E. Chassot and F. Marsac*
IOTC-2008-WPTT-27	Outlook of ocean climate variability in the tropical Indian Ocean, 1997-2008. *F. Marsac*
IOTC-2008-WPTT-28	Preliminary stock assessment of yellowfin tuna (Thunnus albacares) in the Indian Ocean by the ADBM based ASPM. *T. Nishida, R. Rademeyer.*
IOTC-2008-WPTT-28add1	ASPM addendum 1
IOTC-2008-WPTT-28add2	ASPM addendum 2

Document	Title
IOTC-2008-WPTT-29	Developments of Yellowfin Tuna Fishery in Maldives. *M.S. Adam.*
IOTC-2008-WPTT-30	Preliminary growth studies of yellowfin and bigeye tuna (*Thunnus albacares and T. obesus*) in the Indian Ocean by otolith analysis. *E. Morize, J.M. Munaron, J.P. Hallier, J. Million*
IOTC-2008-WPTT-31	CPUE Standardizations for Yellowfin Tuna Caught by Taiwanese Deep Sea Longline Fishery in the Tropical Indian Ocean Using Generalized Linear Model and Generalized Linear Mixed Model. *S.K. Chang, H.L. Liu, S. Chang*
IOTC-2008-WPTT-32	Integrated habitat index of bigeye tuna (*Thunnus obesus*) in the Indian Ocean based on longlining data. *L. Song, Y. Zhou.*
IOTC-2008-WPTT-33	Change of tuna size distribution from tuna purse-seiner landings in Phuket, Thailand from 2003 to 2007. *P. Nootmorn, T. Jaiyen, S. Panjarat, S. Hoimuk, P. Keereerut, N. Nakosiri, K. Maeroh, W. Singtongyam.*
IOTC-2008-WPTT-34	Trends in the recoveries registered by the Regional Tuna Tagging Project-Indian Ocean. *JP. Hallier.*
IOTC-2008-WPTT-35	Catch of Tuna Purse Seine from Research Vessels in the Eastern Indian Ocean during 1993 – 2007. *P. Siripitrakool, W. Utayamakool, P. Singhaboon.*
IOTC-2008-WPTT-36	Analysis of the tagging data using a Brownie approach. *T. Polacheck.*
IOTC-2008-WPTT-37	Application of the PROCEAN model to the yellowfin tuna (*Thunnus albacores*) Indian Ocean Fishery. *E. Chassot, M. Soto, F. Marsac.*
IOTC-2008-WPTT-38	Overview of RTTP-IO recovery process, data quality control and reliability. *T. Athayde*
IOTC-2008-WPTT-INF01	Considerations of Implications of Large Unreported Catches of Southern Bluefin Tuna for Assessments of Tropical Tunas, and the Need for Independent Verification of Catch and Effort Statistics. *Tom Polacheck, Campbell Davies.* CSIRO Marine and Atmospheric Research Paper 023. March 2008
IOTC-2008-WPTT-INF02	Potential bias in multispecies sampling of purse seiner catches. *A. Fonteneau, E. Chassot, F. Abascal and S. Ortega*
IOTC-2008-WPTT-INF03	Atlas of Tuna Fisheries and Resources in Thailand (Andaman Sea and Indian Ocean). *T. Jaiyen, P. Nootmorn, S. Fujiwara, K. Itoh and T. Nishida.*
IOTC-2008-WPTT-INF04	Ecology of bigeye tuna in the Indian Ocean. *M. Koga, M. Mohr and T. Nishida*
IOTC-2008-WPTT-INF05	Fisheries Indicators For Tropical Tunas. *IOTC Secretariat (October 2008)*
IOTC-2008-WPTT-AdHoc1	Comments MFCL 2008 YFT SA. *A. Fonteneau*
IOTC-2008-WPTT-AdHoc2	Number of squares explored by JPN LL. *Secretariat*
IOTC-2008-WPTT-AdHoc3	What are the effects of the closed Somalian area on tuna stocks and fisheries? *A. Fonteneau*
IOTC-2008-WPTT-AdHoc4	SS3figures. *A. Aires-da-Silva*
IOTC-2008-WPTT-AdHoc5	Squares explored by JPN LL in Area2 for Yellowfin. *Secretariat*
IOTC-2008-WPTT-AdHoc6	Yellowfin Natural Mortality. *A. Fonteneau*
IOTC-2008-WPTT-AdHoc7	Steepness Yellowfin Prior. *R. Hillary*
IOTC-2008-WPTT-AdHoc8	Yellowfin Reproduction. *A. Fonteneau*
IOTC-2008-WPTT-AdHoc9	Quarterly maps JPN LL catches 1952-2007. *A. Fonteneau*
IOTC-2008-WPTT-AdHoc10	Quarterly maps TW LL catches 1967-2006. *A. Fonteneau*
IOTC-2008-WPTT-AdHoc11	An overview of catch at size examining some data and problems. *A. Fonteneau*