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

Report of the Second Session of the IOTC Working Party on Temperate Tunas

Bangkok, Thailand

1 November, 2008

TABLE OF CONTENTS

1. Opening of the Meeting and Adoption of the Agenda

1. The Second Meeting of the Working Party on Temperate Tunas (WPTe) was opened on 1 November 2008 in Bangkok, Thailand, by a caretaker Chairperson Dr Francis Marsac.

2. Dr Marsac welcomed the participants (Appendix I) and the agenda for the Meeting was adopted as presented in Appendix II. The list of documents presented to the meeting is given in Appendix III.

3. The participants recalled that this meeting was originally not part of the 2008 schedule of working party meetings, but was requested by the Chair of the Scientific Committee in response to questions from the Commission in June 2008 on the status of albacore tuna.

2. The status of the IOTC Fisheries Statistics relating to Temperate tunas

4. The Secretariat presented a detailed description of the status of the IOTC databases for albacore tuna. The following information is summarised from document IOTC-2008-WPTe-03.

2.1 Albacore tuna (ALB)

Retained catches are generally well known (Figure 1) but catches are uncertain for:

- Non-reporting industrial purse seiners and longliners (NEI)
- Longliners of India, Indonesia and Malaysia operating in southern waters

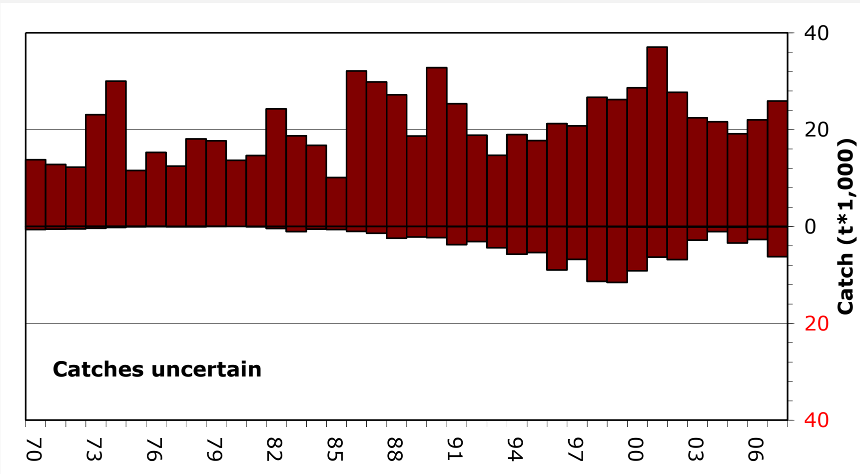


Figure 1. Uncertainty of annual catch estimates for albacore.

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 low although they are unknown for most industrial fisheries.

Changes to the catch series: There have not been significant changes to the catches of albacore since the WPTE in 2004 (Figure 2), other than the catches added for years after 2002. The changes in the late 1980's and early 1990's are due to changes in the catches that the Secretariat estimates for non-reporting fleets.

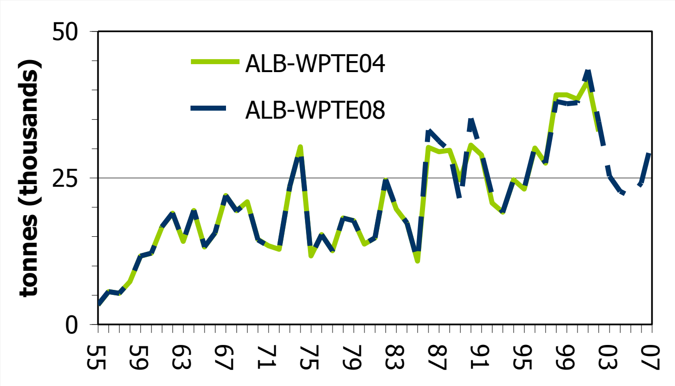


Figure 2. Albacore: Catches used by the WPTE in 2004 *versus* those estimated for the WPTE08 (1958-2007)

CPUE Series: Catch and effort data are available from various industrial fisheries but they are not available from some fisheries or they are considered to be of poor quality, especially those data for 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.

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-1980 and in recent years (for the above fleets plus longliners from South Korea and Seychelles).

Catch-at-Size(Age) table: This is available but the estimates are uncertain (Figure 3) for some years and some fisheries due to:

- the lack 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, Taiwan,China (fresh-tuna))

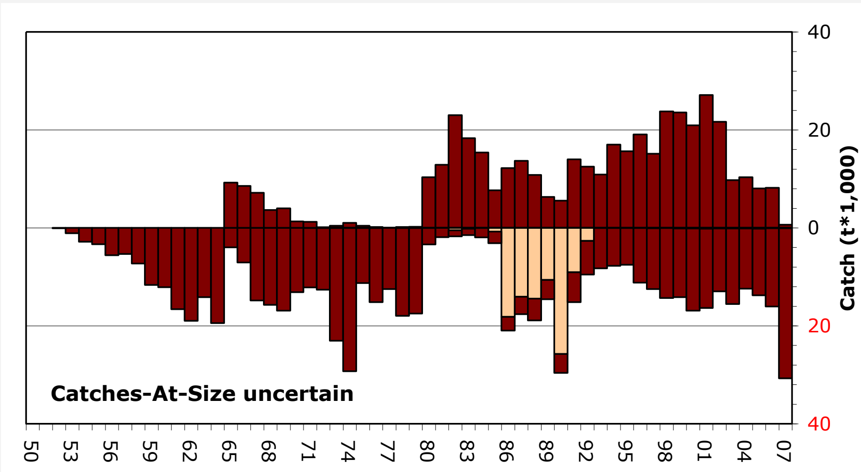


Figure 3. Uncertainty of catch at size data for albacore.

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 drifting gillnets and dark bars represent data for other industrial fleets. Data as of October 2008

2.2 Progress achieved on the data related recommendations outstanding from past WPTe meetings

Lack of size-frequency data from the Republic of Korea and Philippines, Taiwan,China since 1989 and low sample sizes for the Japanese longline fleet

5. Taiwan,China provided length frequency data for its longline fishery for 1980-2006. Philippines and Korea have not provided length frequency data for this species. Sample sizes for Japanese longliners continue to be very low.

Lack of catch and effort data for the Taiwanese fleets for the area between 20-30°E for the whole time series

6. Taiwan,China provided catch data for albacore in this area for the period 1967 to -2006.

Poor knowledge of the catches, effort and size-frequency from fresh tuna longline vessels, especially from Taiwan,China and several non-reporting fleets

7. Taiwan,China has provided estimates of total catches for its fresh-tuna longline fleet for 2000-2007. Data on the sizes taken by Taiwanese fresh-tuna longliners was collected in different locations in the Indian Ocean, under the support of the IOTC Secretariat from 1998 to 2001 and, subsequently under the support of the IOTC-OFCF Project from 2002-2006. No length frequency data is available for these fleets for 2007.

8. No catch and effort data are available for fresh-tuna longline fleets.

9. Taiwan,China informed the Secretariat that efforts are being made to implement a logbook system on Taiwanese fresh-tuna longliners and to implement sampling in several locations of the Indian Ocean

Poor knowledge of the catches, effort and size-frequency from non-reporting fleets of deep-freezing tuna longliners, especially since the mid 1980s.

10. The Secretariat has been revising the catches of non-reporting longliners as more information on vessel types and numbers has been made available. The current catches estimated for this component are much lower than those estimated for previous years.

11. The decrease in the number of vessels from non-reporting countries has coincided with an increase in the number of longliners that operate under the flag of some IOTC members (India, Indonesia, Belize, Philippines, Seychelles). The catches of longliners from India and Indonesia are considered to be incomplete.

Lack of accurate catch, effort and size-frequency data for the Indonesian longline fishery in recent years

12. The IOTC-OFCF Project provided support to the Directorate General for Capture Fisheries and the Research Centre for Capture Fisheries during 2002-06 for the implementation of a multilateral catch monitoring scheme whose main objective was the estimation of total catches and catches-at-size for the Indonesian fresh-tuna longline fishery. The complete catch series for this component was revised by using new information collected during this time. The resulting catches estimated are considered to be more accurate than those existing before in the IOTC database.

13. The IOTC-OFCF Program in Indonesia was discontinued in 2007. Indonesia has continued monitoring the catches of fresh-tuna longliners unloaded in Indonesian ports since 2006. This, however, has not accounted for vessels operating in ports outside Indonesia or for deep-freezing longline vessels, whose numbers have increased considerably in recent years.

14. The IOTC-OFCF Project is currently cooperating with the Indonesian DGCF in the implementation of a logbook system on Indonesian longliners.

Poor knowledge of the catches, effort and size-frequency data for non-reporting purse seiners.

15. The catches of non-reporting purse seiners are currently better known. New catch and effort series for Russian and assimilated vessels were made available during 2007 (Evgeny Romanov) and the catches in the IOTC database are now considered to be more accurate than in the past.

The WPTE recommend that review of existing age and growth information be undertaken with a view to obtaining robust information for input into an albacore stock assessment. If the existing information is uncertain then new work to estimate age and growth should be carried out

16. To date, the Secretariat has not received new information concerning the above recommendation.

The stock structure of albacore is uncertain. It is possible that mixing occurs between the Indian Ocean and south Atlantic Ocean populations. The WPTE noted the need for a large scale tagging program, including archival tags, in the Indian Ocean, and possibly incorporating with other fishery organizations, ICCAT. Tagging program may also provide important information to the knowledge of albacore migration in the Indian Ocean.

17. To date, the Secretariat has not received new information concerning the above recommendation.

18. No albacore was tagged during the IOTC RTTP Programme.

Study related to the maturity of albacore is strongly encouraged by the WPTMT

19. To date, the Secretariat has not received new information concerning the above recommendation.

2.3 Recommendations to improve the data available to IOTC

20. The following list of recommendations was supported by the WPTe 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. 2008 Recommendations to improve the data available on temperate tunas to IOTC

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

- India report catches for its commercial longline fleet.
- Indonesia increase sampling coverage on by-catch unloaded by fresh-tuna and deep-freezing longliners operating under its flag.
- 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.
- 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 provide information on the activities of vessels presumed to be from non-reporting fleets.

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

- 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, Philippines, Seychelles and South Korea provide size data from their longline fleets.
- Japan increase size sampling coverage from its longline fleet.
- Countries catching significant amounts of temperate tunas review their existing sampling schemes to ascertain that the data collected are representative of their fisheries.

3.To reduce uncertainty in biological parameters important for the assessment of temperate tuna species:

- Conversion relationships: Countries catching significant amounts of albacore provide the basic data that would be used to establish length-weight keys, non-standard measurements-fork length keys, processed weight-live weight keys and length-age keys for these species.
- Countries collect biological information on albacore caught in their fisheries, preferably through observer programmes, and provide this information (including the raw data) to the Secretariat.
- Countries conduct studies on growth of albacore in the Indian Ocean

3. New information on the fisheries, biology, ecology and oceanology relating albacore tuna

3.1 Fisheries

21. Albacore are caught almost exclusively under drifting longlines (98 %), and between 20° and 40°S in the Indian Ocean, with remaining catches recorded under purse seines and other gears (Figure 4). A fleet using drifting gillnets targeting juvenile albacore operated in the southern Indian Ocean (30° to 40° South) between 1985 and 1992 harvesting important amounts of this species. This fleet, from Taiwan,China, ceased fishing with this gear in 1992 due to a worldwide ban on the use of drifting gillnets. Albacore is currently both a target species and a bycatch of industrial longline fisheries and a bycatch of other fisheries.

22. The catches of albacore increased rapidly during the first years of the fishery, remaining relatively stable until the mid-1980s, except for some very high catches recorded in 1973, 1974 and 1982. The catches increased markedly during the 1990's due to the use of drifting gillnets, with total catches reaching around 30,000 t. Catches have steadily increased since 1993, after the drop recorded in 1992 and 1993 as a consequence of the end of the drifting gillnet fishery. Catches between 1998 and 2001 were relatively high (ranging from 37,700 t to 40,600 t). By contrast, the average annual catch for the period from 2003 to 2007 was 25,500 t.

23. Longliners from Japan and Taiwan,China have been operating in the Indian Ocean since the early-mid 1950s and they have been the major fishers for albacore since then (Figure 5). Catches by all countries are shown in Figure 6. While the Japanese albacore catch ranged from 8,000 t to 18,000 t in the period 1959 to 1969, in 1972 catches rapidly decreased to around 1,000 t due to changing the target species mainly to southern bluefin and bigeye tuna, then ranged between 200 t to 2,500 t as albacore became a bycatch fishery. In recent years the Japanese albacore catch has been around 2,000 to 4,000 t. By contrast, catches by Taiwanese longliners increased steadily from the 1950's to average around 10,000 t by the mid-1970s. Between 1998 and 2002 catches ranged between 21,500 t to 26,900 t, equating to just over 60 % of the total Indian Ocean albacore catch. Since 2003 the albacore catches by Taiwanese longliners have been less that 13,200 t. The location of the fishery has changed little since 1990. Albacore tuna is fished throughout the Indian Ocean (Figure 7). Catches of albacore tuna taken in the Indian Ocean are low compared to those taken in the other oceans (Figure 8).

24. Additional figures characterising the fisheries for albacore are provided in Appendix IV.

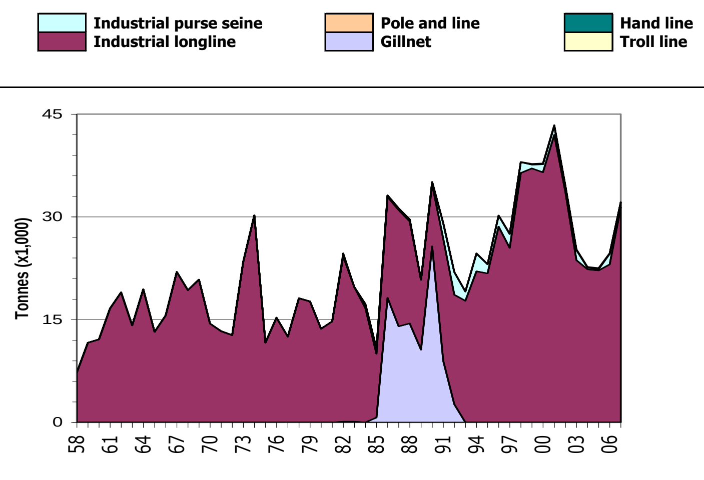


Figure 4. Annual catches of albacore tuna by gear from 1958 to 2007.

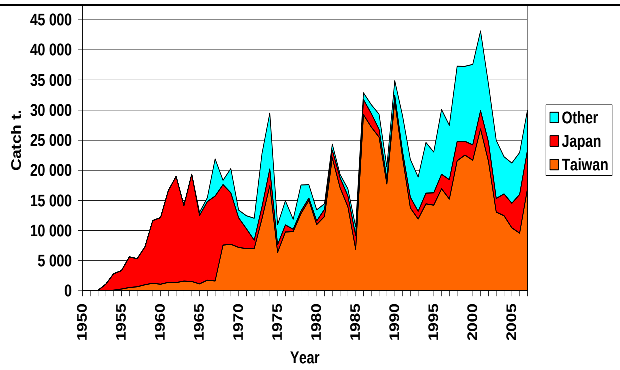


Figure 5. Annual catches of albacore tuna by country From IOTC-2008-WPte-06.

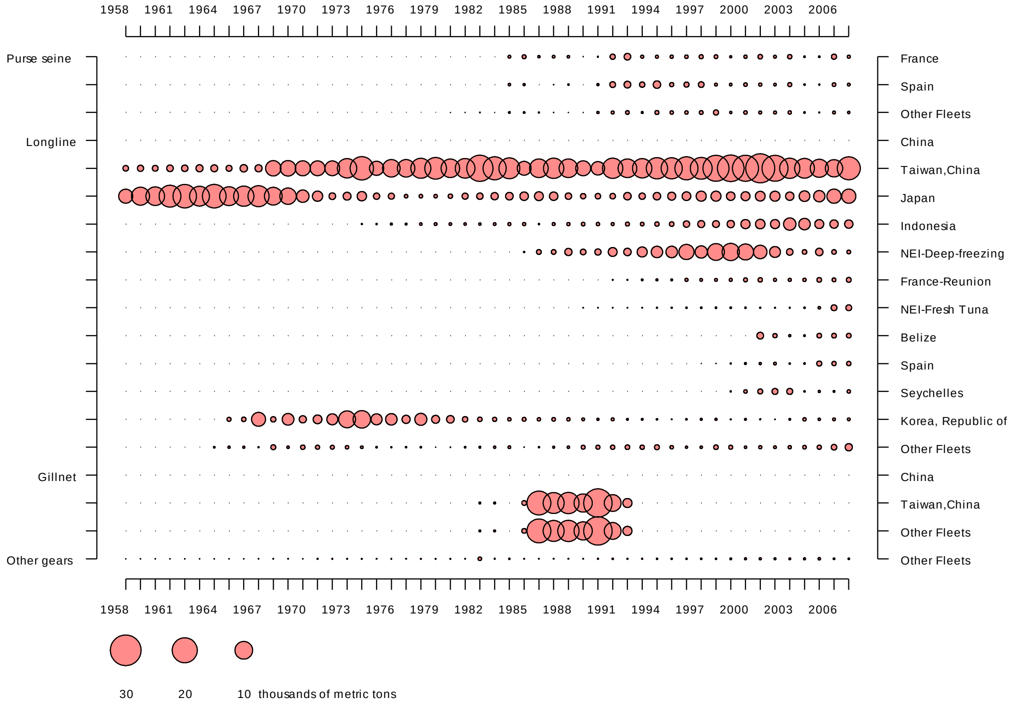


Figure 6. Catches of albacore (ts) by flag in the Indian Ocean for the period 1958- 2007.

1990-1999

2000-2007

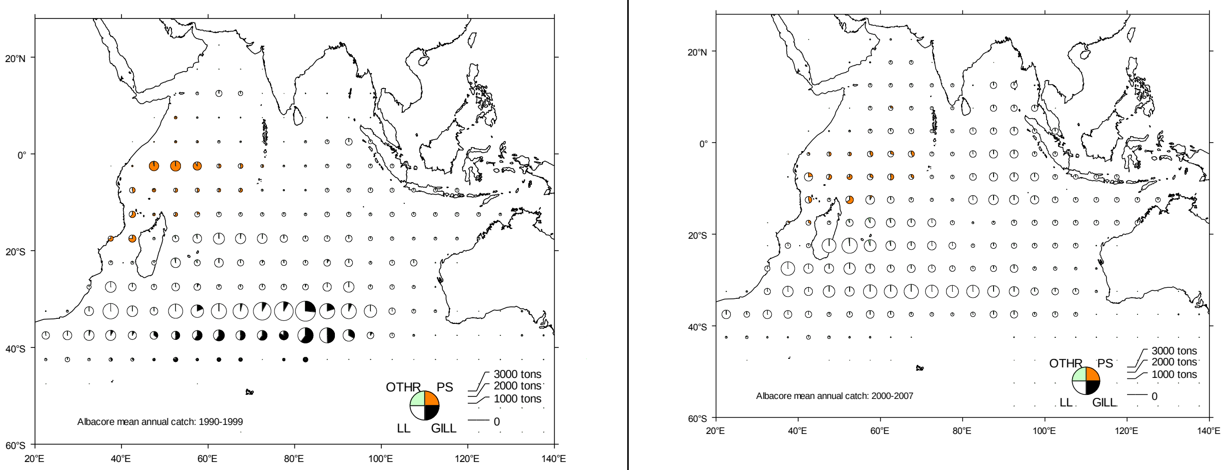


Figure 7. Mean of annual total catches of albacore tuna by longline and purse seine vessels operating in the Indian Ocean over the period 1990 to 1999 and 2000-2007. PS = purse seine, LL = longline.

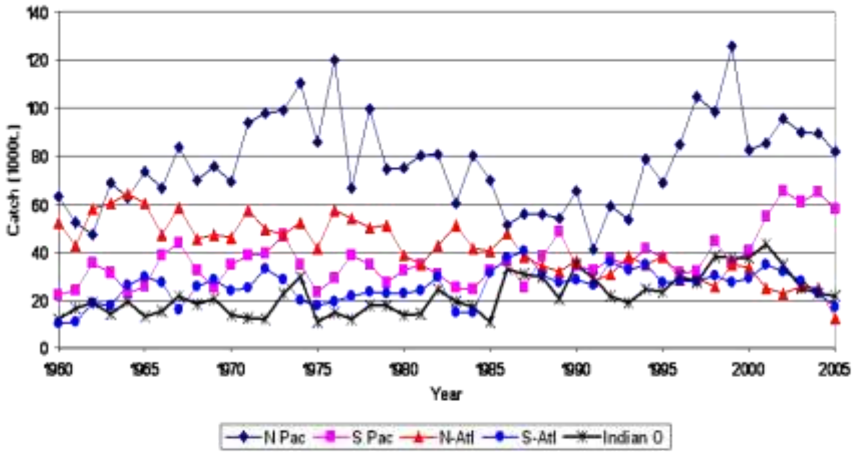


Figure 8. Catches of albacore (t) in the major oceans. From IOTC-2008-WPte-06.

25. The size distribution of long line caught albacore ranges from 50-130 cm with a unique mode at 80 cm, whereas the fish caught by purse seine are only large individuals (with a mode of around 106 cm)..The South African pole and line fishery is catching in SE Atlantic albacore tuna ranging from 60-110 cm with a mode at 85 cm. (Figure 9). Additional catch at size information for albacore is given in Figures 8-12 in Appendix IV.

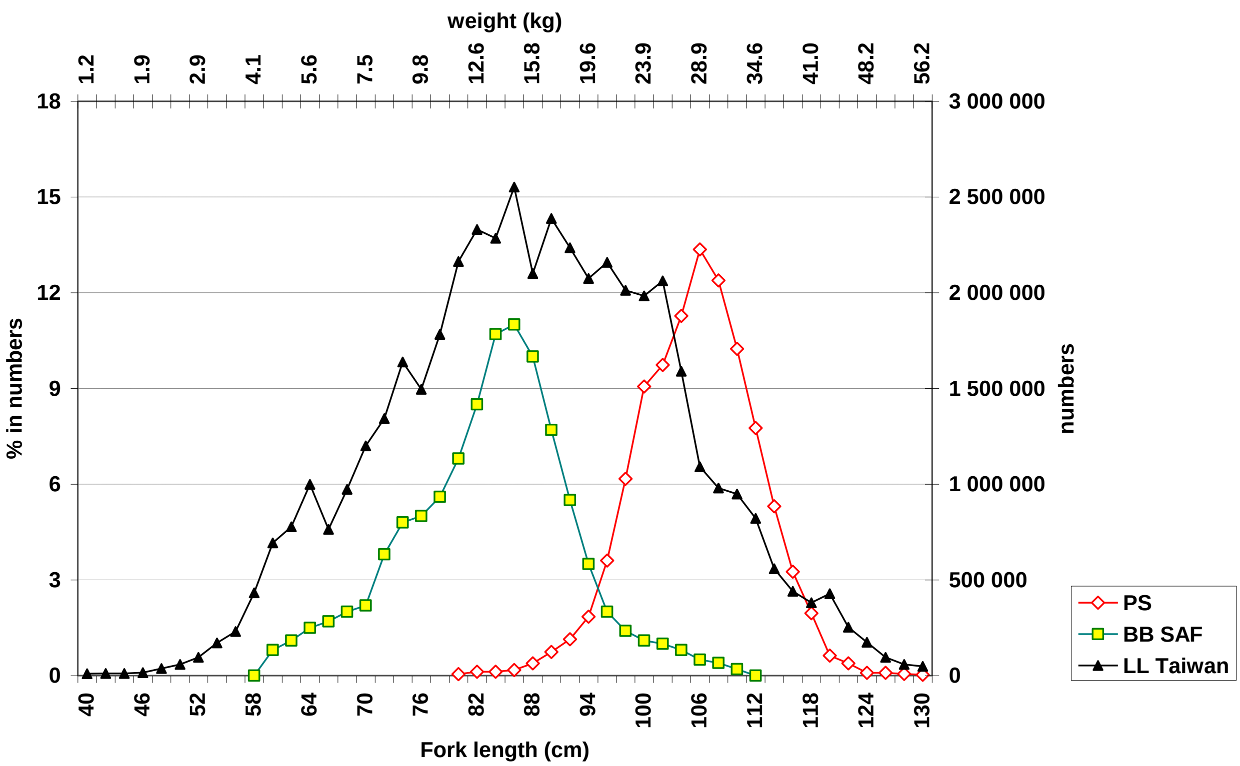


Figure 9. Size distributions of albacore in the catches of the purse seine, Taiwanese longline and South African pole and line fishery.

26. The WPTe noted that the albacore fishery in the Indian Ocean comprises mostly larger sized fish (> 7 kg). The WPTe was informed that this was also the case in the South Pacific, and was considered to be problematic for stock assessments. By contrast, the albacore fishery in the North Atlantic is dominated by surface gears with a large proportion of small fish (most important modes located at 50 and 65 cm).

27. The WPTe questioned Taiwanese scientists on whether the apparent stability in the catches of large-size albacore could be due to changes in gear. In reply, the WPTe was informed that Taiwanese scientists have a comprehensive port sampling programme underway in Mauritius for the Taiwanese longline fleet but the average

size of albacore measured in port may be biased, and as a result inflated, because vessels tend to land only the larger sized fish and retain the small fish in their holds. The WPTe also acknowledged that if a similar tendency exists with respect to transhipment, this would also contribute to an inflated average size estimate.

28. The WPTe was informed that Taiwanese scientists are taking steps to improve the current sampling programme and an emphasis will placed on measuring the entire catches of some vessels. In addition, the sampling programme will also endeavour to increase its coverage of vessels and obtain information from vessels fishing over a wider area of the Indian Ocean.

29. The WPTe was informed that size data for longline-caught albacore are also held in Mauritius. It was suggested that a comparative study between the two datasets be conducted to ascertain the quality of the different datasets

30. An overview of the purse seine fishery was presented in IOTC-2008-WPTe-07. The purse seine fishery accounts for around 2 % of the total albacore catch and most of this is from free schools. Albacore is usually found in association with other species. Only 6 out of 8000 free schools sampled were comprised solely of albacore. Catches can fluctuate widely from year to year, (Figure 10) but have decreased since the 1990's despite purse seine effort increasingly slightly (Figure 11). The highest catches are taken in June and July (Figure 12). The sizes of albacore caught by the purse seine fishery has a narrow mode of 90-110 cm (Figure 10) that has remained stable over the years. Similarly the mean weight of the fish caught has been stable at around 20-25 kg (Figure 13). Longliners take a wider size distribution, including the smaller sized fish therefore the average weight of albacore taken with longline is substantially lower (around 15 kg) than that for the purse seiners.

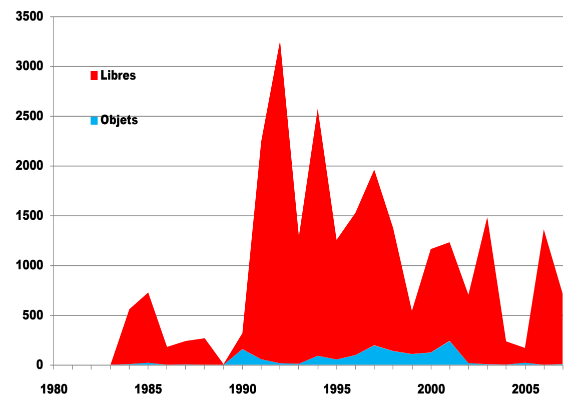


Figure 10. Annual catches of albacore tuna by purse seiners on free schools (red) and log associated schools (blue).

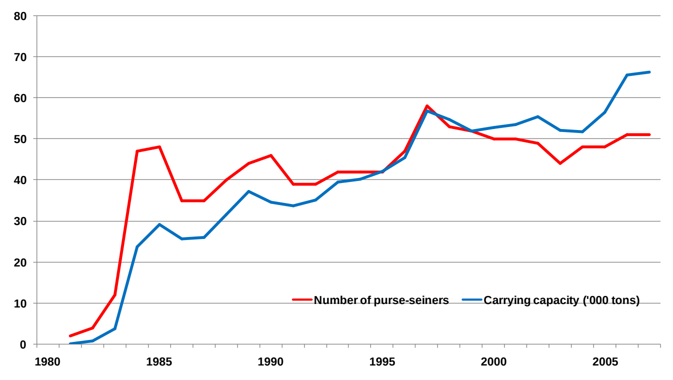


Figure 11. Effort expended by purse seiners with respect to albacore tuna in terms of numbers of vessels (red) and carrying capacity in thousands of tonnes (blue).

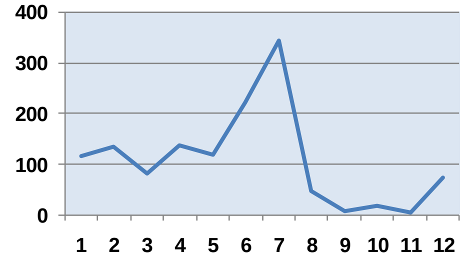


Figure 12. Seasonality of albacore catches taken by purse seiners. X-axis is months, y-axis represents the average catch in tonnes.

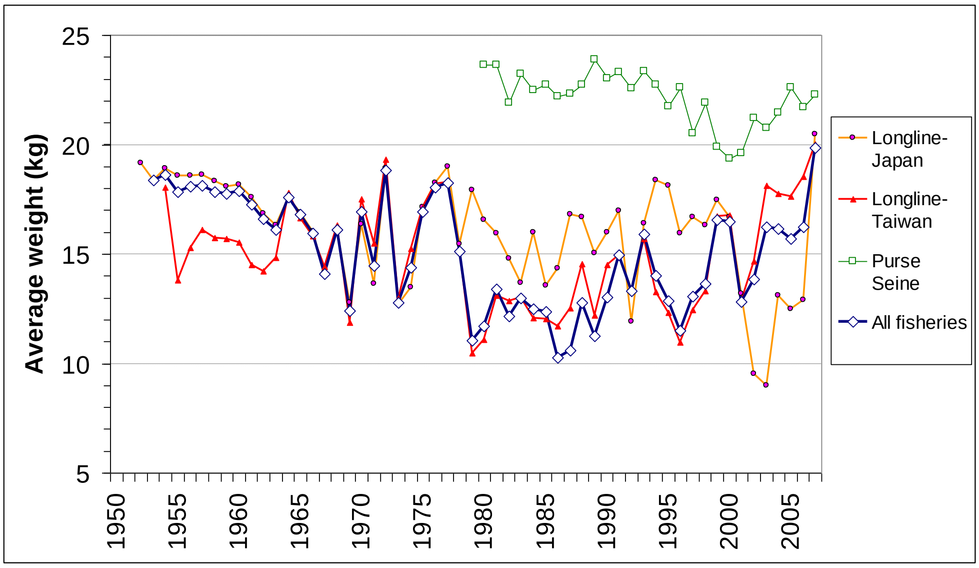


Figure 13. Mean weight of albacore by year and gear: purse seine (green), Japanese (orange) and Taiwanese (red) longline, average for all gears (blue)

31. The analysis of the catch and effort data from Japanese longliners (IOTC-2008-WPTe-INF03), indicates that this fleet has been catching large quantities (and high proportions) of albacore in the south west Indian Ocean as bycatch of the southern bluefin fishery (Figure 14).

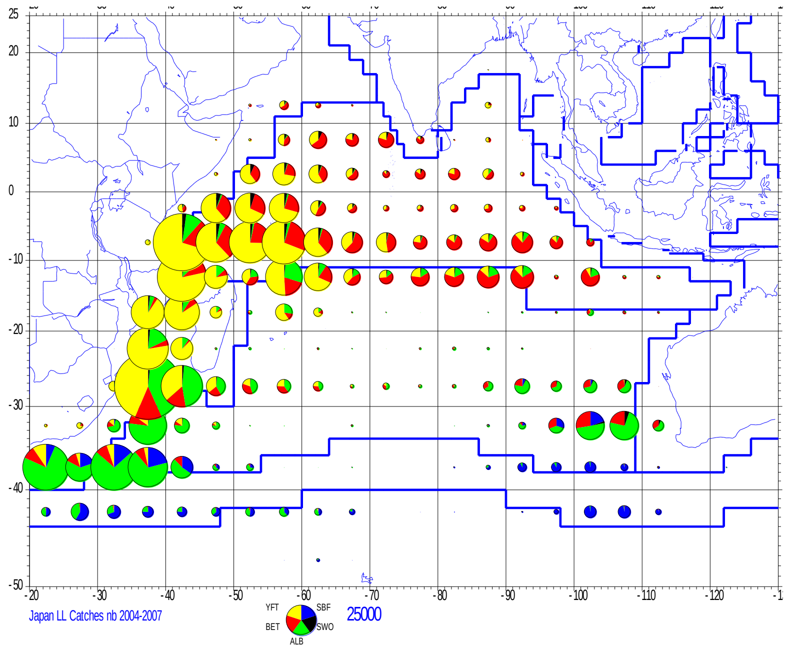


Figure 14. Average annual catches (t) by species of Japanese longliners during recent years (period 2004-2007). Albacore is in green.

32. Document IOTC-2008-WPTe-04 examined the mean price of major tunas fished by Taiwanese Longliners in the Indian Ocean from 2003 to 2007. Six Taiwanese tuna longliners operating in the Indian Ocean were tracked to examine the price fluctuations of major Indian Ocean tunas (albacore, bigeye, yellowfin, and swordfish) sold in major markets of from 2003 to 2007. Mean price of larger albacore (size greater than 10 kg per fish) fluctuated from a low of US$1650 per t in 2003 to a high of about US$2400 in 2006. There was a sharp decrease to US$1700 in 2007, yet a gradual increase trend was observed to about US$2000 in early 2008. The price of smaller albacore (less than 10 kg) generally showed a similar trend to that of large albacore with a maximum price difference of about US$200 per t (Figure 15) The price of larger bigeye (greater than 25 kg) remained rather stable, ranged from US$5500 to US$7500 per ton with a mean about US$6500 in this period, although the smaller bigeye (smaller than 25 kg) appeared an increase from US$3500 before 2006 to US$4500 recently. Price

fluctuation trend of yellowfin is quite similar as smaller bigeye, the larger yellowfin (larger than 25 kg) ranged from US$4000 in the first period increase to about US$5000 in the 2nd period, while small sized (less than 25 kg) changed from US$3000 to US$4000. Price of larger swordfish (greater than 20 kg) remained about US$4500 throughout the whole period, while smaller sized (less than 20 kg) fluctuated between US$1500 to US$3500 periodically. During recent years, the per kg value of albacore caught by longliners has always been considerably lower than that of yellowfin and of bigeye. Furthermore it is likely that that these differential values/kg are influenced by the much lower average weight of albacore (about 16 kg for albacore compared to 40kg for bigeye tuna).

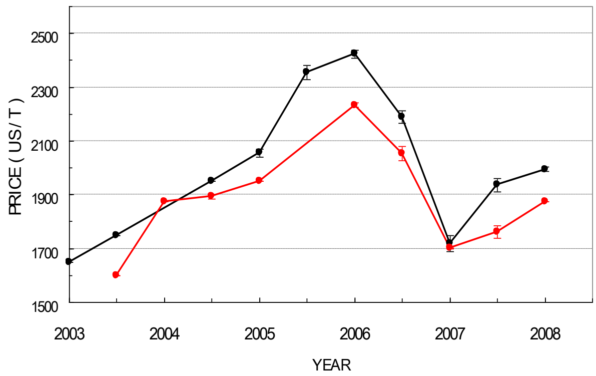


Figure 15. Mean (half year) price of the fished Indian albacore (sampled from six Taiwanese longliners) sold in major markets dating from early-2003 to mid-2008. The black line represents fish greater than 10 kg. The red line represents small fish less than 10 kg. The vertical bar represents the confidence interval of 2SE.

33. The WPTe was informed that the Taiwanese longliners operating in the albacore fishery are the oldest vessels of the fleet, using regular longlines. The deep freezer fleet launched in the 1980s, using deep longlines, are targeting yellowfin and bigeye in the equatorial grounds. The Taiwanese scientists explained that the low market value of albacore cannot offer other opportunity that operating vessels already paid off. In this context of relatively low relatively albacore values and likely lower profitability of the albacore fishery, the remaining longliners still targeting this stock tend to be the older and less efficient. This recent trend could well contribute to explain the recent decline in the recent albacore nominal CPUEs (Figure 21).

34. Maps illustrating CPUE expressed in dollars per unit of effort were discussed by the WPTe (IOTC-2008-WPTe-07). These maps tend to show that in the core of the gyre albacore area the CPUEs in dollars were lower than those in equatorial areas, were a mixture of bigeye, yellowfin and swordfish are targeted by longliners (Figure 16). These low CPUEs in value may, in some part, explain the major decline that has been recently observed in the longline albacore targeted effort and albacore catches.

35. The WPTe recommended that the Secretariat should maintain a database of tuna prices so these data can be readily available to scientists include in their analyses and assist them interpret tuna targeting and catch rates.

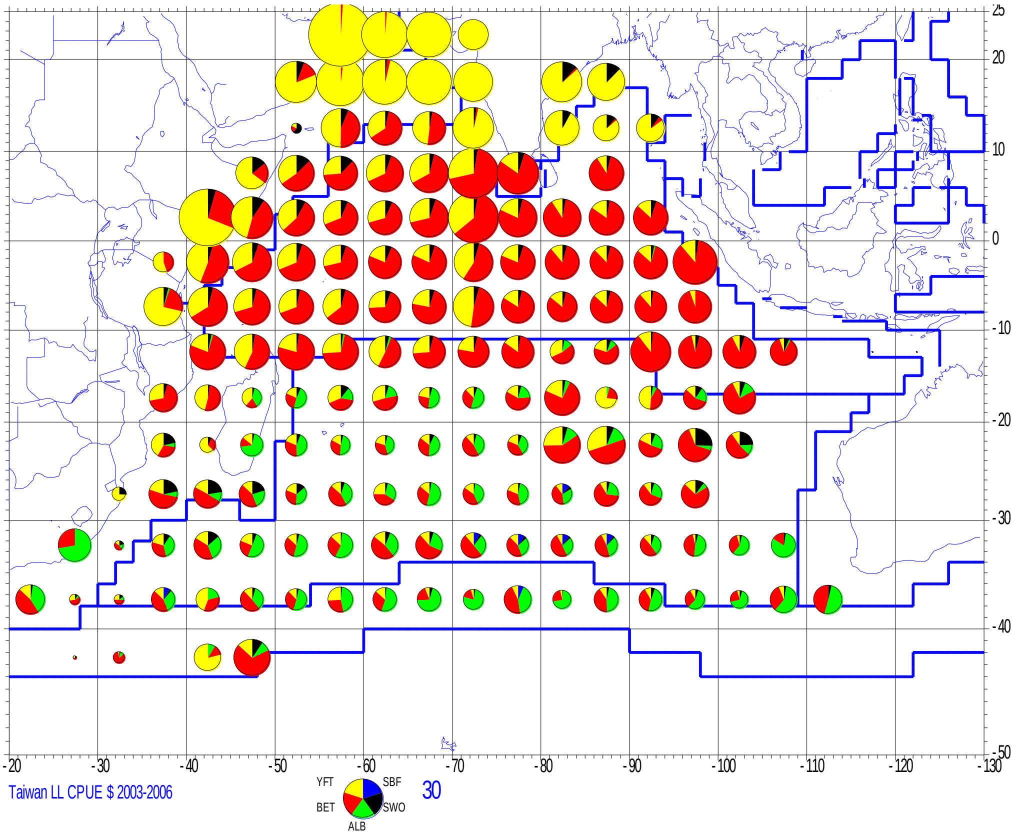


Figure 16. CPUEs of Taiwanese longliners during the 2003-2006 period expressed in US $.

3.2 Biology

36. An overview of the albacore fishery and biology was presented in IOTC-2008-WPTe-07. Worldwide, albacore is a typical temperate tuna, undertaking extensive migrations annually between feeding and spawning grounds. Albacore are distributed in the tropical gyres and subtropical convergences (15° to 40° latitudes) in both hemispheres, and it is in these areas that the fisheries targeting albacore operate. Albacore spawn in warm waters (SST>25°C). In the Indian Ocean, the spawning season takes place during the first and last quarters of the year (December to February) between 10°S and 25°S (Figure 17).

37. While management of albacore tuna is based on the hypothesis of there being separate stocks between the Indian and the South Atlantic Ocean, there is no evidence of any barrier to migration between the two oceans (Figure 18). Therefore, mixing is likely between those two regions, but the degree of mixing is not known.

38. The WPTe was informed that Taiwanese scientists have begun DNA analyses of albacore collected from the Indian and the Atlantic Oceans. To-date around 1000 samples have been collected and the analyses are ongoing. Two fish, one taken in the Atlantic ocean and the other one in the Indian ocean, were shown to have exactly the same DNA sequence, providing evidence that the same mother produced these recruits. The WPTe congratulated Taiwan,China scientists for this initiative and recommended that further genetics work be conducted to better understand the stock structure of Atlantic and Indian ocean albacore.

39. If the small albacore caught by South African pole and line vessels are from the Indian Ocean (totally or partly) this could have implications for future assessments (and possibly the management) of the Indian Ocean albacore stock. As a consequence, the WPTe recommended that the above genetics work be augmented by tagging albacore to between understand the movement of albacore and the degree of mixing between oceans.

40. The WPTe recommended that gonads be collected and examined to confirm the spawning time and location of the spawning area that are presently hypothesized for albacore. To this end, the WPte suggested that the gonads and stomachs of albacore caught by the EU purse seiners in the western Indian Ocean be sampled and noted that the fish might have to be bought at the landing ports as the catch rates of albacore by purse seiners are relatively low and the use of (purse seine) observers to collect samples may not result in the numbers of samples required being obtained efficiently.

41. Furthermore the WPTe recommended that IOTC scientists collaborate more with ICCAT scientists to improve understanding of the albacore stocks from the South Atlantic and the Indian Ocean, and their potential rate of exchange.

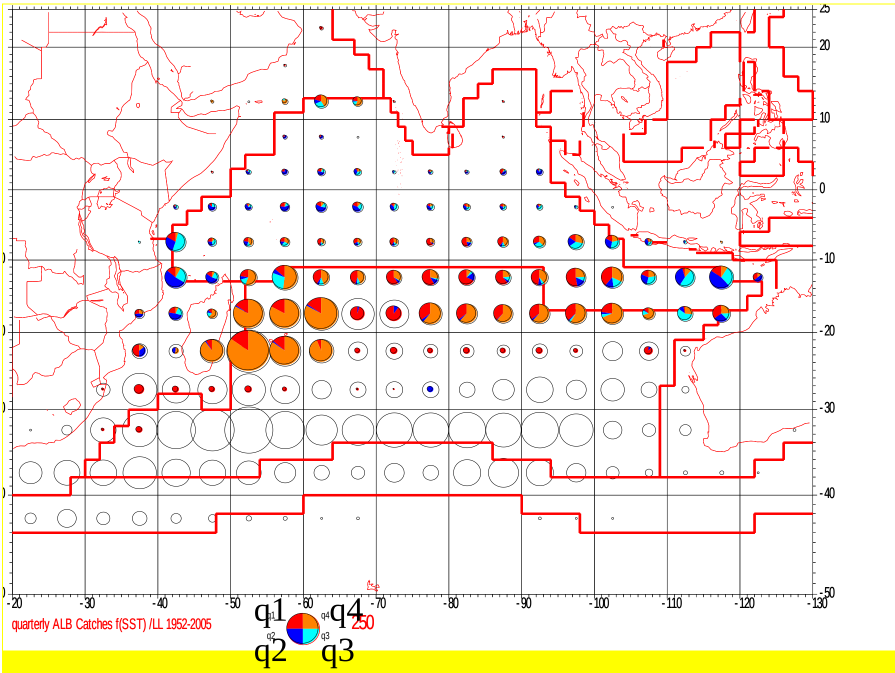


Figure 17. Albacore catches (t) in cold (open circle) and warm waters (>25°C, coloured circles, by quarter) indicating spawning and feeding areas.

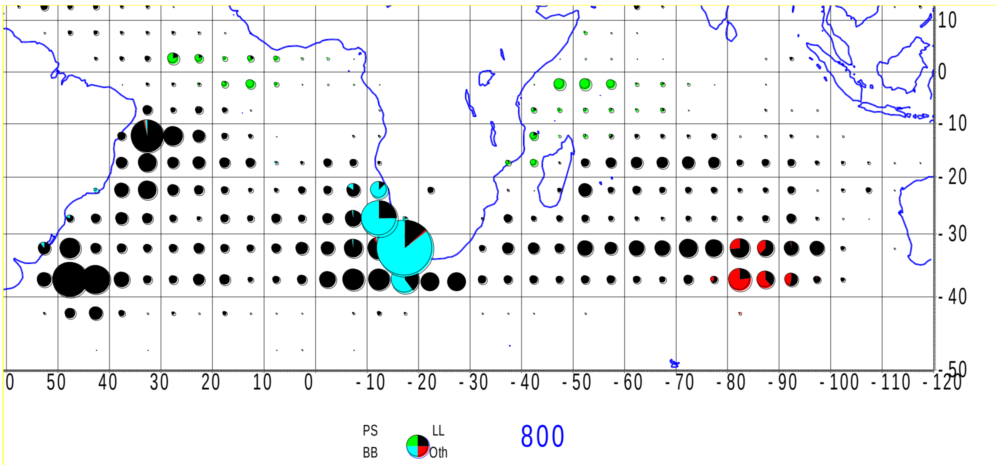


Figure 18. Continuity of albacore catches (t) across the Atlantic and Indian Ocean boundary at 20°E.

42. Document IOTC-2008-WPTe-INF03, provided an overview of the fisheries, biology, ecology and management of albacore tuna in the Indian Ocean. The following possible inputs for future stock assessment were reported[1].

1 Hsu,C.C. (1991): Parameters estimation of generalized von Bertalanffy growth equation. *ACTA Oceanographics Taiwanica*, 26:66-77. Huang, C.S., C.L. Wu, C.L. Kuo and S.C. Su (1990): Age and growth of the Indian ocean albacore, *Thunnus alalunga*, by scales. FAO/IPTP/TWS/90/53: 12pp. Lee, Y.C. and H.C. Liu (1992): Age determination, by vertebra reading, in Indian albacore,

Length weight relationships: Male $W = (3.383 \times 10^{-5})L^{2.8676}$ Lee and Kuo (1988) Female $W = (4.183 \times 10^{-5})L^{2.8222}$ Lee and Kuo (1988) *Where W = weight (kg) and L = fork length (cm)*
Growth. Indian Ocean albacore has been reported to live up to 8 years. (a) Huang et al (1990): based on scale $L_{t(cm)} = 128.13\left(1 - e^{-0.162\left(t-(-0.897)\right)}\right)$ (b) Lee and Liu (1992): based on vertebrae $L_{t(cm)} = 75.5\left(1 - e^{-0.1019\left(t-(-2.0668)\right)}\right)$ (c) Hsu (1991): based on size frequency distributions $L_{t(cm)} = 136\left(1 - e^{-0.159\left(t-(-1.6849)\right)}\right)$ *Where L = fork length (cm), t: age0*
Natural mortality (a) M=0.206 (estimated using the method of Pauly (1990) by Lee *et al.* (1990). (b) M=0.2207 (estimated from Z=q*F+M using longline fishing data by Lee and Liu 1992)

4. STOCK ASSESSMENT FOR ALBACORE TUNA

4.1 Overview

43. The WPTe recalled the major difficulties in the assessment of albacore tuna. These include: the lack of contrast in the catch and effort data over the entire period of the fishery (a "one-way trip" situation with catches), the marked decline of CPUEs during the early years of the fishery (Figure 21) when the total albacore catches were still at a low level (this early decline being probably due a catchability decline and not to a corresponding decline of biomass), and that only adult fish are presently exploited.

44. In 2004, the WPTe fitted a production model to various combinations of catch-and-effort data (from Japanese and Taiwanese longline fisheries, and the Taiwanese gillnet fishery). All but one model case failed to produce plausible parameter estimates and in all analyses, there was a discrepancy between the observed and predicted CPUE trends for the most recent years and the model could not explain appropriately the apparent lack of response in the CPUE to the increase in the catch.

45. In 2008, members at the Plenary of the 12th Session of the Commission expressed their concerns regarding the lack of information on the stock status of albacore, in particular, the members were concerned that a current stock assessment for albacore is not available and the current management advice is based on data up to the year 2002. Responding to this, the Chair of the Scientific Committee (Dr Francis Marsac) requested that a meeting of the WP on Temperate tunas be added to the 2008 schedule of WP meetings and that an attempt be made to update the albacore CPUE and undertake an albacore stock assessment.

4.2 CPUE

46. Document IOTC-2008-WPTe-05 presented the standardization of the Taiwanese longline CPUE series Indian Ocean albacore, from 1980 to 2006 using Generalized Liner Model (GLM) procedures. The three region spatial stratification for the CPUE analyses in 2008 is illustrated in Figure 19. Factors as year, quarter, subarea, bycatch effects of bigeye tuna, yellowfin tuna, and swordfish were included in the analysis. Standardized quarterly CPUE series from the 1st quarter of 1980 to the 4th quarter of 2006 were also obtained by using quarter-series, subarea, bycatch effects of bigeye tuna, yellowfin tuna, and swordfish as factors of concern.

Thunnus alalunga (Bonnaterre). *J. Fish. Soc. Taiwan* 19(2):89-102. Pauly, D. (1980): On the interrelationships between natural mortality, growth parameters, and mean environmental temperature in 175 fish stocks. *Cons. Int. Explor. Mer.*, 39(2):175-192.

47. The CPUE index for Indian Ocean albacore decline markedly from early 1980 to the late 1980's but over the period 1990 to 2006, it has been shown an undulating, but relatively stable trend (Figure 20). Catch rates in 2007 are the lowest reported however, this has coincided with a reduction of traditional Taiwanese albacore targeting longline fishing, and a larger proportion of small-sized longliners operating in the fishery. Quarterly CPUE trend showed a similar trend as those of yearly fluctuations.

48. The WPTe considered that the undulating trend may be due to changes in targeting practices and noted that vessels may target albacore, southern bluefin, or bigeye.

49. The WPTe was informed about a developing deep long line fishery since the 1980's and with many sets targetting bigeye. The WPte noted this might confound the CPUE analysis. Taiwanese scientists informed the WPTe that a logbook system has been in place since 1995 and this could be used to examine the matter.

50. The WPTe recommended the following matters be taken into account in the next CPUE analysis:

- area should be more representative of the fishery
- processing to be conducted from individual sets instead of aggregated data (by incorporating the catch ratios of the species associated to albacore in the GLMs)
- examination of the effects of targeting practices on albacore, bigeye, swordfish and southern bluefin
- incorporation of oceanographic information and environmental factors such as SST, temperature at depths and Chlorophyll content.
- examination of hook per basket
- take into account the changes in the fleet characteristics over time

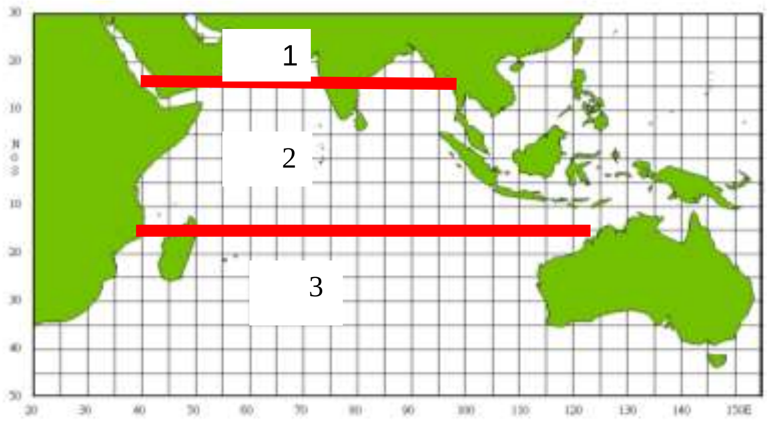


Figure 19. Areas used in the 2008 CPUE analysis.

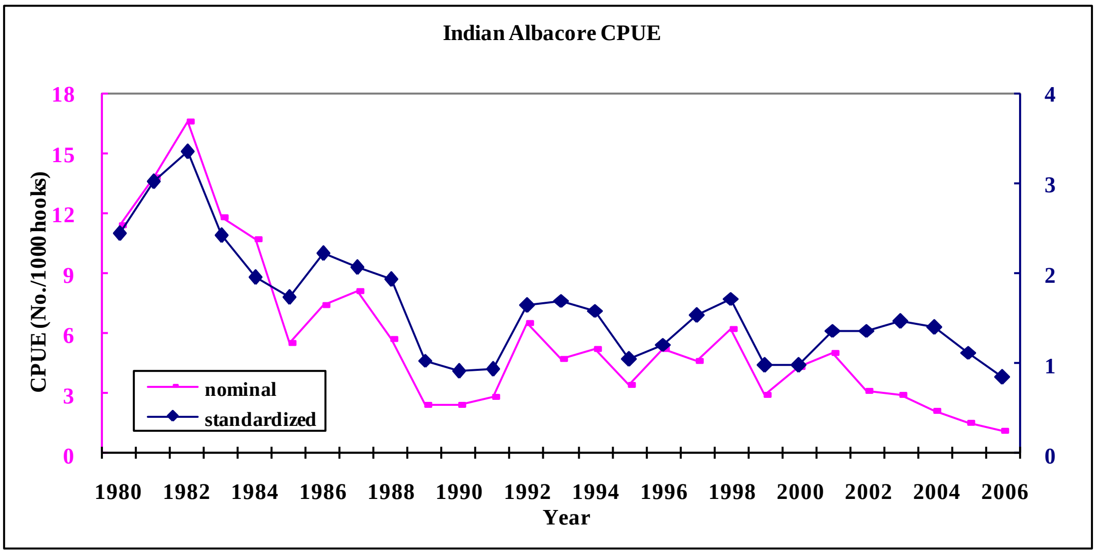


Figure **20.** Nominal and standardised CPUE indices for the Taiwanese longline fishery for albacore in the Indian Ocean.

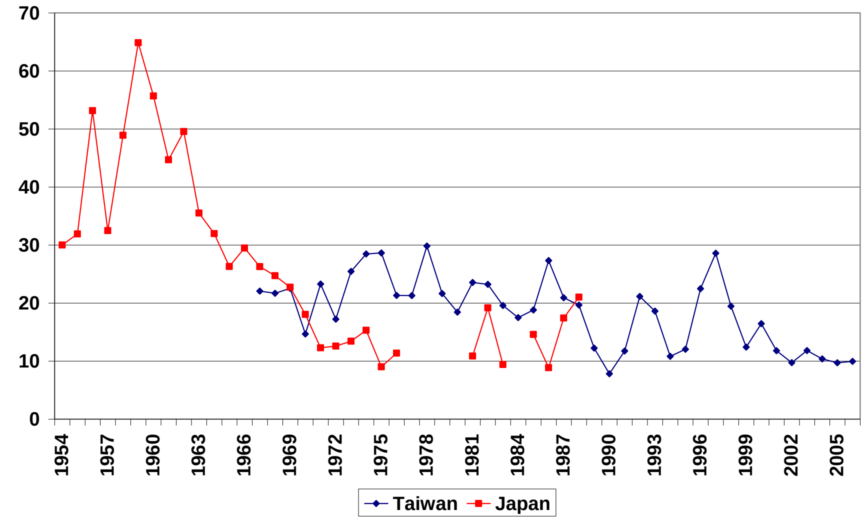


Figure **21.** Nominal CPUE of Taiwanese and Japanese Longliners in the core of the albacore area (15°S-35°S, 55°E-95°E)

4.3 Stock assessment

Surplus production model

51. A simple surplus production model was used to examine the status of Indian Ocean albacore tuna (IOTC-2008-WPTe-06). Given the clear age-specific nature of the catches (younger fish are rarely caught) the WPTe decided that the assumptions made when using this model (all the age classes are fished) could lead to biased and likely over-pessimistic results.

52. Upon instruction from the WPTe, additional work was done after the meeting using an age structured production model to examine the effect of the interaction between age at selection by the fishery and age-at-maturity and how this might affect stock status (IOTC-2008-WPTe-09). Note, this work was considered to be more of risk assessment than a stock assessment given there are still many data and technical issues that need to be settled before a reliable assessment of this stock can undertaken. The overall objectives were to examine a range of plausible scenarios and determine whether there are any strong indications of imminent stock problems and also highlight potential future research directions.

Model inputs

53. One major issue facing any assessment of Indian Ocean albacore is the lack of biological information on growth, maturity and natural mortality. The following inputs for the above model were derived thusly:

Selectivity and maturity

54. The albacore fishery mainly exploits fish from the age of 4 year old and this translates into a sharp increase in selectivity at around age 5.

55. Based on information from other oceans the age at 50% maturity was estimated at age 5 (also maturity occurring between ages 4 and 6 was used to derive the natural mortality value).

56. To explore the importance of what age classes are selected and what age classes are mature two cases were examined: Case 1 - where selection preceded maturation by one age- class; and Case 2 - where selection and maturation followed the same age-specific trend. The selectivity Cases were decided by inspection of the catch-at-age data, looking at what age the transition from low-to-high catch numbers occurs.

Stock-recruit parameters & natural mortality

57. Based on previous work (IOTC-2008-WPTe-06), mean natural mortality = 0.34 (CV 0.09). This value of M was similar to the M=0.37 estimated using a Pauly approximation method during the meeting) and mean steepness was 0.75 (CV 0.1).

Catch and CPUE data

58. The total catch biomass (1950-2007) and Taiwanese long-line CPUE data (1980-2006) used to estimate the parameters of the model. With respect to the likelihood for the CPUE we assumed a log-normal relationship between CPUE and exploitable stock biomass with the catchability coefficient estimated as a nuisance parameter.

Scenarios

59. Two scenarios were examined: Case 1 where selection begins one age-class before maturation i.e selectivity is at age 4 and maturity is at age 5; and Case 2 where selection follows the maturity ogive i.e. selectivity is at age 5 and maturity is at age 5, but spawning occurs before fishing.

Results

60. The results of this work were preliminary and indicative only.

61. For both cases, the models do not fit very well to the CPUE data but the responses are similar as the models do not fit well fit the more extreme values in the CPUE series, especially the early years, but they do fit the general decline in CPUE over time.

62. For both cases there was no outstanding indications that the stock was over-fished (B2007/BMSY >1), or that overfishing is occurring (hcurrent < hMSY); however, there were considerable differences in the estimates of other stock parameters (the current levels of exploitation rate and current relative to MSY levels) (Figure 22). It appears that the interaction of age-at-maturity and age-at-selection has a major influence on the results. In Case 1 fish are available to the fishery a little earlier than they mature (it does not fully select immature fish but assumes the fishery begins to take fish before they can effectively spawn). For Case 2 the ages at selection and maturation are the same and, given that the population model assumes that fishing occurs post-spawning, all fish are allowed to spawn at least once before they are exploited. This makes a large difference to the estimated MSY levels. For the values of steepness here (in fact even for lower values) if the fish are permitted to spawn at least once before being exploited then the model estimates that population can permanently sustain very high levels of exploitation.

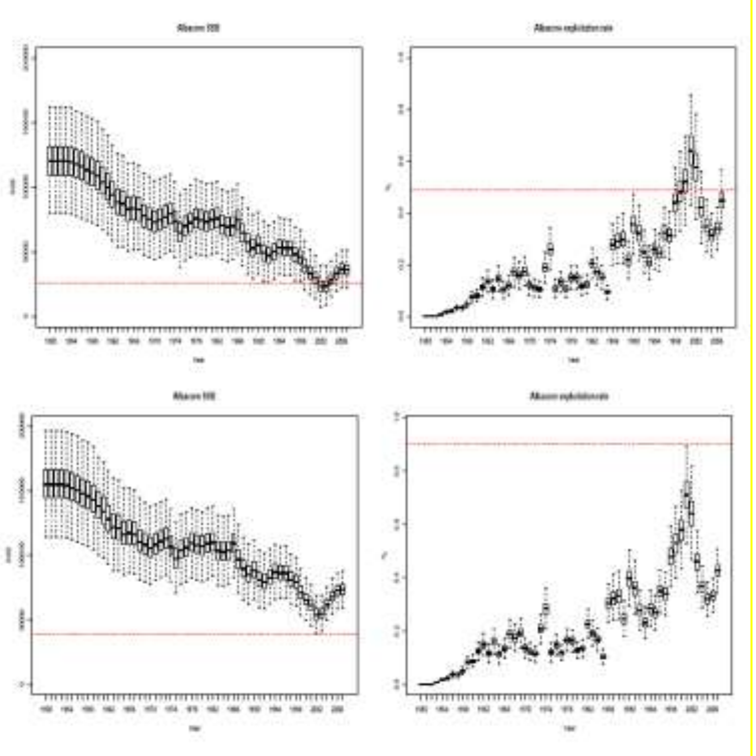


Figure 22. Stock dynamics of Case 1 (top) and Case 2 (bottom). SSB is represented on the left and exploitation rates are represented on the right hand side. In all cases the red dotted line represents the expected MSY.

63. Both models indicated that annual catches at the historically high level experienced over the period 1998 to 2001 (range 35,000 to 43,000 t, average 38,300 t) would likely exceed MSY levels.

64. There appears to be a well defined spatial nature to the dynamics of albacore, with relatively few juvenile and immature fish being available to the fishery compared to mature fish. With more information on the spawning condition of fish by location, growth and maturity, as well as improvements to the current indices of abundance and how to interpret the catch data, a well defined spatial assessment model for albacore may be possible in the future.

4.4 Technical advice on albacore tuna

65. The WPTe based its advice in 2008 on the results of an age-structured production model and a range of fishery indicators.

MANAGEMENT ADVICE:

Current status

Based on the preliminary analyses undertaken in 2008 there are no indications that that the albacore stock is over-fished (B2007/Bmsy >1) and overfishing is currently likely not occurring for the scenarios envisaged. However, there was an indication that continuous annual catches at a level approaching 38,000 t (equivalent to the historically high level of catch experienced over the period 1998 to 2001) may not be sustainable in the long term.

Albacore catches have been around 26,000 t annually over the past five years (2003-2007) and this level is only slightly higher than the historical average annual catch taken for the past 50 years (23,000 t). Other fisheries-based indicators show considerable stability over long periods. The mean weight of albacore in the catches has remained relatively stable over a period of more than 50 years. Furthermore, the average weight of albacore in the Indian Ocean is higher than that reported in the other oceans and is likely to result in a higher yield per recruit. The catch rates of albacore have also been stable over the past 20 years.

Because of the low value and, as a likely result, low profitability of the albacore longline fishery compared to the fisheries for other tuna species, there is likely to be very little incentive for an increase in fishing effort on this species in the immediate future.

On balance of the information available, albacore is considered to be not overfished and overfishing is not occurring.

Recommendation.

The WPTe acknowledges the preliminary nature of the albacore tuna assessment in 2008, but on balance of the available stock status information considers that the status of the stock of albacore is not going to change markedly over the next 2-3 years and no immediate action is required on the part of the Commission. The WPTe recommend that a new albacore tuna assessment be presented to the Scientific Committee at the latest in 2010.

5. SUMMARY OF WPTE RECOMMENDATIONS IN 2008

DATA
That the actions in Table 1 be taken to improve the standing of the data on tropical tuna species currently available at the Secretariat (Paragraph 20).
COLLECTION OF BIOLOGICAL SAMPLES
That the Secretariat should maintain a database of tuna prices so these data can be readily available to scientists include in their analyses and assist them interpret tuna targeting and catch rates (Paragraph 35).
That genetics work be conducted to better understand the stock structure of Atlantic and Indian ocean albacore (Paragraph 38).
That [the above genetics work] be augmented by tagging albacore to between understand the movement of albacore and the degree of mixing between oceans (Paragraph 39).
The WPTe recommended that gonads be collected and examined to confirm the spawning time and location of the spawning area that are presently hypothesized for albacore (Paragraph 40).
That IOTC scientist collaborate more with ICCAT scientists to improve understanding of the stocks (Paragraph 41).
IMPROVING CPUE
That the following matters be taken into account in the next CPUE analysis: (a) area should be more representative of the fishery (b) processing to be conducted from individual sets instead of aggregated data (c) examination of the effects of targeting practices on albacore, bigeye, swordfish and southern bluefin (d) incorporation of oceanographic information and environmental factors such as SST, temperature at depths and Chlorophyll content (e) examination of hook per basket (f) take into account the changes in the fleet characteristics over time (Paragraph 50).

6. ITEMS PUT FORWARD BY THE WPTE FOR CONSIDERATION BY THE SCIENTIFIC COMMITTEE IN 2008

66. Advice on the stock status of albacore tuna for consideration (Section 4.4).

67. Research recommendations and priorities for endorsement (Section 5).

7. OTHER BUSINESS

7.1 SOUTHERN BLUEFIN TUNA

68. The WPTe noted the contents of a report on the biology, stock status and management of southern bluefin tuna (IOTC-2008-WPTe-INF02) and thanked CCSBT for providing it.

8. ADOPTION OF THE REPORT

69. The Report of the Second Session of the Working Party on Temperate Tunas was adopted by correspondence up to 26 November 2008.

APPENDIX I
LIST OF PARTICIPANTS

Mr Juan José Areso Goiricelaya
Director
P.O.Box 497
Victoria, Mahé
SEYCHELLES
Fax: 00 248 324578
E-mail: jjareso@seychelles.net

Dr. Emmanuel Chassot
Research scientist
CRH
Avenue Jean Monnet
BP 171 34203 SETE cedex
FRANCE
Fax: 0033499573295
E-mail: Emmanuel.Chassot@ird.fr

Dr Alain Fonteneau
Scientist
CRH
BP 171 34200 Sete
FRANCE
Fax: 33 4 99 57 32 95
E-mail: fonteneau@ird.fr

Dr John Hampton
Manager, Oceanic Fisheries Programme
Secretariat of the Pacific Community
B.P. D5
98848 Noumea Cedex
NEW CALEDONIA
Fax: +687-263818
E-mail: JohnH@spc.int

Dr. Richard Hillary
Imperial college of Science,
Technology and Medicine
8 princess Garden
127, SW 7 1 NA
UNITED KINGDOM
Phone:+44-207 589 5111
Fax:+44-207 589 5319
Email: r.hillary@imperial.ac.uk

Mr Adam Langley
Independent Consultant
IOTC
7 Van Diemen St Nelson, NZ
NEW ZEALAND
Tel.: 0064 35456306
E-mail: adam_langley@xtra.co.nz

Dr Francis Marsac
Head, THETIS Research Group
Centre de Recherche Halieutique
Avenue Jean Monnet - BP 171
34203 Sète Cedex
FRANCE
Fax: +33 4 99 57 32 95
E-mail: marsac@ird.fr

Dr Iago Mosqueira Sánchez
Scientist
Lowestoft Laboratory
Pakefield Rd.
Lowestoft NR33 0HT
UNITED KINGDOM
Fax: +441502552451
E-mail: iago.mosqueira@cefas.co.uk

Dr. Tom Nishida
Scientist
National Research Institute of Far Seas Fisheries (NRIFSF), Fisheries Research Agency
5-7-1, Orido Shimizu-Ward, Shizuoka-City,
JAPAN 424-8633
Phone/Fax: 81 543366052
Email: tnichida@affrc.go.jp

M. Renaud Pianet
Scientist
BP 570
Victoria
Mahé,
SEYCHELLES
Fax: +248 22 47 42
E-mail: renaud.pianet@ird.fr

Cdr Pornchai Singhaboon
Senior Fisheries Biologist
Department of Fisheries
THAILAND
Tel.: 0 2562 0533, 0 2940 6148
Fax.: 0 2562 0533, 0 2562 0543
E-mail: pornslek@hotmail.com

Dr David Wilson
Senior Scientist
Bureau of Rural Sciences
Fisheries and Marine Science Program
GPO Box 858
Canberra ACT 2601,
AUSTRALIA
Fax: +61-2-62724018
E-mail: david.wilson@brs.gov.au

Dr. Shean-Ya Yeh
National Taiwan University, Taipei,
Taiwan,China
Email: sheanya@ntu.edu.tw

IOTC Secretariat

M. Julien Million
Tagging Assistant
PO Box 1011 Victoria
SEYCHELLES
Fax: + 224364
E-mail: jm@iotc.org

Dr Chris O'Brien
Deputy Secretaryoooo
PO Box 1011Victoria,
SEYCHELLES
Fax: + 248 224364
E-mail: cob@iotc.org

Thanks to the support team from the Department of Fisheries
Dr. Smith Thummachua

Ms. Montana Piromnim
Ms. Chutima Tawachsupa
Ms. Suchittra Mawade
Mr. Pattapol Bualombai
Ms. Jidapa Ta-vay-teekul
Ms. Rattana Tia-ye

APPENDIX II
AGENDA OF THE MEETING

1. **REVIEW OF THE DATA**
   Review of the statistical data available for the temperate tuna species (doc 03, INF01).

2. **NEW INFORMATION ON BIOLOGY, FISHERY AND ENVORONMENT OF ALBACORE**
   Overview of albacore fisheries in the Indian Ocean (doc 07, INF03)

   Purse seine fisheries (doc 08)

   Price of albacore (doc 04).

3. **REVIEW OF NEW INFORMATION ON THE STATUS OF ALBACORE TUNA**
   Review of data:
   - CPUE (doc 05)

   Stock assessments (doc 06)

   Selection of Stock Status indicators

4. **DEVELOP TECHNICAL ADVICE ON THE STATUS OF ALBACORE**

5. **RESEARCH RECOMMENDATIONS AND PRIORITIES**

6. **OTHER BUSINESS**
   - Southern bluefin tuna (doc INF02)

APPENDIX III
LIST OF DOCUMENTS PRESENTED TO THE MEETING

Document	Title
IOTC-2008-WPTe-01	Draft agenda of the Working Party on Temperate tunas
IOTC-2008-WPTe-02	WPTe List of documents
IOTC-2008-WPTe-03	Status of IOTC databases for Albacore. *IOTC Secretariat*
IOTC-2008-WPTe-04	Mean Price of Major Tunas Fished by Taiwanese Longliners in the Indian Ocean from 2003 to 2007. *Hsieh, Wen-Jung, Hong-Yen Huang and Shean-Ya Yeh.*
IOTC-2008-WPTe-05	Standardized CPUE of Indian albacore (*Thunnus alalunga*) based on Taiwanese longline catch and effort statistics dating from 1980 to 2006. *Feng-Chen Chang, Chiee-Young Chen and Shean-Ya Yeh*
IOTC-2008-WPTe-06	Surplus production analyses for Indian Ocean albacore. *R.M. Hillary*
IOTC-2008-WPTe-07	An overview of albacore tuna in the Indian Ocean: biology, fisheries and stock status. *Alain Fonteneau*
IOTC-2008-WPTe-08	Albacore catches in the EU purse seine IO fishery. *R. Pianet*
IOTC-2008-WPTe-09	Risk assessment of Indian Ocean albacore stock status using an age-structured production model. *R. Hillary*
IOTC-2008-WPTe-INF01	Fisheries Indicators For Albacore. *IOTC Secretariat*
IOTC-2008-WPTe-INF02	Report on biology, stock status and management of southern bluefin tuna: 2008. *CCSBT*
IOTC-2008-WPTe-INF03	General reviews of Indian Ocean Albacore (*Thunnus alalunga*). *Tom Nishida and Miyako Tanaka*

APPENDIX IV
ADDITIONAL INFORMATION ON THE FISHERIES, BIOLOGY, ECOLOGY AND OCEANOLOGY RELATING TO ALBACORE TUNA
(FROM IOTC-2008-WPTE-INF01)

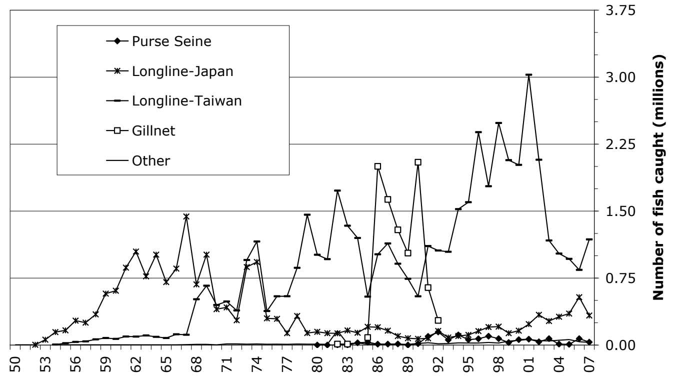


Figure 1. Yearly catches (numbers) of albacore by gear from 1958 to 2007

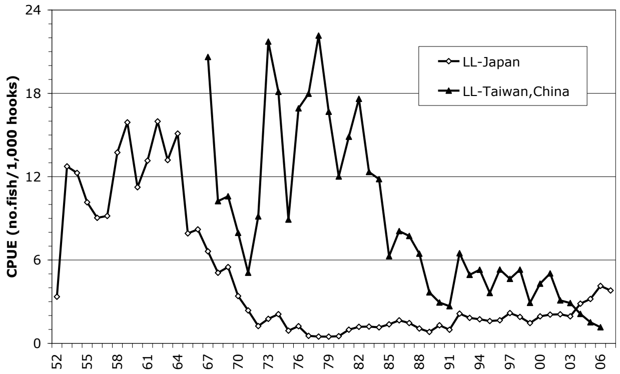


Figure 2. Nominal CPUE for the Japanese and Taiwanese longline fleets in the Indian Ocean

Figure 3: Catches of albacore (tons) by industrial fleets in the Indian Ocean by quarter for the period 1958- 2007

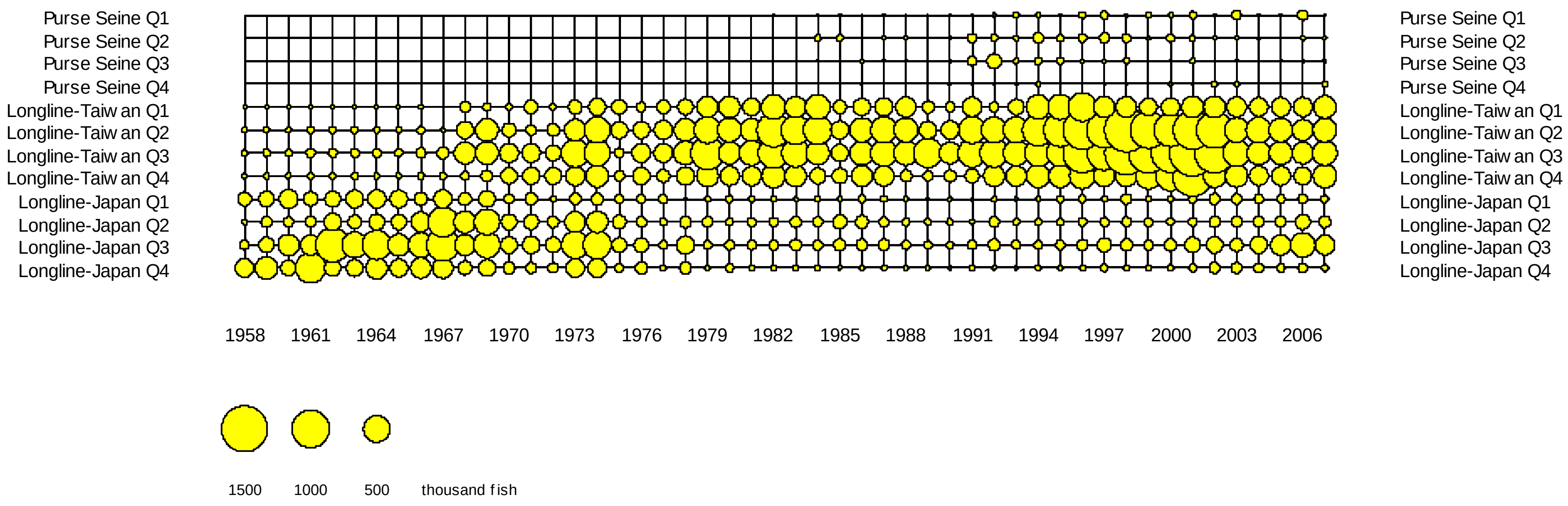
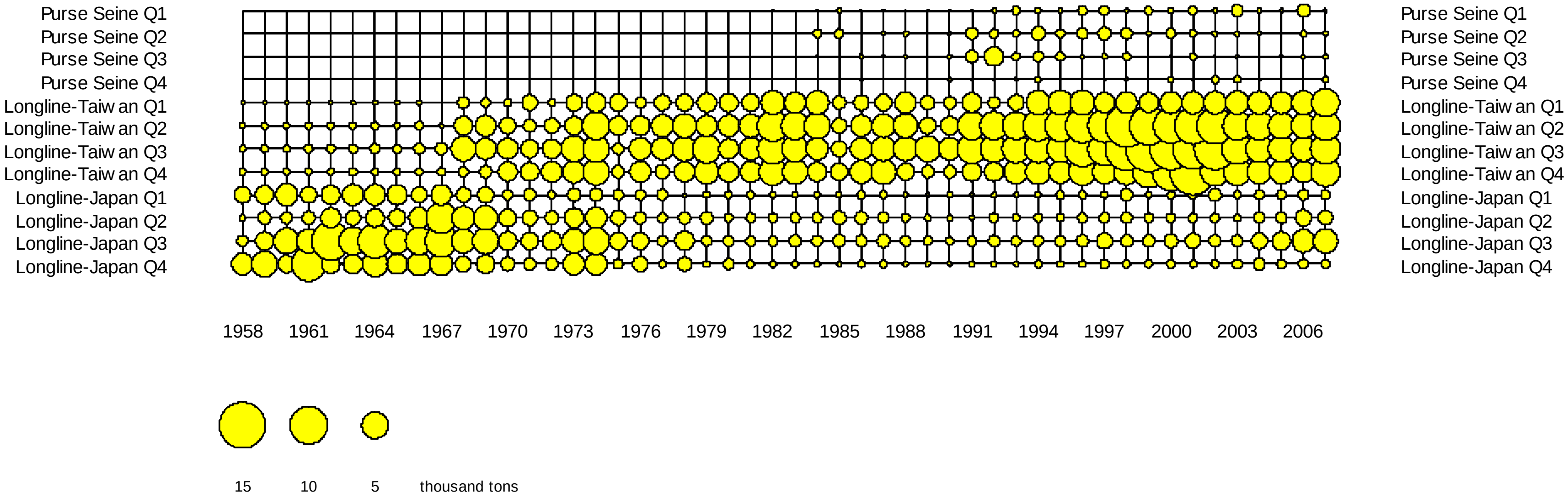


Figure 4: Catches of albacore (numbers) by industrial fleets in the Indian Ocean by quarter for the period 1958- 2007



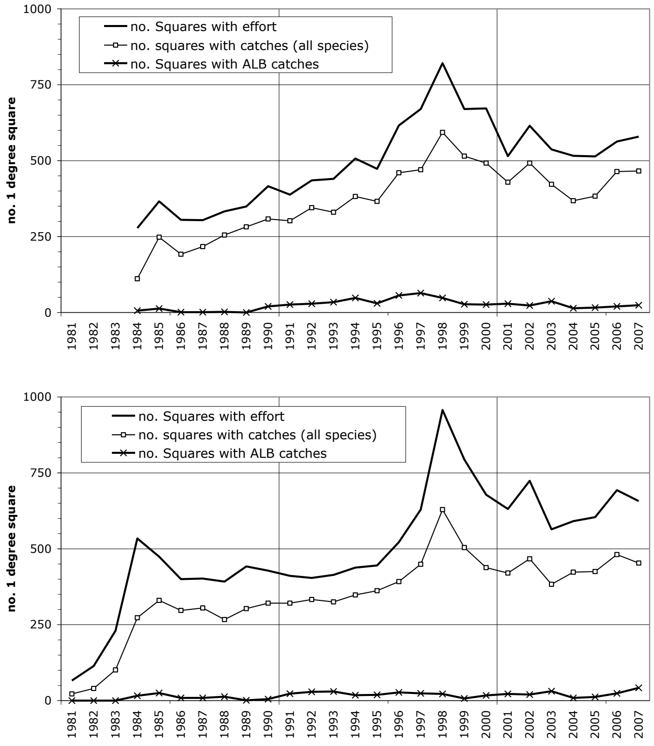


Figure 5-. Number of one degree squares explored by the purse seine fishery, 1981-2007

Purse seiners from Spain (top) and France (bottom)

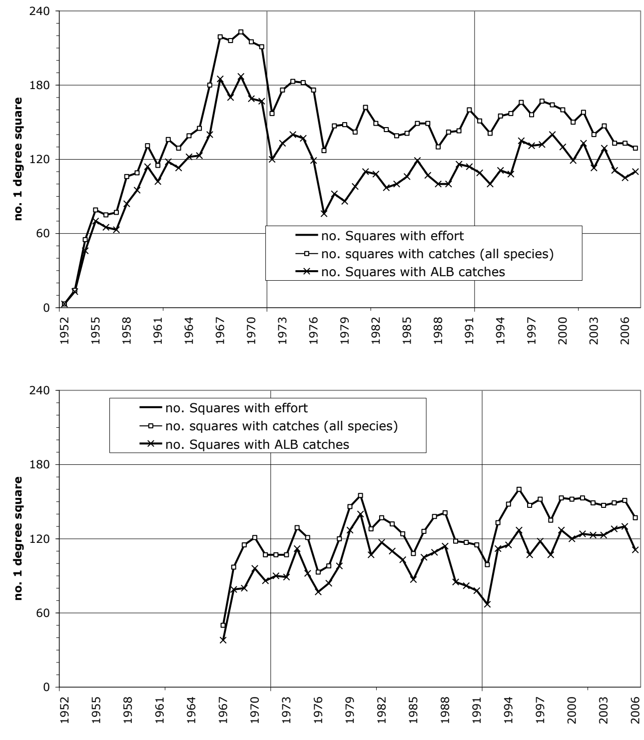


Figure 6. Number of five degree squares explored by the longline fishery, 1952-2007

Longliners from Japan (top) and Taiwan,China (bottom)

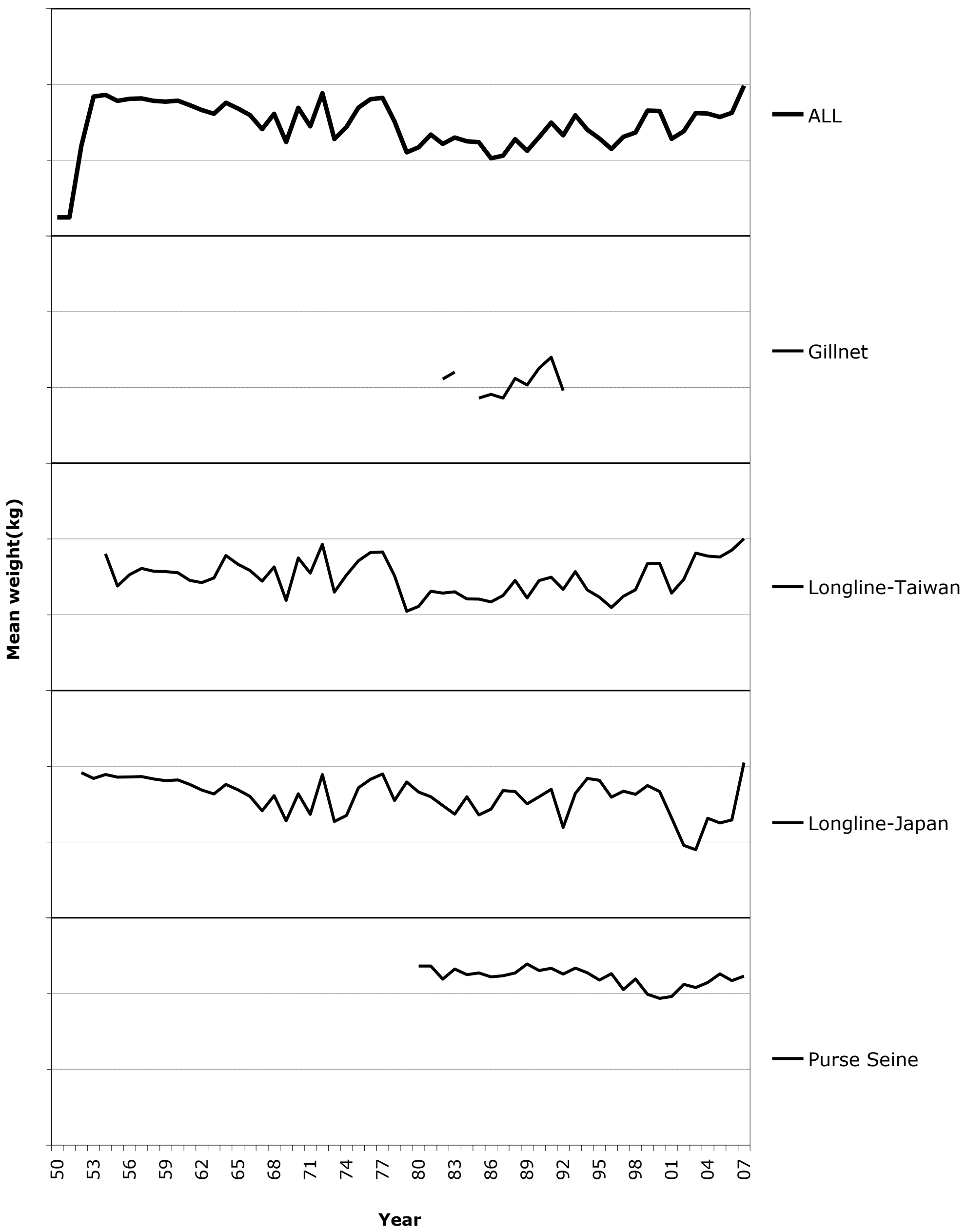
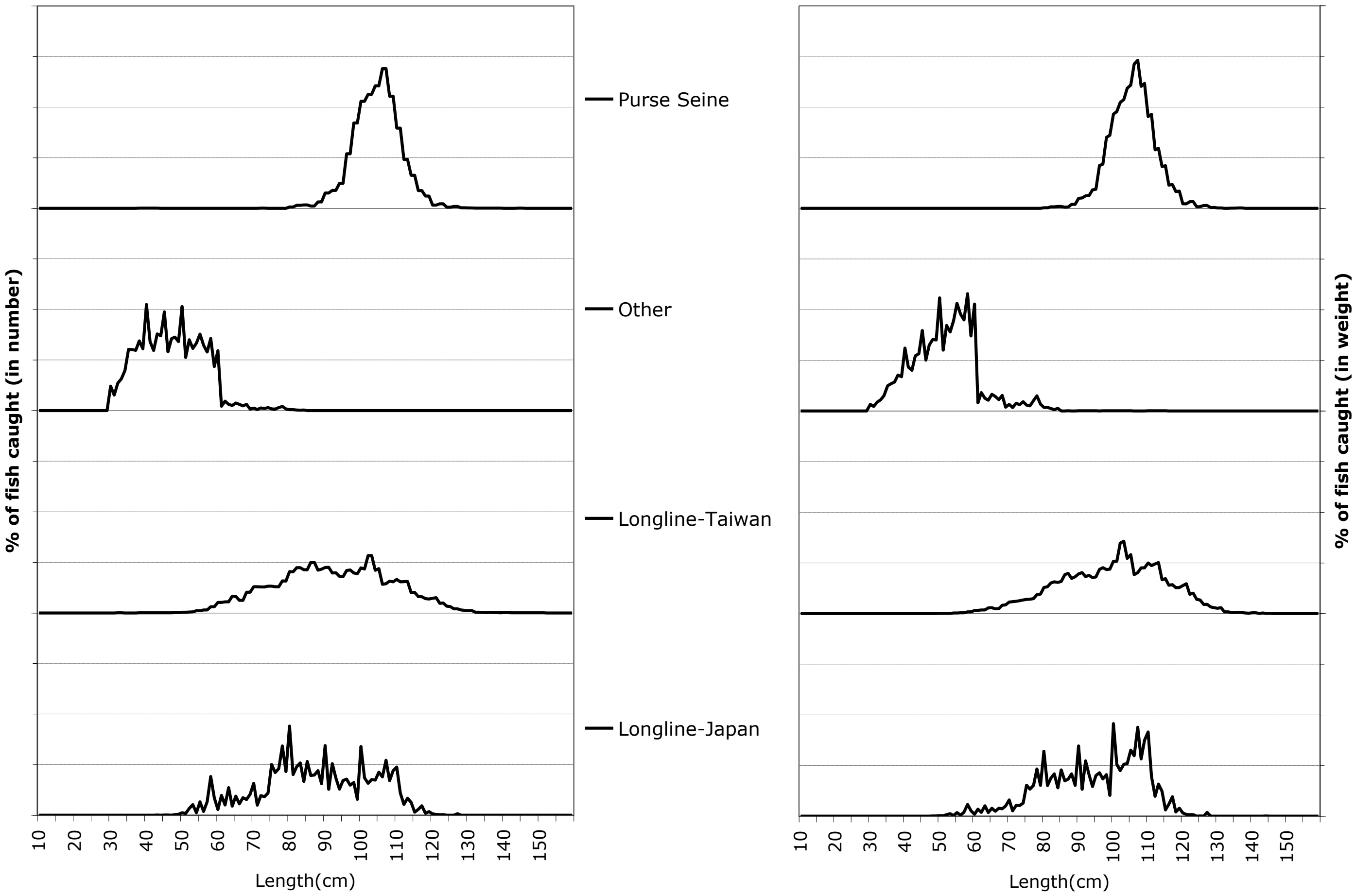


Figure 7. Mean weight of albacore measured from purse seine and longline catches over time (broken lines represent 10kg each)



Figures 8. Mean catch at size of albacore measured from purse seine and longline catches from 1998-2007: in number (left panels) and weight (right panels)

(broken lines represent 2.5% each)

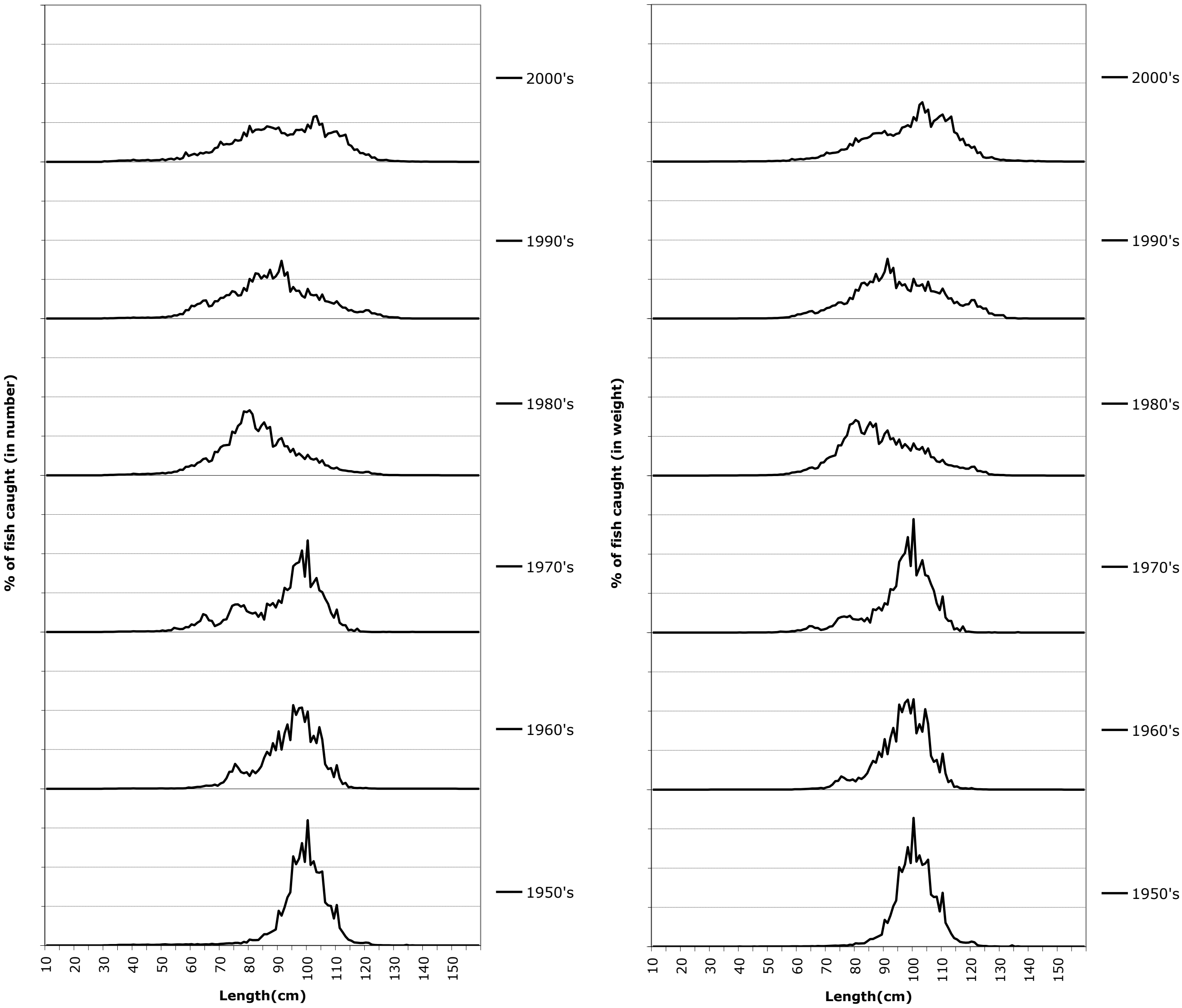


Figure 9. Mean catch by size in numbers (left panels) and weight (right panels) for six ten-year mean periods: 1950-59, 1960-69, 1970-79, 1980-89, 1990-99 and 2000-2007 (broken lines represent 2.5% each)

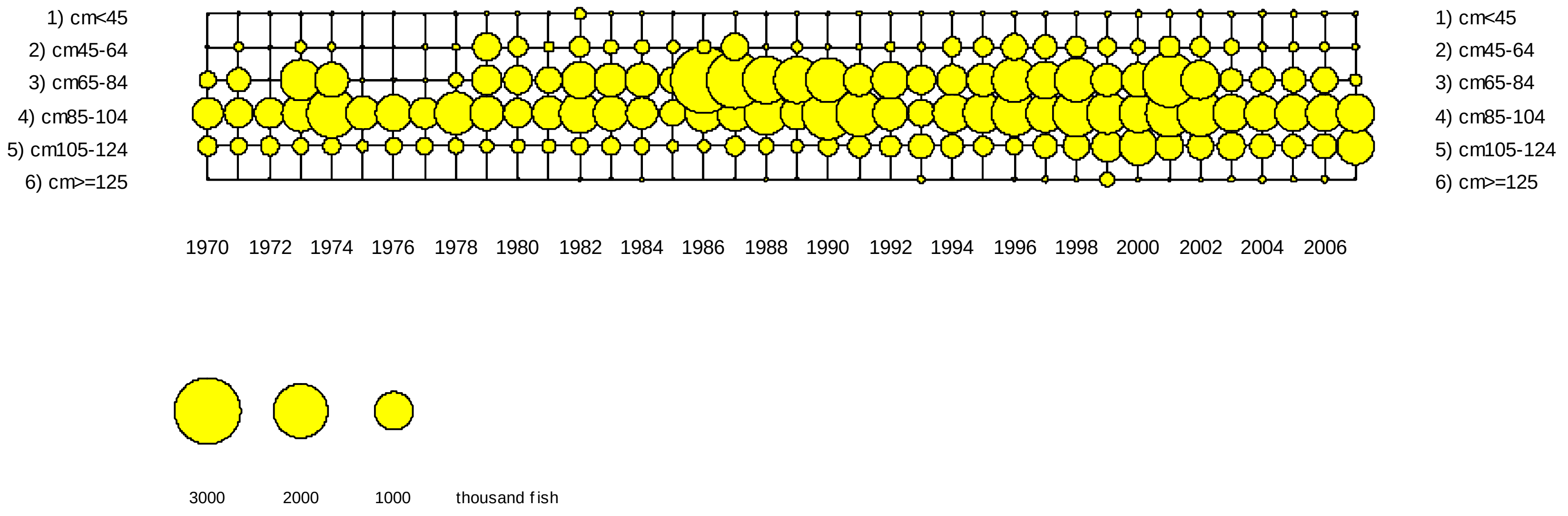


Figure 10. Mean catch at size (number) of albacore in purse seine, longline and other gears (including lines, gillnets and baitboats) catches over the period 1970-2007

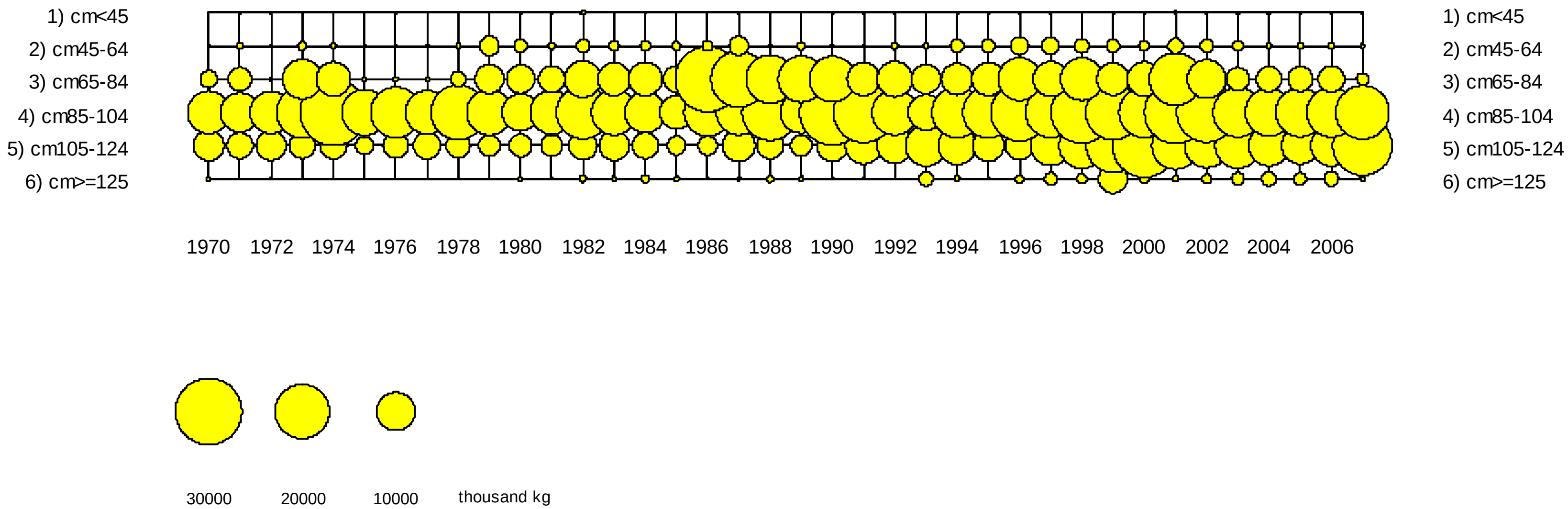


Figure 11. Mean catch at size (weight) of albacore in purse seine, longline and other gears (including lines, gillnets and baitboats) catches over the period 1970-2007

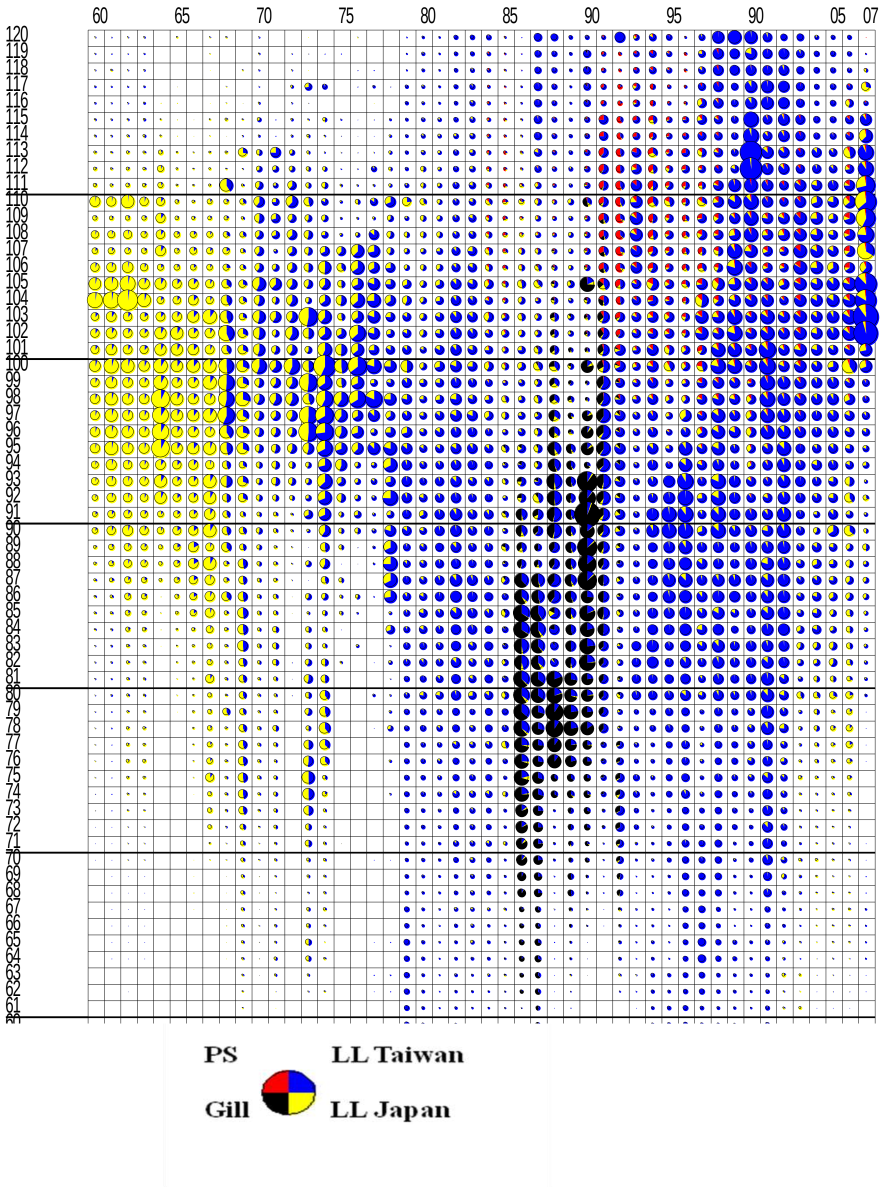

60
65
70
75
80
85
90
95
90
05
07
120
110
100
90
80
70
60
PS
LL Taiwan
Gill
LL Japan

Figure 12. Albcore annual catch at size, by gear (From IOTC-2008-WPTe-07)

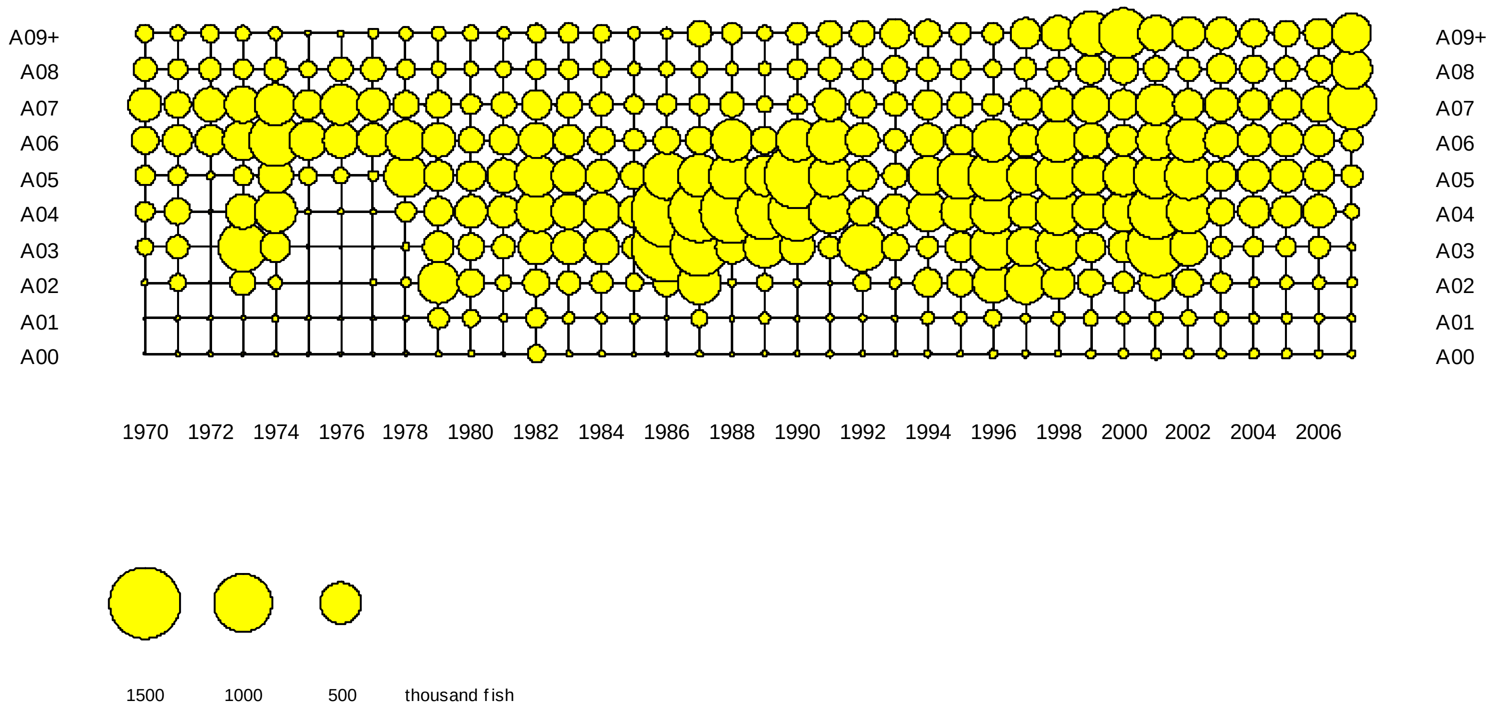


Figure 13. Mean catch at age (number) of albacore per quarter over the period 1970-2007